CHAPTER 6

ESTIMATION RESULTS OF INDIVIDUAL BEHAVIOURAL EQUATIONS

6.1 INTRODUCTION

This chapter presents the behavioural equations of the model. First, the chapter presents the specifications of the econometrically estimable equations. This is followed by an examination of the statistical properties of the time series data used for estimation. This is followed by the presentation of the estimation results and a brief review of the estimation results. All equations, except for two in which the two-step procedure was deemed unnecessary, are estimated in two stages. The first stage involves level-based long-run estimation of the equations by OLS. Given that these estimations may produce spurious results depending on the order of integration of the variables included in the estimation, the residuals from the long-run estimations are used to test for cointegration between the given set of variables. Obtaining at least one cointegrating vector in the long-run equations allowed the estimation process to proceed to the second step of estimation. This involved the estimation of the error correction models for the equations. The errors obtained from the error correction model were then subjected to a series of statistical tests for normality, serial correlation, heteroscedasticity, misspecification and stability of parameters over the sample range.

6.2 LISTING OF BEHAVIOURAL EQUATIONS OF THE MODEL

A list of the behavioural equations that are estimated and reported in this chapter is presented in this section for a convenient reference. The equations are presented here in both their long-run versions.

6.2.1 The real sector

Aggregate supply

Real domestic output

$$LRGDP = \alpha + \beta_1 LL + \beta_2 LK + \beta_3 TIME + \varepsilon \quad (6.1)$$

Real private investment expenditure

$$LRPINV = \alpha + \beta_1 LRGDP + \beta_2 LRUCC + \varepsilon \quad (6.2)$$

Labour demand

$$LL = \alpha + \beta_1 LRGDP + \beta_2 LRWAGES2 + \varepsilon \quad (6.3)$$

Real wages

$$LRWAGES2 = \beta_1 LLABPROD1 + \beta_2 LCPI95 + \varepsilon \quad (6.4)$$

Aggregate demand

Real private consumption expenditure

$$LRPCONS = \alpha + \beta_1 LRYD + \beta_2 RTBRATE1 + \beta_3 LRM31 + \varepsilon \quad (6.5)$$

Prices

Consumer prices

$$LCPI95 = \alpha + \beta_1 LGDPDEF + \beta_2 LED + \beta_3 LPMGS1 + \varepsilon \quad (6.6)$$

Producer prices

$$LGDPDEF = \alpha + \beta_1 LCU2 + \beta_2 LRWAGESUCC2 + \varepsilon \quad (6.7)$$

Export prices

$$LPXGS = \alpha + \beta_1 LPW1 + \beta_2 LEXRATE + \beta_3 LGDPDEF + \varepsilon \quad (6.8)$$

Import prices

$$LPMGS1 = \alpha + \beta_1 LPW1 + \beta_2 LEXRATE + \varepsilon \quad (6.9)$$

6.2.2 The external sector

Real exports of goods and services

$$LRXGS = \alpha + \beta_1 LWDEMND + \beta_2 LXGSRELP1 + \varepsilon \quad (6.10)$$

Real imports of goods and services

$$LRMGS = \alpha + \beta_1 LRGNP + \beta_2 LMGSRELP1 + \varepsilon \quad (6.11)$$

6.2.3 The government sector

Individual income tax

$$LIITAX = \alpha + \beta_1 LNWAGES + \varepsilon \quad (6.12)$$

Other income taxes

$$LOINCTAX = \alpha + \beta_1 LRGDP + \varepsilon \quad (6.13)$$

Company tax

$$LCOMPTAX = \alpha + \beta_1 LRPINV + \varepsilon \quad (6.14)$$

Goods and services tax

$$LGSTAX = \alpha + \beta_1 LRPCONS + \beta_2 LRXGS + \varepsilon \quad (6.15)$$

Other taxes

$$LOTAX = \beta_1 LRGNP + \varepsilon \quad (6.16)$$

Government domestic debt

$$DOMDEBT = \alpha + \beta_1 GOVBAL + \beta_2 LTBRATE + \varepsilon \quad (6.17)$$

Government external debt

$$EXTDEBT = \alpha + \beta_1 NCAB3 + \varepsilon \quad (6.18)$$

6.2.4 The monetary sector

Real currency demand

$$LRCUR = \alpha + \beta_1 LRGNP + \varepsilon \quad (6.19)$$

Demand for real demand deposits

$$LRDD = \alpha + \beta_1 LRGNP + \beta_2 RTBRATE1 + \varepsilon \quad (6.20)$$

Demand for real time and saving deposits

$$LRTSD = \alpha + \beta_1 LRGNP + \beta_2 RBRATE1 + \varepsilon \quad (6.21)$$

Nominal Treasury bill interest rate

$$LTBRATE = \alpha + \beta_1 LRGNP + \beta_2 GOVBAL + \beta_3 LINFL1 + \varepsilon \quad (6.22)$$

6.3 STATISTICAL PROPERTIES OF INDIVIDUAL TIME SERIES

While formal tests, namely the ADF and PP tests, are used to assess the order of integration of the individual time series in this study, the trends of the individual series are also plotted to visually assess their probable statistical properties as a backup mechanism because of the well-know problem of low power of these tests. The plots of the individual series are presented in appendix A. The ADF results for tests of the order of integration are reported in tables 6.1 and 6.2 for each of the variables used in the estimation of the behavioural equations. Table 6.1 reports the tests for the variables in levels. The variables that are found to be non-stationary are differenced and re-tested. The tests of the first differences of these variables are presented in table 6.2. As is often

the case with many time series variables, most of the variables that are used in the estimation of the behavioural equations are found to be integrated of the first order. Only a few variables are found to be stationary.

Table 6.1 Statistical properties of variables in the model – ADF tests for the order of integration of variables in levels, 1980 – 2000

Series	Model	Lags	τ_τ, τ_μ, τ^a	Φ_3, $\Phi_1{}^b$
BOP	Intercept and trend	0	-2.632682	3.515199
	Intercept	0	-2.329532	5.426720**
	None	0	-1.904637	
LCOMPTAX	Intercept and trend	3	-2.334783	2.703430
	Intercept	3	-1.545698	1.888101
	None	3	0.001487	
LCPI95	Intercept and trend	0	-0.555810	2.334436
	Intercept	0	-2.191396	4.802217
	None	1	1.496711	
LCU2	Intercept and trend	0	-3.339085*	6.134950**
	Intercept	0	-3.405926**	11.60033***
	None	0	-0.523624	
GOVBAL	Intercept and trend	3	-2.999692	4.801298
	Intercept	3	-2.753932*	5.358795**
	None	1	-3.024169***	
DOMDEBT	Intercept and trend	1	-3.191264	3.739192
	Intercept	0	-0.690707	0.477077
	None	0	0.345336	
EXTDEBT	Intercept and trend	1	1.883554	19.51842***
	Intercept	1	7.080783	31.22901***
	None	1	9.303658	
LEXRATE	Intercept and trend	0	-2.251470	2.763131
	Intercept	0	-1.105634	1.222427
	None	0	2.471614	
LGDPDEF	Intercept and trend	0	-0.486437	1.085889
	Intercept	0	-1.457330	2.123810
	None	0	11.61382	
LGSTAX	Intercept and trend	2	-6.319810***	50.72404***
	Intercept	3	-2.850050*	62.25590***
	None	3	1.066389	
LIITAX	Intercept and trend	0	-2.389501	3.007283
	Intercept	0	-0.173729	0.030182
	None	0	1.902944	
LINFL1	Intercept and trend	0	-2.430407	2.986701
	Intercept	0	-2.249809	5.061641
	None	0	-0.372629	
LK	Intercept and trend	0	-2.459789	20.21536***
	Intercept	3	-2.043720	19.57919***
	None	1	1.433561	
LL	Intercept and trend	0	-2.870028	4.189632
	Intercept	0	-0.0200010	0.000400
	None	0	4.695357	
LLABPROD1	Intercept and trend	0	-3.378440*	5.727237
	Intercept	0	-1.559659	2.432535
	None	0	-0.678525	

LMGSRELP1	Intercept and trend	0	-0.657443	1.754548
	Intercept	0	0.779866	0.608191
	None	0	1.859082	
LNWAGES	Intercept and trend	0	-2.419610	3.069313
	Intercept	2	0.943109	1.647535
	None	3	4.104553	
LOINCTAX	Intercept and trend	0	-2.588890	3.661697
	Intercept	0	0.016457	0.000271
	None	0	1.634293	
LOTAX	Intercept and trend	0	-1.985451	3.411704
	Intercept	1	-1.371714	2.739488
	None	0	-0.775040	
LPMGS1	Intercept and trend	0	-0.789872	1.730262
	Intercept	0	-1.775226	3.151428
	None	1	1.568131	
LPW1	Intercept and trend	0	-1.942746	2.155251
	Intercept	2	-1.565412	2.592121
	None	0	3.822762	
LPXGS	Intercept and trend	0	-1.484626	1.178230
	Intercept	0	-0.554016	0.0306934
	None	0	5.091378	
LRCUR	Intercept and trend	0	-2.853160	4.803047
	Intercept	0	-3.127629*	9.782062***
	None	0	0.770352	
LRDD	Intercept and trend	0	-2.928213	4.680361
	Intercept	0	-1.328487	1.764877
	None	0	1.788332	
LRGDP	Intercept and trend	0	-2.583138	3.366381
	Intercept	0	-0.115328	0.013301
	None	0	4.577838	
LRGINV	Intercept and trend	0	-3.690753**	6.815297
	Intercept	0	-2.381101	5.669640**
	None	2	0.532671	
LRGNP	Intercept and trend	0	-1.798041	3.035599
	Intercept	0	-2.132204	4.546293
	None	0	1.850368	
LRUCC	Intercept and trend	0	-2.485756	3.216769
	Intercept	0	-1.115064	1.243367
	None	0	-1.988348	
LRM31	Intercept and trend	0	-0.448620	1.130188
	Intercept	0	-1.543545	2.382532
	None	0	1.686870	
LRMGS	Intercept and trend	0	-0.238695	1.468644
	Intercept	0	-1.709893	2.923733
	None	0	1.170750	
LRPCONS	Intercept and trend	0	-0.836128	2.227080
	Intercept	0	-2.171667	4.716140
	None	0	0.963420	
LRPINV	Intercept and trend	0	-1.32381	0.772223
	Intercept	0	-0.874250	0.764313
	None	0	1.798144	
LRTSD	Intercept and trend	0	-0.517089	8.591061**
	Intercept	0	-2.638687	6.962670**
	None	1	-0.419878	
LRWAGES2	Intercept and trend	0	-1.940856	2.353117
	Intercept	0	-1.751754	3.068641

	None	0	-0.013848	
LRWAGESUCC2	Intercept and trend	0	-2.355819	3.031746
	Intercept	0	-1.465653	2.148139
	None	0	1.452586	
LRXGS	Intercept and trend	2	-3.709943**	9.490754**
	Intercept	2	1.418119	3.173491
	None	2	3.705750	
LRYD	Intercept and trend	0	-1.328458	2.243631
	Intercept	3	-3.141379**	3.196291
	None	0	2.360940	
LTBRATE	Intercept and trend	1	-4.400218**	7.657137**
	Intercept	1	-4.000410***	9.153859***
	None	3	-0.495142	
LUCC	Intercept and trend	0	-3.274210*	5.589335
	Intercept	0	-2.945576*	8.676420***
	None	3	0.196657	
LWDEMND	Intercept and trend	0	-2.987110	5.086071
	Intercept	0	-1.499209	2.247626
	None	0	4.132118	
LXGSRELP1	Intercept and trend	0	-2.246244	2.627842
	Intercept	0	-2.244737	5.038846
	None	0	0.431892	
RTBRATE1	Intercept and trend	1	-3.754133**	4.962878
	Intercept	1	-3.972275***	7.936427***
	None	0	-2.726388***	
RF	Intercept and trend	3	-5.985278***	9.981270**
	Intercept	3	-4.901219***	8.703180***
	None	0	-0.512589	
STDDEBT	Intercept and trend	0	-2.657333	3.690135
	Intercept	0	-1.027343	1.055434
	None	0	0.143761	
NCAB3	Intercept and trend	0	-2.226235	2.511470
	Intercept	0	-0.808668	0.653944
	None	0	0.459876	
LED	Intercept and trend	0	0.203275	4.623873
	Intercept	0	2.391558	5.719551
	None	0	-1.691920	

*(**) Significant at 10(5) per cent level.

*** Significant at one per cent level.

a At a 5(1)% significance level the McKinnon critical values are –3.63(-4.44) when a trend and a constant are included (τ_τ), -3.00(-3.77) when only a constant is included (τ_μ) and –1.96(-2.68) when neither is included (τ). The standard normal critical value is –1.703(-2.473).

b At the 5(1)% significance level the Dickey-Fuller critical values (for 25 observations) are 7.24(10.61) when a trend and a constant are included (Φ_3) and 5.18(7.88) when only a constant is included (Φ_1).

Table 6.2 Statistical properties of variables in first differenced form, 1980-2000

Series	Model	Lags	τ_τ, τ_μ, τ^a	Φ_3, $\Phi_1{}^b$
ΔBOP	Intercept and trend	2	-7.254052***	30.56257***
	Intercept	2	-6.437668***	33.21234***
	None	2	-6.658008***	
ΔLCOMPTAX	Intercept and trend	1	-7.371361***	28.08958***
	Intercept	1	-7.481063***	43.49622***
	None	1	-7.732246***	
ΔLCPI95	Intercept and trend	0	-4.557221	10.38425**
	Intercept	0	-4.686744***	21.96557***
	None	0	-4.824680***	
ΔLED	Intercept and trend	0	-3.082064	4.820445
	Intercept	0	-2.287041	5.230558
	None	0	-1.898857	
ΔGOVBAL	Intercept and trend	1	-3.936603**	5.951404
	Intercept	1	-4.282131***	9.168374***
	None	1	-4.483153***	
ΔDOMDEBT	Intercept and trend	0	-5.948542***	18.24422***
	Intercept	0	-6.145670***	37.76926***
	None	0	-6.307518***	
ΔNCAB3	Intercept and trend	0	-3.867946**	7.925621***
	Intercept	0	-4.087356***	16.70648***
	None	0	-3.679826***	
ΔEXTDEBT	Intercept and trend	0	-15.78625***	127.5372***
	Intercept	0	-16.28977***	265.3565***
	None	0	-15.94031***	
ΔLEXRATE	Intercept and trend	1	-5.825779***	14.79793***
	Intercept	1	-6.061359***	23.87193***
	None	1	-6.271037***	
ΔLGDPDEF	Intercept and trend	0	-4.734499***	11.26556***
	Intercept	0	-4.883367***	23.84728***
	None	0	-5.018944***	
ΔLGSTAX	Intercept and trend	1	-8.929510***	31.01976***
	Intercept	3	-3.012858*	36.48425***
	None	3	-2.856536***	
ΔLIITAX	Intercept and trend	0	-5.939815***	17.64963***
	Intercept	0	-6.108635***	37.31542***
	None	0	-6.295810***	
ΔLINFL1	Intercept and trend	2	-5.619301***	19.70048***
	Intercept	2	-5.638358***	26.14097***
	None	2	-5.933184***	
ΔLK	Intercept and trend	0	-4.089328**	8.417263**
	Intercept	0	-4.136721***	17.11246***
	None	1	-3.640496***	
ΔLL	Intercept and trend	0	-5.843479***	17.27435***
	Intercept	0	-5.890916***	34.70289***
	None	0	-6.072072***	
ΔLLABPROD1	Intercept and trend	1	-5.050229***	40.99532***
	Intercept	1	-5.277165***	61.03207***
	None	1	-5.344521***	
ΔLMGSRELP1	Intercept and trend	0	-5.627681***	15.87172***
	Intercept	0	-5.714419***	32.65458***
	None	0	-5.887492***	
ΔLNWAGES	Intercept and trend	1	-8.535959***	32.66631***

	Intercept	1	-8.444830***	47.77922***
	None	1	-8.719876***	
ΔLOINCTAX	Intercept and trend	0	-7.228017***	26.12884***
	Intercept	0	-7.390682***	54.62218***
	None	3	-4.298097***	
ΔLOTAX	Intercept and trend	0	-3.600418*	6.706827
	Intercept	0	-3.651990**	13.33703***
	None	0	-3.776493***	
ΔLPMGS1	Intercept and trend	0	-4.973702***	12.37308***
	Intercept	0	-5.135973***	26.37822***
	None	0	-5.289311***	
ΔLPW1	Intercept and trend	1	-5.256757***	10.90594***
	Intercept	1	-5.415845***	17.32061***
	None	1	-5.606983***	
ΔLPXGS	Intercept and trend	0	-8.164805***	34.35616***
	Intercept	0	-7.606986***	57.86623***
	None	0	-7.841387***	
ΔLRCUR	Intercept and trend	0	-5.583146***	15.77093***
	Intercept	0	-5.674147***	32.19595***
	None	0	-5.786141***	
ΔLRDD	Intercept and trend	1	-7.337548***	31.15524***
	Intercept	1	-7.198147***	45.36800***
	None	1	-7.430394***	
ΔLRGDP	Intercept and trend	1	-5.770603***	17.34311***
	Intercept	1	-5.238691***	22.10316***
	None	1	-5.435199***	
ΔLRGINV	Intercept and trend	1	-10.83305***	75.13648***
	Intercept	1	-10.85769***	110.8683***
	None	1	-10.93627***	
ΔLRGNP	Intercept and trend	0	-7.748922***	30.37467***
	Intercept	0	-8.000984***	64.01574***
	None	0	-8.153395***	
ΔLRM1	Intercept and trend	0	-5.805066***	17.19772***
	Intercept	0	-5.998954***	35.98745***
	None	0	-6.205730***	
ΔLRM31	Intercept and trend	0	-6.242058***	19.73975***
	Intercept	0	-6.339048***	40.18353***
	None	0	-6.413640***	
ΔLRMGS	Intercept and trend	0	-4.766668***	11.40382***
	Intercept	0	-4.910257***	24.11062***
	None	0	-5.019676***	
ΔLRPCONS	Intercept and trend	0	-5.492664***	15.09063***
	Intercept	0	-5.625581***	31.64717***
	None	0	-5.734521***	
ΔLRPINV	Intercept and trend	1	-7.196825***	18.47611***
	Intercept	1	-6.911644***	25.60151***
	None	1	-7.154420***	
ΔLRTSD	Intercept and trend	0	-6.393192***	20.52580***
	Intercept	0	-6.540929***	42.78375***
	None	0	-6.285225***	
ΔLRWAGES2	Intercept and trend	0	-4.808977***	11.56678***
	Intercept	0	-4.581319***	20.98848***
	None	0	-4.714392***	
ΔLRXGS	Intercept and trend	1	-7.682961***	21.47944***
	Intercept	1	-7.586279***	31.39041***
	None	1	-7.712139***	

ΔLRYD	Intercept and trend	0	-7.318394***	26.94928***
	Intercept	2	-5.001757***	24.37124***
	None	1	-4.080616***	
ΔLRUCC	Intercept and trend	0	-4.469635**	10.13285***
	Intercept	0	-4.377088***	19.15890***
	None	0	-3.773602***	
ΔLWDEMND	Intercept and trend	2	-6.681594***	20.71653***
	Intercept	2	-5.840700***	20.67769***
	None	2	-5.780435***	
ΔLXGSRELP1	Intercept and trend	1	-5.299615***	13.46284***
	Intercept	1	-5.474570***	21.56699***
	None	1	-5.664231***	
ΔLRWAGESUCC2	Intercept and trend	0	-4.804748***	11.65213***
	Intercept	0	-4.590040***	21.06847***
	None	0	-4.150798***	

*(**) Significant at 10(5) per cent level.

*** Significant at one per cent level.

a At a 5(1)% significance level the McKinnon critical values are –3.63(-4.44) when a trend and a constant are included (τ_τ), -3.00(-3.77) when only a constant is included (τ_μ) and –1.96(-2.68) when neither is included (τ). The standard normal critical value is –1.703(-2.473).

b At the 5(1)% significance level the Dickey-Fuller critical values (for 25 observations) are 7.24(10.61) when a trend and a constant are included (Φ_3) and 5.18(7.88) when only a constant is included (Φ_1).

6.4 ESTIMATION RESULTS OF INDIVIDUAL EQUATIONS

6.4.1 Estimation results of the real sector

6.4.1.1 Real domestic output

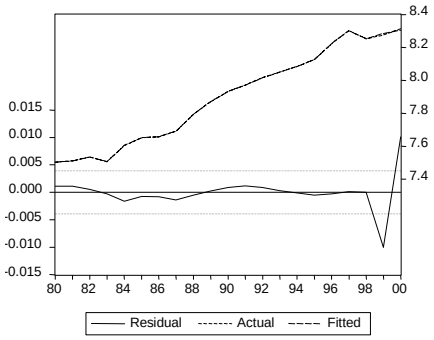
Estimation of the production function reveals that both capital and labour are important determinants of real domestic output. Labour appears to be a leading factor as judged by the magnitude of the coefficients and its statistical significance. Technological advancements exert a meagre effect and less significant influence on domestic output. It is evident from these results that the political instability of 1998 adversely affected the level of economic activity.

$$LRGDP = \underset{(-14.15)}{-3.830} + \underset{(35.06)}{0.893}LL + \underset{(2.39)}{0.046}LK + \underset{(1.02)}{0.001}TIME - \underset{(-25.33)}{0.121}DUM98 - \underset{(-11.48)}{0.049}DUM9920 \qquad (6.23a)$$

$\bar{R}^2 = 0.99 \quad S.E. = 0.004 \quad T = 21\,(1980 - 2000)$

The residuals of the above long-run equation are plotted in Figure 6.1 below and are indicative of stationarity by visual inspection. The stationarity of the residuals is confirmed by the Engle-Granger test for cointegration. Comparing the Engle-Granger test statistic of –7.160939 with the computed McKinnon critical value of –6.158925 leads to the rejection of the null hypothesis of no cointegration in favour of stationary residuals, and hence cointegration between the variables included in the long-run specification at one per cent level of significance and zero lags.[87]

Figure 6.1 Residuals for real GDP cointegration equation



With cointegration confirmed, the results of the second step, the error correction model, are presented below.

$$\Delta LRGDP = \underset{(1.93)}{0.001} + \underset{(83.06)}{0.89}\Delta LL + \underset{(3.43)}{0.06}\Delta LK - \underset{(-2.196)}{0.696}\hat{\varepsilon}_{-1} - \underset{(-84.05)}{0.12}DUM98 + \underset{(35.46)}{0.06}DUM99 - \underset{(-14.27)}{0.05}DUM20 \qquad (6.23b)$$

$\bar{R}^2 = 0.99 \quad S.E. = 0.001 \quad T = 20\ (1981 - 2000)$

[87] See McKinnon (1991) for the response surface of the critical values. The response surface for any number of regressors between one and six ($1 \le n \le 6$) excluding the constant and trend components can be obtained as $C(p) = \phi_\infty + \phi_1 T^{-1} + \phi_2 T^{-2}$ where p represents the percentage of the critical value and T the sample size.

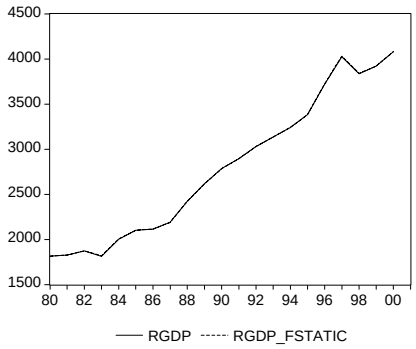
Table 6.3 Diagnostic tests: Real domestic output

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	9.516968	0.008579*
Serial Correlation	Ljung Box Q	Q(12)	7.8429	0.797
	Breusch-Godfrey	$N*R^2(2)$	6.148208	0.05
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.064623	0.799332
	White	$N*R^2(1)$	14.44239	0.107436
Misspecification	Ramsey RESET	LR(2)	115.9221	0.000000*
Parameter Stability	Recursive Estimates			

The estimation results of the error correction model for production are satisfactory in general. All included variables exhibit expected signs and magnitudes and are statistically significant. Diagnostic testing of the errors of this equation indicates that the residuals are free from the problems of heteroscedasticity and multicollinearity and that the equation is specified correctly. The RESET test and the Jarque-Bera test however suggest some error in the specification of the equation and non-normality of the distribution of the residuals.[88]

The solution of the long-run and short-run equations yields a series that tracks the trend of real GDP fairly well. This is shown in figure 6.2.

Figure 6.2 Static solution of real GDP



[88] An asterisk is used in all tables that display diagnostic tests to indicate the non-rejection of the hypotheses of non-normality of errors, no serial correlation, heteroscedasticity and the non-existence of misspecification errors.

6.4.1.2 Real private investment expenditure

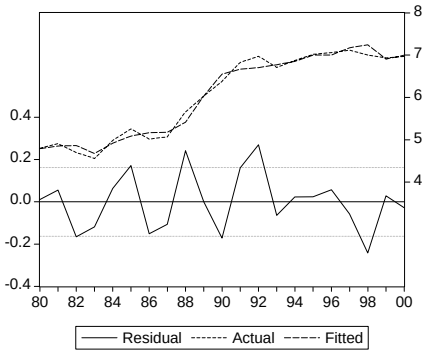
The following equation (6.24a) displays the estimation results of the long run equation for real private investment. Real output, as expected, influences the level of real private investment positively and significantly. Although insignificant, the real user cost of capital influences real private investment negatively as predicted by the neo-classical theory.

$$\begin{aligned} LRPINV = & \underset{}{-14.89} + \underset{(4.39)}{2.66}LRGDP - \underset{(-1.03)}{0.18}LRUCC - \underset{(-4.07)}{0.85}DUM8088 \\ & - \underset{(-2.09)}{0.41}DUM89 - \underset{(-1.34)}{0.21}DUM9697 - \underset{(-2.59)}{0.45}DUM9920 \end{aligned} \qquad (6.24a)$$

$$\bar{R}^2 = 0.97 \quad S.E. = 0.16 \quad T = 21\,(1980 - 2000)$$

The residuals of the above long run estimation are plotted in figure 6.3 below. While they portrayed the existence of cointegration, the Engle-Granger cointegration test was nevertheless performed for confirmation. With the Engle-Granger statistic of –5.503796, a conclusion of the presence of cointegration at the ten per cent level of significance was made. The resulting error correction model and accompanying diagnostic tests are presented in equation (6.24b) and table 6.4 respectively.

Figure 6.3 Residuals for the real private investment cointegration equation



$$\Delta LRPINV = \underset{(6.197)}{3.52}\Delta LRGDP - \underset{(-3.63)}{0.34}\Delta LRUCC - \underset{(-4.12)}{0.74}\hat{\varepsilon}_{-1} - \underset{(-2.53)}{0.13}DUM86$$
$$- \underset{(4.12)}{0.16}DUM8892 - \underset{(-1.76)}{0.15}DUM9697 + \underset{(2.49)}{0.36}DUM20 + \underset{(3.85)}{0.42}DUM9920 \qquad (6.24b)$$

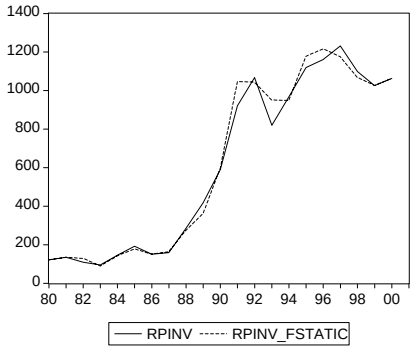
$\bar{R}^2 = 0.85 \quad S.E. = 0.09 \quad T = 20\ (1981 - 2000)$

Table 6.4 Diagnostic tests: Real private investment expenditure

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.153233	0.561796
Serial Correlation	Ljung Box Q	Q(12)	12.199	0.430
	Breusch-Godfrey	$N*R^2(2)$	0.354303	0.837653
Homoscedasticity	ARCH LM	$N*R^2(1)$	1.774496	0.182827
	White	$N*R^2(1)$	11.30765	0.502753
Misspecification	Ramsey RESET	LR(1)	5.241097	0.072763
Parameter Stability	Recursive Estimates			

Judging by the outcome of the diagnostic tests, the residuals of the short-run estimation appear to satisfy the classical OLS assumptions. Given this outcome, the short- and long-run equations are solved simultaneously. The solution shows that the estimated value of real private investment tracks the actual value fairly well. This outcome is shown in figure 6.4.

Figure 6.4 Statics solution of the private investment



6.4.1.3 Labour demand

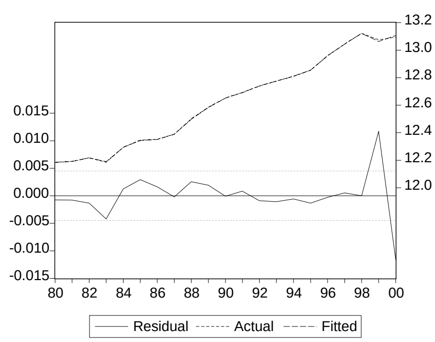
Labour demand is positively and significantly influenced to a large extent by real domestic economic activity and negatively affected by real wages. The coefficient for real wages is however relatively small. Both the user cost of capital and the ratio of real wages to the user cost of capital were tested as arguments in this equation, but did not perform well and hence were omitted.

$$\underset{(47.44)}{LL = 4.25} + \underset{(260.25)}{1.08LRGDP} - \underset{(-1.60)}{0.014LRWAGES} + \underset{(25.06)}{0.13DUM98} + \underset{(12.12)}{0.05DUM99} \quad (6.25a)$$

$$\bar{R}^2 = 0.99 \quad S.E. = 0.005 \quad T = 21\,(1980-2000)$$

The residuals for the labour demand cointegration equation are plotted in figure 6.5 below and are shown to be stationary by the Engle-Granger test for cointegration. The test statistic for this test is –6.146177 at zero lags and the McKinnon critical value is –5.605, confirming cointegration at the one per cent level of significance.

Figure 6.5 Residuals of the labour demand cointegration equation



The results of the error correction model for labour demand are presented in equation (6.25b). In general, the estimation results of the labour demand equation appear as expected from *a priori* theory.

$$\Delta LL = \underset{(151.94)}{1.085}\Delta LRGDP - \underset{(-1.33)}{0.0054}\Delta LRWAGES2 - \underset{(-2.21)}{0.62}\hat{\varepsilon}_{-1} + \underset{(74.52)}{0.13}DUM98 - \underset{(-41.4)}{0.07}DUM99 + \underset{(13.99)}{0.05}DUM20 \quad (6.25b)$$

$$\bar{R}^2 = 0.99 \quad S.E. = 0.002 \quad T = 20\ (1980 - 2000)$$

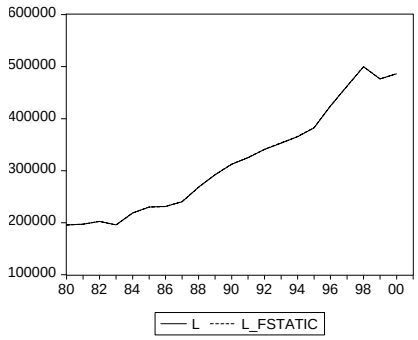
Table 6.5 Diagnostic tests: Labour demand

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.752103	0.686567
Serial Correlation	Ljung Box Q	Q(12)	8.8400	0.717
	Breusch-Godfrey	N*R^2(2)	0.0000	1.0000
Homoscedasticity	ARCH LM	N*R^2(1)	1.190685	0.275191
	White	N*R^2(1)	9.279124	0.411918
Misspecification	Ramsey RESET	LR(2)	129.6919	0.000000*
Parameter Stability	Recursive Estimates			

The residuals of this estimation were subjected to a host of diagnostic tests to assess whether they conform to the assumptions of the classical OLS regression analysis. The test results are reported in table 6.5 and show that the residuals satisfy all the requirements of OLS with the exception of the Ramsey RESET test that suggests the existence of misspecification errors in the equation.

Static solution of the labour demand sub-model yields the following plot, which shows that the overall combined fit of the long- and short-run equations and the actual series is satisfactory.

Figure 6.6 Static solution of labour demand



6.4.1.4 Real wages

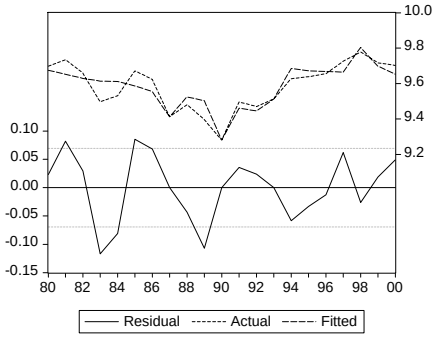
Estimation results of the long run equation for real wages are given in equation (6.26a) below. Labour productivity and consumer prices have a negative and highly significant influence on real wages.

$$\begin{aligned} LRWAGES2 = {} & 21.75 - 1.24LLABPROD1 - 0.19LCPI95 - 0.39DUM8092 \\ & \quad (4.06) \qquad (-2.13) \qquad (-3.96) \qquad (-4.30) \\ & - 0.12DUM87 - 0.20DUM90 - 0.18DUM93 \\ & \quad (-1.65) \qquad (-2.67) \qquad (-2.36) \end{aligned} \tag{6.26a}$$

$\bar{R}^2 = 0.72 \quad S.E. = 0.07 \quad T = 21\,(1980 - 2000)$

The Engle-Granger test confirmed the existence of cointegration in the residuals of the long run equation plotted in figure 6.7 below, hence the estimation of the ECM in equation (6.26b).

Figure 6.7 Residuals for the real wages cointegration equation



$$\begin{aligned} \Delta LRWAGES2 = {} & 0.43\Delta LCPI95 - 0.56\hat{\varepsilon}_{-1} - 0.18DUM83 - 0.23DUM90 \\ & \quad (4.12) \qquad (-2.38) \qquad (-2.21) \qquad (-1.81) \\ & - 0.23DUM87 - 0.18DUM89 - 0.09DUM99 \\ & \quad (-2.99) \qquad (-2.32) \qquad (-1.67) \end{aligned} \tag{6.26b}$$

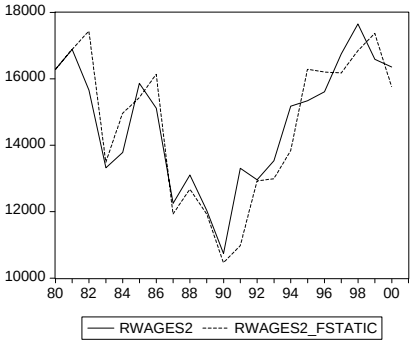
$\bar{R}^2 = 0.54 \quad S.E. = 0.07 \quad T = 20\,(1981 - 2000)$

Table 6.6 Diagnostic tests: Real wages

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.724259	0.422262
Serial Correlation	Ljung Box Q	Q(12)	10.535	0.569
	Breusch-Godfrey	$N*R^2(2)$	1.726630	0.421762
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.720400	0.396013
	White	$N*R^2(1)$	4.914977	0.841656
Misspecification	Ramsey RESET	LR(2)	1.160383	0.559791
Parameter Stability	Recursive Estimates			

Tests performed on the residuals show that none of the classical OLS assumptions are violated by the residuals.

Figure 6.8 Static solution of real wages



6.4.1.5 Real private consumption expenditure

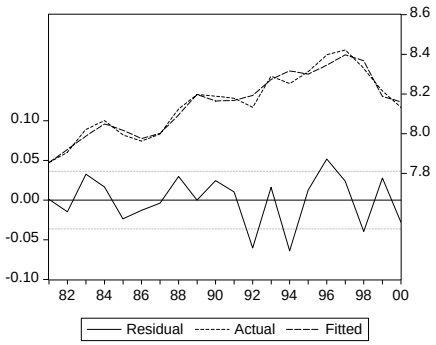
The estimation results of the long-run equation of real private consumption are given below. Real private consumption is positively and significantly influenced by disposable income as predicted by theory. The marginal propensity to consume out of disposable income is 0.24. It is also positively influenced by real wealth as represented by the real M3 money supply. The real rate of interest also plays a significant role in private consumption decisions in contrast to most empirical evidence applied to developing countries. It has a positive and significant influence.

$$LRPCONS = \underset{(4.81)}{0.33} + \underset{(1.60)}{0.24}LRYD + \underset{(4.396)}{0.25}LRM31 + \underset{(2.03)}{0.004}RTBRATE1 + \underset{(2.16)}{0.084}DUM89 - \underset{(-2.46)}{0.08}DUM99 \quad (6.27a)$$

$\bar{R}^2 = 0.95 \quad S.E. = 0.04 \quad T = 20\ (1981 - 2000)$

A visual inspection of the plot of the residuals, presented in the figure 6.9 below, from the long-run equation suggests that there is cointegration among the included variables. Formal tests attest to the fact that the long-run equation cointegrates at the five per cent level of significance.

Figure 6.9 Residuals of the private consumption cointegration equation



Given cointegration in the long run equation, the ECM was formulated and estimated. The results of the ECM are given below.

$$\Delta LRPCONS = \underset{(1.51)}{0.29}\Delta LRYD + \underset{(4.03)}{0.35}\Delta LRM31 + \underset{(0.62)}{0.001}RTBRATE1 - \underset{(-2.02)}{0.64}\hat{\varepsilon}_{-1}$$
$$- \underset{(-1.70)}{0.068}DUM85 - \underset{(-2.28)}{0.097}DUM94 - \underset{(-1.47)}{0.029}DUM982 \quad (6.27b)$$

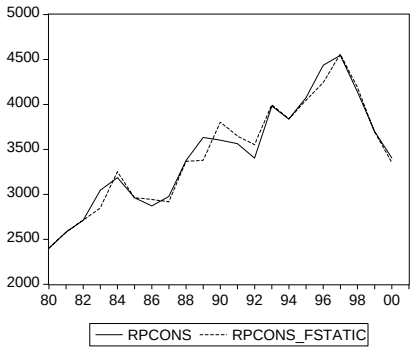
$\bar{R}^2 = 0.74 \quad S.E. = 0.04 \quad T = 19\ (1982 - 2000)$

Table 6.7 Diagnostic tests: Real private consumption expenditure ECM

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.485018	0.475918
Serial Correlation	Ljung Box Q	Q(12)	10.814	0.545
	Breusch-Godfrey	$N*R^2(2)$	2.081542	0.353182
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.035499	0.850554
	White	$N*R^2(1)$	10.20177	0.598265
Misspecification	Ramsey RESET	LR(1)	0.624837	0.731675
Parameter Stability	Recursive Estimates	Indicative of Stability		

The residuals seem to fulfil all the requirements of the OLS assumptions. With this in mind, the private consumption sub-model was then solved statically. The solution results produced a relatively good fit as presented in the figure 6.10 below.

Figure 6.10 Static solution of the private consumption



6.4.1.6 Consumer prices

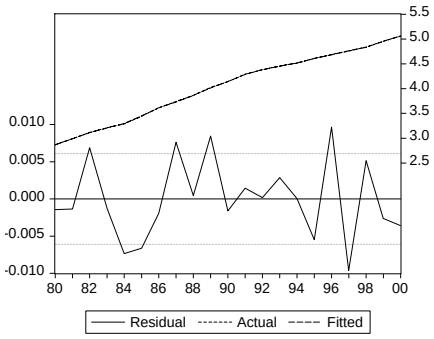
In the long run estimation, consumer prices are positively and significantly influenced by producer prices, excess demand, and the price of imports. The signs of all the variables in this estimation conform to theoretical expectations.

$$LCPI95 = \underset{(1.84)}{0.08}LGDPDEF + \underset{(2.51)}{0.006}LED + \underset{(21.50)}{0.91}LPMGS1 + \underset{(2.72)}{DUM9092} - \underset{(-11.02)}{0.05}DUM982 - \underset{(-3.86)}{0.03}DUM9697 \qquad (6.28a)$$

$$\bar{R}^2 = 0.99 \quad S.E. = 0.006 \quad T = 21\,(1980 - 2000)$$

The Engle-Granger test performed on the residuals of the long run estimation, plotted below, confirms that the variables included in the cointegration equation are cointegrated.

Figure 6.11 Residuals of the consumer prices cointegration equation



Estimation results of the ECM are shown in the equation (6.28b).

$$\Delta LCPI95 = \underset{(90.32)}{0.99}\Delta LPMGS1 - \underset{(-2.04)}{0.52}\hat{\varepsilon}_{-1} - \underset{(-1.96)}{0.01}DUM84 - \underset{(-6.93)}{0.04}DUM98 + \underset{(-3.39)}{0.01}DUM9697 \qquad (6.28b)$$

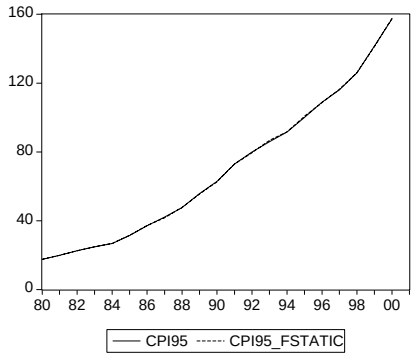
$$\bar{R}^2 = 0.97 \quad S.E. = 0.005 \quad T = 20\ (1981 - 2000)$$

Table 6.8 Diagnostic tests: Consumer prices

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.169349	0.918811
Serial Correlation	Ljung Box Q	Q(12)	19.878	0.069
	Breusch-Godfrey	N*R^2(2)	3.035607	0.219193
Homoscedasticity	ARCH LM	N*R^2(1)	0.830586	0.362103
	White	N*R^2(1)	5.226049	0.632399
Misspecification	Ramsey RESET	LR(2)	4.944282	0.084404
Parameter Stability	Recursive Estimates			

Tests on the residuals of the ECM, plotted in the graph above, show that none of the assumptions of OLS are violated by the residuals. The series that results from these estimations closely follows the actual trend of consumer prices.

Figure 6.12 Static solution of consumer prices



6.4.1.7 Producer prices

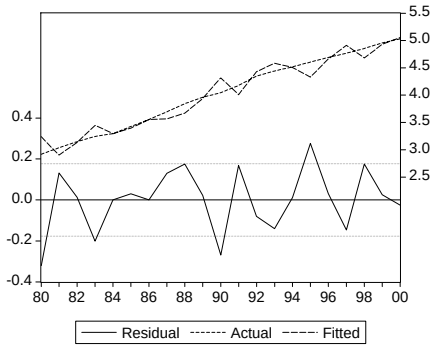
Estimation results of the cointegration equation for producer prices are given in equation (6.29a). In accordance to the results, producer prices are positively and significantly related to capacity utilisation and negatively to the ratio of real wages to the user cost of capital. The political disturbance of 1986 and the inception of the structural adjustment in 1988/89 tended to lower the producer prices. In contrast, the political riots of 1998 resulted in a hike of producer prices.

$$\begin{aligned} LGDPDEF = {} & \underset{(19.7)}{2.96}LCU2 - \underset{(-14.05)}{0.82}LRWAGESUCC2 - \underset{(-2.03)}{0.37}DUM84 + \underset{(-2.61)}{0.25}DUM86 \\ & - \underset{(-1.46)}{0.09}DUM8892 + \underset{(3.17)}{0.45}DUM99 \end{aligned} \qquad (6.29a)$$

$$\bar{R}^2 = 0.93 \quad S.E. = 0.18 \quad T = 21\,(1980 - 2000)$$

The Engle-Granger cointegration test revealed that the residuals of the long-run equation, plotted in figure 6.13, were cointegrated.

Figure 6.13 Residuals for the Producer Prices Cointegration Equation



The ECM results of the producer prices equation are presented in equation (6.29b).

$$\Delta LGDPDEF = \underset{(1.96)}{1.21} - \underset{(1.16)}{0.05}\Delta LRWAGES2(-1) - \underset{(-1.75)}{0.24}LCU2(-1) - \underset{(-1.51)}{0.05}\hat{\varepsilon}_{-1} - \underset{(-5.07)}{0.12}DUM84$$
$$+ \underset{(5.11)}{0.1}DUM92 - \underset{(-3.77)}{0.03}DUM9020 - \underset{(-1.44)}{0.03}DUM20 \qquad (6.29b)$$

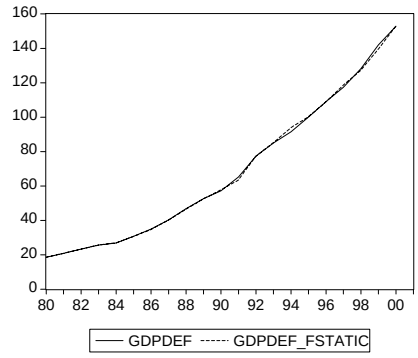
$$\bar{R}^2 = 0.74 \quad S.E. = 0.01 \quad T = 19\ (1982 - 2000)$$

Table 6.9 Diagnostic tests: Producer prices

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.690580	0.708015
Serial Correlation	Ljung Box Q	Q(12)	7.9471	0.789
	Breusch-Godfrey	$N*R^2(2)$	0.761864	0.683224
Homoscedasticity	ARCH LM	$N*R^2(1)$	1.243999	0.264702
	White	$N*R^2(1)$	11.41232	0.326309
Misspecification	Ramsey RESET	LR(2)	0.799391	0.670524
Parameter Stability	Recursive Estimates			

Diagnostic tests on these residuals show that none of the assumptions of OLS is violated by the residuals. The static solution of the long run and short run equations of producer prices yields a good fit between the estimated and actual values.

Figure 6.14 Static solution of producer prices



6.4.1.8 Export prices

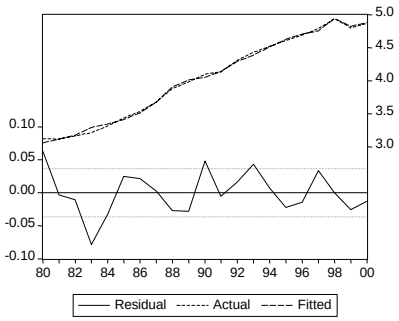
Results of the cointegration equation for export prices are given below. As predicted by theory, export prices are positively and significantly related to world prices and producer prices and negatively and significantly related to the nominal exchange rate. The political riots of 1998 tended to elevate export prices.

$$LPXGS = \underset{(-4.76)}{-1.57} + \underset{(4.92)}{0.47}LPW1 - \underset{(-5.62)}{0.43}LEXRATE + \underset{(14.07)}{0.87}LGDPDEF + \underset{(4.39)}{0.17}DUM98 \qquad (6.30a)$$

$$\bar{R}^2 = 0.99 \quad S.E. = 0.04 \quad T = 21\,(1980 - 2000)$$

The Engle-Granger cointegration test performed on the residuals of the long run equation shows that the variables included in the long run equation are cointegrated.

Figure 6.15 Residuals for the export prices cointegration equation



$$\Delta LPXGS = \underset{(9.10)}{0.898}\Delta LGDPDEF + \underset{(3.21)}{0.31}\Delta LPW1 - \underset{(-3.29)}{0.31}\Delta LEXRATE - \underset{(-3.32)}{0.89}\hat{\varepsilon}_{-1} + \underset{(4.0)}{0.15}DUM98 - \underset{(-6.22)}{0.21}DUM99 + \underset{(4.30)}{0.197}DUM20 \quad (6.30b)$$

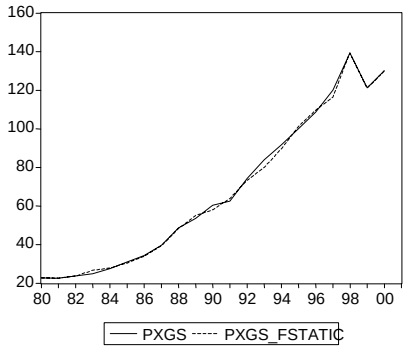
$\bar{R}^2 = 0.80 \quad S.E. = 0.03 \quad T = 20\ (1981 - 2000)$

Table 6.10 Diagnostic tests: Export prices

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.115401	0.572524
Serial Correlation	Ljung Box Q	Q(12)	6.4914	0.889
	Breusch-Godfrey	$N*R^2(2)$	1.582960	0.453174
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.171577	0.678714
	White	$N*R^2(1)$	6.009467	0.872732
Misspecification	Ramsey RESET	LR(2)	2.773061	0.249941
Parameter Stability	Recursive Estimates			

Diagnostic tests on residuals of export prices show that none of the assumptions of OLS analysis are violated and a static solution of the exports demand model gives a reasonable fit.

Figure 6.16 Static solution of exports price



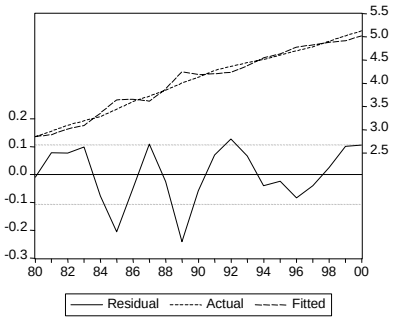
6.4.1.9 Import prices

Estimation results of the long run equation for import prices are presented in equation (6.31a). Import prices are positively and significantly related to world price and the nominal exchange rate.

$$LPMGS1 = \underset{(37.26)}{0.74}LPW1 + \underset{(2.54)}{0.205}LEXRATE - \underset{(-3.31)}{0.246}DUM8088 \qquad (6.31a)$$

$\bar{R}^2 = 0.98 \quad S.E. = 0.11 \quad T = 21\,(1980 - 2000)$

Figure 6.17 Residuals for import prices cointegration equation



The Engle-Granger test for cointegration shows that there is evidence of cointegration between the variables included in the long run equation, hence the estimation of the ECM in equation (6.31b). Estimation results of the ECM show that import prices are positively related to the own lagged values in addition to the nominal exchange rate.

$$\Delta LPMGS1 = \underset{(2.58)}{0.093} + \underset{(0.707)}{0.178}\Delta LPMGS1_{-1} + \underset{(1.73)}{0.086}\Delta LEXRATE - \underset{(-3.01)}{0.13}\hat{\varepsilon}_{-1} - \underset{(-2.24)}{0.027}DUM9298 \qquad (6.31b)$$

$\bar{R}^2 = 0.60 \quad S.E. = 0.02 \quad T = 19\,(1982 - 2000)$

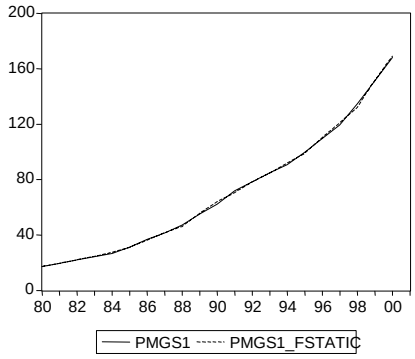
Table 6.11 Diagnostic tests: Import prices

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.577353	0.749254
Serial Correlation	Ljung Box Q	Q(12)	15.903	0.196
	Breusch-Godfrey	$N*R^2(2)$	3.518342	0.172188
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.017903	0.893559
	White	$N*R^2(1)$	7.819195	0.348807
Misspecification	Ramsey RESET	LR(2)	0.233820	0.889665
Parameter Stability	Recursive Estimates			

Diagnostic tests on the residuals of the ECM show that none of the OLS classical assumptions have been violated in this estimation. The solution of the equations of import

prices show that the estimations fit the actual series adequately. The estimated and actual series are plotted in figure 6.18.

Figure 6.18 Static solution of import prices



6.4.2 Estimation results of the external sector

6.4.2.1 Real exports of goods and services

The demand for real exports of goods and services is positively and highly driven by changes in world demand. The relative price of exports has a positive though less significant effect on the demand for exports. This indicates that a rise in the domestic price of exports relative to the world price will work to raise the value of exports as would be expected. It is also noteworthy that the institution of the sales tax in 1982 worked in favour of exports while the political instability of 1986 and 1998 adversely affected the performance of exports in international markets. The latter effects are evident from the short-run model presented in equation (6.32a).

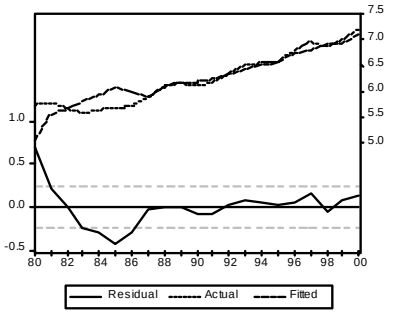
$$LRXGS = \underset{(9.086)}{0.59}LWDEMND + \underset{(1.53)}{0.15}LRXGSRELP1 + \underset{(1.64)}{0.28}DUM82 \qquad (6.32a)$$

$$\bar{R}^2 = 0.80 \quad S.E. = 0.23 \quad T = 21\,(1980 - 2000)$$

A plot of the residuals derived from the long run estimation is shown below. The stationarity feature portrayed in the plot is confirmed by a comparison of the Engle-

Granger test statistic of –4.167591 against the McKinnon critical value of –3.7553 at the ten per cent level of significance, hence the estimation of the ECM in equation (6.32b) below.

Figure 6.19 Residuals for the exports cointegration equation



$$\Delta LRXGS = \underset{(4.00)}{0.29}LWDEMND + \underset{(3.53)}{0.399}\Delta LRXGS_{-1} - \underset{(-5.0896)}{0.44}\hat{\varepsilon}_{-1} - \underset{(-4.26)}{0.14}DUM8086 - \underset{(-2.28)}{0.12}DUM90 + \underset{(2.39)}{0.097}DUM9697 - \underset{(-2.899)}{0.17}DUM98 + \underset{(3.74)}{0.14}DUM99 \quad (6.32b)$$

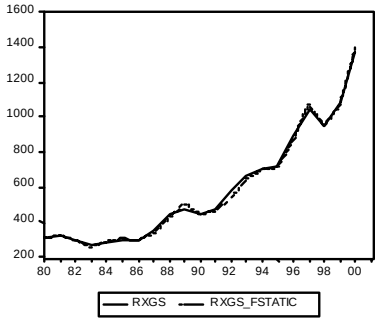
$$\bar{R}^2 = 0.79 \quad S.E. = 0.05 \quad T = 19\ (1982 - 2000)$$

Table 6.12 Diagnostic tests: Real exports of goods and services

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.487164	0.783815
Serial Correlation	Ljung Box Q	Q(12)	20.856	0.053
	Breusch-Godfrey	N*R^2(2)	8.180742	0.016733*
Homoscedasticity	ARCH LM	N*R^2(1)	0.089412	0.764926
	White	N*R^2(1)	7.076043	0.792892
Misspecification	Ramsey RESET	LR(1)	6.135586	0.013249*
Parameter Stability	Recursive Estimates			

The test results of the residuals of the ECM show some presence of serial correlation and misspecification errors, reflected in the Ljung Box Q and Breusch-Godfrey, and RESET tests, respectively. Other tests show that the residuals conform to other assumptions of the OLS assumptions.

Figure 6.21 Static solution of real exports model



6.4.2.2 Real imports of goods and services

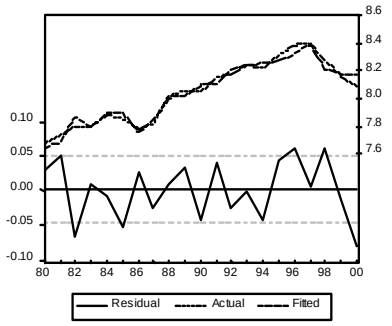
The estimation results of the long run equation for real imports of goods and services are given in equation (6.33a) below. The demand for imports of goods and services relies heavily on the level of national economic activity. A surge in the relative price of imports will lower the level of imports.

$$LRMGS = \underset{(16.64)}{1.49}LRGNP - \underset{(-5.80)}{0.94}LMGSRELP1 - \underset{(-1.48)}{0.055}DUM8384 - \underset{(-3.26)}{0.12}DUM8687 - \underset{(-2.27)}{0.07}DUM8890 \qquad (6.33a)$$

$$\bar{R}^2 = 0.96 \quad S.E. = 0.047 \quad T = 21\ (1980 - 2000)$$

Visual inspection of the residuals derived from the long run estimation plotted below suggests the existence of cointegration. The Engle-Granger test of cointegration confirms this.

Figure 6.22 Residuals of the imports cointegration equation



The resulting ECM estimation is presented in equation (6.33b).

$$\Delta LRMGS = \underset{(6.74)}{1.42}LRGNP + \underset{(0.83)}{0.75}LMGSRELP1 - \underset{(-4.46)}{1.48}\hat{\varepsilon}_{-1} - \underset{(-1.91)}{0.09}DUM83$$
$$- \underset{(-2.66)}{0.061}DUM86 - \underset{(-2.076)}{0.09}DUM20 \qquad (6.33b)$$

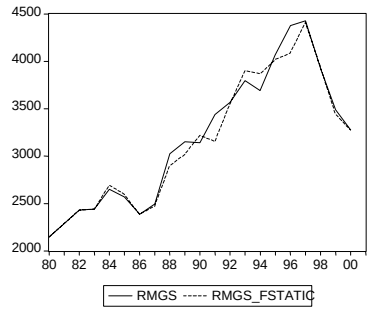
$$\bar{R}^2 = 0.70 \quad S.E. = 0.04 \quad T = 20\ (1981 - 2000)$$

Table 6.13 Diagnostic tests: Real imports of goods and services

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.774253	0.411838
Serial Correlation	Ljung Box Q	Q(12)	10.646	0.559
	Breusch-Godfrey	$N*R^2(2)$	0.00000	1.00000
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.591506	0.441837
	White	$N*R^2(1)$	5.405525	0.797623
Misspecification	Ramsey RESET	LR(2)	2.069368	0.355339
Parameter Stability	Recursive Estimates			

Tests on the residuals of the ECM, reported in table 13, reveal that they satisfy all the assumptions of the OLS regression analysis.

Figure 6.23 Static solution of real imports



6.4.3 Estimation results of the government sector

6.4.3.1 Individual income tax

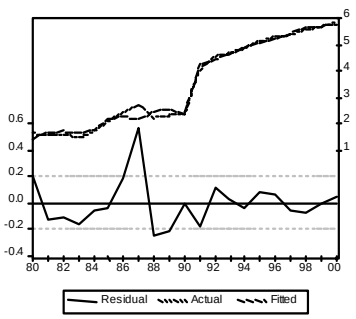
Results of the individual income tax long run equation are presented in equation (6.34a). Nominal wages take the lead and are highly significant in explaining changes in individual income tax. The reforms of the 1990s have also increased the individual income tax significantly.

$$LIITAX = \underset{}{-10.28} + \underset{(10.19)}{1.46}LNWAGES + \underset{(6.077)}{1.24}DUM9020 - \underset{(-5.69)}{1.397}DUM90 \qquad (6.34a)$$
$$\qquad\qquad (-8.53)$$

$$\overline{R}^2 = 0.99 \quad S.E. = 0.19 \quad T = 21\,(1980 - 2000)$$

The Engle-Granger test for cointegration reveals that there is cointegration among the variables included in the long-run equation, hence the estimation of the ECM presented in equation (6.34b) below.

Figure 6.24 Residuals for the individual income tax cointegration equation



$$\Delta LIITAX = \underset{(3.31)}{1.11}\Delta LNWAGES - \underset{(-3.78)}{0.88}\hat{\varepsilon}_{-1} + \underset{(6.21)}{1.33}DUM91 \qquad (6.34b)$$

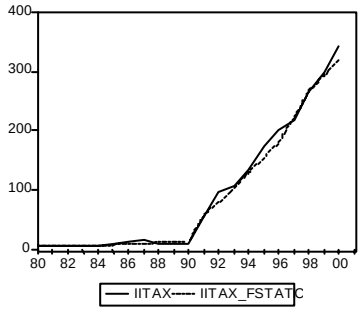
$$\bar{R}^2 = 0.81 \quad S.E. = 0.18 \quad T = 20\ (1981 - 2000)$$

Table 6.14 Diagnostic tests: Individual income tax

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	7.830645	0.019934*
Serial Correlation	Ljung Box Q	Q(12)	12.440	0.411
	Breusch-Godfrey	$N*R^2(2)$	5.860912	0.053373
Homoscedasticity	ARCH LM	$N*R^2(1)$	1.161500	0.281155
	White	$N*R^2(1)$	11.31184	0.045536*
Misspecification	Ramsey RESET	LR(2)	1.616328	0.445676
Parameter Stability	Recursive Estimates			

A battery of diagnostic tests to which the residuals of the ECM were subjected to, reveal that, the probability distribution of the residuals may not be normal as is required by the OLS estimations. In addition, a plot of the estimated and the actual series shows a reasonably close fit.

Figure 6.25 Static solution of individual income tax



6.4.3.2 Other income tax

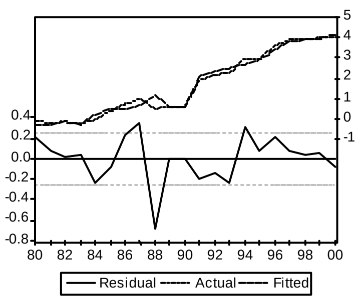
The estimation results of the long run equation for other income tax show that other income taxes depend positively and significantly on the level of economic activity as expected. According to these results, the reforms as represented by DUM89 and DUM90 had adverse effects on other income tax.

$$\underset{(-20.89)}{LOINCTAX = -38.48} + \underset{(21.64)}{5.089LRGDP} - \underset{(-3.74)}{0.99DUM89} - \underset{(-4.86)}{1.29DUM90} + \underset{(1.59)}{0.23DUM982} \quad (6.35a)$$

$\bar{R}^2 = 0.98 \quad S.E. = 0.26 \quad T = 21\,(1980 - 2000)$

A plot of the residuals of the long run estimation of other income tax is given below. According to the Engle-Granger test for cointegration, these residuals are stationary, implying cointegration amongst the variables in the long run equation.

Figure 6.26 Residuals of other income tax cointegration equation



The error correction model for other income tax shows that the tax reforms of 1991 and 1994 have influenced other income tax positively and significantly. The political riots of 1998 had adverse effects on other income tax, while the reforms that started in 1999 under the SMP had a positive and significant effect.

$$\Delta LOINCTAX = \underset{(0.604)}{0.75\Delta LRGDP} - \underset{(-1.94)}{0.52\hat{\varepsilon}_{-1}} + \underset{(5.14)}{1.27DUM91} + \underset{(2.30)}{0.58DUM94} + \underset{(1.90)}{0.34DUM9598}$$
$$- \underset{(-0.696)}{0.22DUM98} + \underset{(0.35)}{0.061DUM99} \quad (6.35b)$$

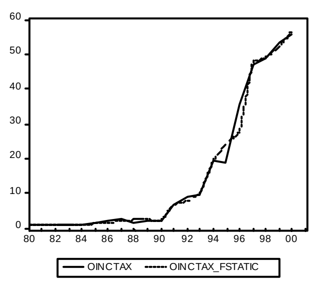
$\bar{R}^2 = 0.59 \quad S.E. = 0.24 \quad T = 20\,(1981 - 2000)$

Table 6.15 Diagnostic tests: Other income tax

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.246720	0.883945
Serial Correlation	Ljung Box Q	Q(12)	9.1917	0.686
	Breusch-Godfrey	$N*R^2(2)$	1.239408	0.538104
Homoscedasticity	ARCH LM	$N*R^2(1)$	9.564919	0.001983*
	White	$N*R^2(1)$	10.46937	0.313839
Misspecification	Ramsey RESET	LR(2)	1.264993	0.531264
Parameter Stability	Recursive Estimates			

Tests performed on the residuals derived from the ECM show that they satisfy the OLS assumptions with the exception of the ARCH LM test that suggests that there is a presence of heteroscedasticity.

Figure 6.27 Static solution of other income tax



6.4.3.3 Company tax

The long run estimation results of the company tax equation show that the level of company tax is highly influenced by private investment.

$$\underset{}{LCOMPTAX} = \underset{(-3.99)}{-2.51} + \underset{(10.64)}{0.96}LRPINV + \underset{(-2.29)}{0.40}DUM8090 - \underset{(-1.54)}{0.21}DUM9192 - \underset{(-1.28)}{0.18}DUM9697 \quad (6.36a)$$

$$\overline{R}^2 = 0.98 \quad S.E. = 0.16 \quad T = 21\,(1980-2000)$$

The residuals derived from the long run estimation above are shown in figure 6.28. In accordance with the Engle-Granger test, there is evidence of cointegration amongst the variables in the long-run equation.

Figure 6.28 Residuals of the company tax cointegration equation

The results of the ECM are given in equation (6.36b).

$$\Delta LCOMPTAX = \underset{(2.71)}{0.095} + \underset{(5.03)}{0.66}\Delta LRPINV - \underset{(-2.84)}{0.59}\hat{\varepsilon}_{-1} - \underset{(-2.36)}{0.31}DUM96 - \underset{(-1.20)}{0.16}DUM99 + \underset{(0.98)}{0.18}DUM20 \qquad (6.36b)$$

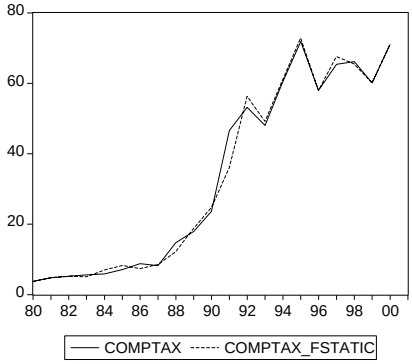
$\bar{R}^2 = 0.64 \quad S.E. = 0.13 \quad T = 20\ (1981 - 2000)$

Table 6.16 Diagnostic tests: Company tax

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	2.195205	0.333670
Serial Correlation	Ljung Box Q	Q(12)	14.582	0.265
	Breusch-Godfrey	$N*R^2(2)$	4.567699	0.101891
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.054637	0.815182
	White	$N*R^2(1)$	11.05232	0.136353
Misspecification	Ramsey RESET	LR(2)	16.49513	0.000262
Parameter Stability	Recursive Estimates			

Tests performed on the residuals of the ECM reveal that they conform to the classical assumptions of OLS. Results of the tests are given in table 6.16. The solution values of company tax closely track the actual series.

Figure 6.29 Static solution of company tax



6.4.3.4 Goods and services tax

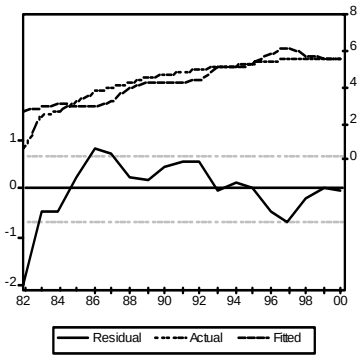
As expected, in the long run goods and services tax is positively and significantly influenced by private consumption expenditure and exports of goods and services.

$$LGSTAX = \underset{(-2.65)}{-31.53} + \underset{(1.89)}{3.29}LRPCONS + \underset{(2.91)}{1.44}LRXGS \qquad (6.37a)$$

$$\bar{R}^2 = 0.74 \quad S.E. = 0.68 \quad T = 19\ (1982 - 2000)$$

The Engle-Granger test for cointegration suggests that there is cointegration between the variables that are included in the long run estimation. A plot of the residuals of this estimation is given in figure 6.30 below.

Figure 6.30 Residuals for goods and services tax cointegration equation



The results of the error correction model show that private consumption has a positive and significant effect on goods and services tax.

$$\Delta LGSTAX = 0.41 + 1.46\Delta LRPCONS - 0.48\hat{\varepsilon}_{-1} + 0.41DUM92 \quad (6.37b)$$

(6.28) (1.90) (–6.54) (1.798)

$$- 0.31DUM9298 - 0.21DUM97$$

(–3.07) (–1.82)

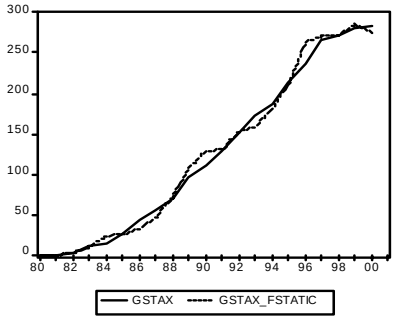
$\bar{R}^2 = 0.77 \quad S.E. = 0.19 \quad T = 18$ (1983 – 2000)

Table 6.17 Diagnostic tests: Goods and services tax

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	3.595037	0.165710
Serial Correlation	Ljung Box Q	Q(12)	7.6366	0.813
	Breusch-Godfrey	$N*R^2(2)$	3.547477	0.169697
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.143988	0.704348
	White	$N*R^2(1)$	7.385435	0.495674
Misspecification	Ramsey RESET	LR(2)	18.05722	0.000120*
Parameter Stability	Recursive Estimates			

Tests performed on the residuals for the ECM show that the residuals satisfy the OLS assumptions with the exception of the Ramsey RESET test that suggests the existence of misspecification errors. The simultaneous solution of the long- and short-run equations for goods and services tax yield a close fit of the estimated series to the actual series.

Figure 6.31 Static solution of the goods and services tax



6.4.3.5 Other taxes

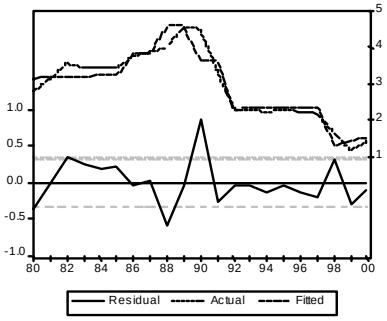
The long run estimation of the equation for other taxes shows that national output has a positive and significant impact on other taxes.

$$LOTAX = \underset{(25.02)}{0.39LRGNP} - \underset{(-2.41)}{0.73DUM8687} + \underset{(6.81)}{1.33DUM8691} - \underset{(-5.73)}{0.98DUM9020} - \underset{(-3.89)}{0.68DUM982} \qquad (6.38a)$$

$$\bar{R}^2 = 0.88 \quad S.E. = 0.34 \quad T = 21\,(1980 - 2000)$$

In addition to a plot of residuals shown in figure 6.29, the Engle-Grange test provided evidence of cointegration between the variables in the long run specification.

Figure 6.32 Residuals for other taxes cointegration equation



Results of the ECM are given in equation (6.38b) and show a positive and significant impact for the 1986 political disturbances. On the other hand, the reforms in 1992 and the political riots of 1998 had adverse effects on other taxes.

$$\Delta LOTAX = \underset{(3.52)}{2.46\Delta LRGNP} - \underset{(-7.97)}{0.96\hat{\varepsilon}_{-1}} + \underset{(3.85)}{0.295DUM86} - \underset{(-9.24)}{1.47DUM92} - \underset{(-3.67)}{0.41DUM9798} \qquad (6.38b)$$

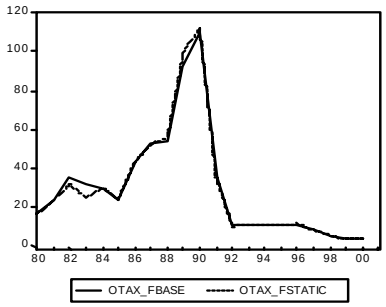
$$\bar{R}^2 = 0.88 \quad S.E. = 0.15 \quad T = 20\,(1981 - 2000)$$

Table 6.18 Diagnostic tests: Other taxes

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.130266	0.568285
Serial Correlation	Ljung Box Q	Q(12)	13.783	0.315
	Breusch-Godfrey	$N*R^2(2)$	3.864771	0.144802
Homoscedasticity	ARCH LM	$N*R^2(1)$	1.370482	0.241727
	White	$N*R^2(1)$	7.886550	0.342704
Misspecification	Ramsey RESET	LR(1)	3.077962	0.079360
Parameter Stability	Recursive Estimates			

Diagnostic tests performed on the residuals of the ECM reveal that the residuals are in line with all the classical OLS assumptions. It is also noteworthy that the estimated series tends to follow the actual series of other taxes well.

Figure 6.33 Static solution of other taxes



6.4.3.6 Government domestic debt

The estimation results of the long run government domestic debt equation are presented in equation (6.39a) below. The results suggest that a worsening of the government balance will induce a significant growth in government domestic debt as expected. In addition, an increase in the nominal Treasury bill rate will raise the level of domestic debt.

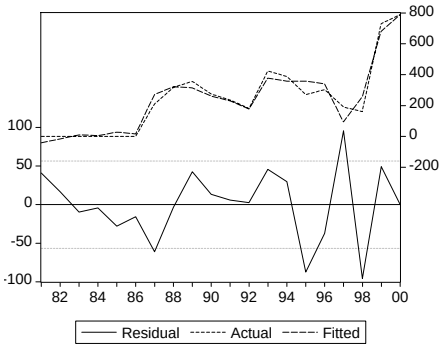
$$DOMDEBT = 284.73 - 0.78GOVBAL + 73.74LTBRATE - 241.02DUM8086 - 270.43DUM8092$$
$$(2.03) \quad (-5.96) \quad (1.29) \quad (-7.26) \quad (-6.64)$$
$$- 298.58DUM9798$$
$$(-6.02)$$

(6.39a)

$\overline{R}^2 = 0.94 \quad S.E. = 56.55 \quad T = 20\ (1981 - 2000)$

The Engle-Granger test shows that the residuals of the long run estimation are stationary, thus giving evidence of cointegration among the variables in the long run specification.

Figure 6.34 Residuals of the government domestic debt cointegration equation



$$\Delta DOMDEBT = 97.99LTBRATE - 1.026\Delta GOVBAL - 0.82\hat{\varepsilon}_{-1} - 266.82DUM8086 - 165.23DUM8892$$
$$(8.39) \quad (-4.76) \quad (-2.73) \quad (-6.62) \quad (-5.75)$$
$$- 270.99DUM95 - 440.21DUM9798$$
$$(-6.25) \quad (-7.46)$$

(6.39b)

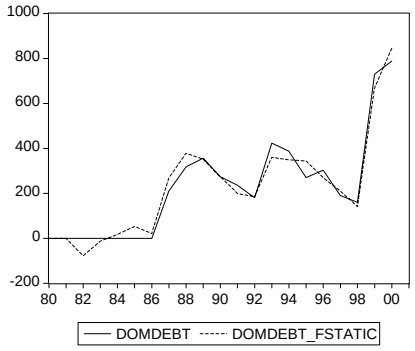
$\overline{R}^2 = 0.87 \quad S.E. = 56.15 \quad T = 19\ (1982 - 2000)$

Table 6.19 Diagnostic tests: Government domestic debt

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	0.946142	0.623086
Serial Correlation	Ljung Box Q	Q(12)	6.8751	0.866
	Breusch-Godfrey	$N*R^2(2)$	0.035300	0.982505
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.542822	0.461265
	White	$N*R^2(1)$	11.53680	0.399447
Misspecification	Ramsey RESET	LR(2)	8.270602	0.015998*
Parameter Stability	Recursive Estimates			

Tests performed on the residuals of the ECM show that they satisfy the assumptions of OLS except for the White test that shows that the residuals may be heteroscedastic, and the RESET test that shows that there is evidence of misspecification errors.

Figure 6.35 Static solution of government domestic debt



6.4.3.7 Government external debt

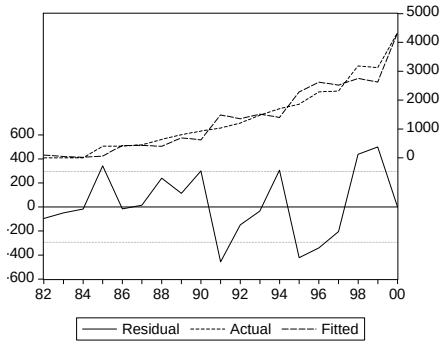
Estimation results of the long run equation for government external debt show that there is a negative and highly significant relationship between government external debt and the nominal current account balance.

$$EXTDEBT = \underset{(-22.04)}{-1.94}NCAB3 + \underset{(1.74)}{363.21}DUM8687 + \underset{(7.15)}{2215.14}DUM20 \qquad (6.40a)$$

$$\bar{R}^2 = 0.94 \quad S.E. = 294.73 \quad T = 19\ (1982 - 2000)$$

The Engle-Granger test confirms cointegration in the residuals of the long run specification above hence the estimation of the ECM in equation (6.40b).

Figure 6.36 Residuals for government external debt cointegration equation



$$\Delta EXTDEBT = \underset{(2.59)}{143.33} - \underset{(-1.57)}{0.52}NCAB3 - \underset{(-2.19)}{0.447}\hat{\varepsilon}_{-1} + \underset{(5.2)}{1410.62}DUM20 \qquad (6.40b)$$

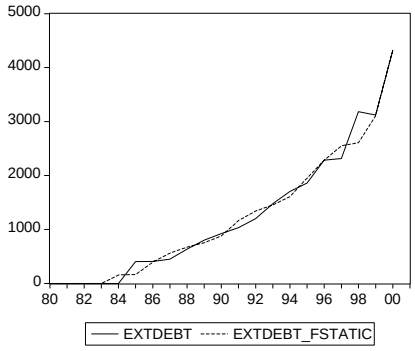
$\overline{R}^2 = 0.61 \quad S.E. = 202.63 \quad T = 18\ (1983 - 2000)$

Table 6.20 Diagnostic tests: Government external debt

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	18.56865	0.000093*
Serial Correlation	Ljung Box Q	Q(12)	8.5777	0.739
	Breusch-Godfrey	$N*R^2(2)$	3.907326	1.141754
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.012772	0.910020
	White	$N*R^2(1)$	2.509588	0.775050
Misspecification	Ramsey RESET	LR(2)	0.150258	0.927624
Parameter Stability	Recursive Estimates			

Diagnostic tests on the residuals of the ECM show that the residuals satisfy all the assumptions of OLS, with the exception of the Jarque-Bera test for normality that shows that the distribution of the residuals is not normal.

Figure 6.37 Static solution of government external debt



6.4.4 Estimation results of the monetary sector

6.4.4.1 Real currency

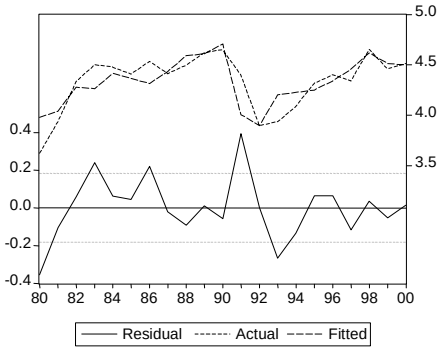
Equation (6.41a) gives the estimation results of the real currency demand cointegration equation. As expected *a priori*, the level of national economic activity positively and significantly influences the demand for real transaction balances. The long run income elasticity of demand for real currency is 2.06.

$$LRCUR = \underset{(-3.29)}{-13.23} + \underset{(4.35)}{2.06}LRGNP + \underset{(4.19)}{0.62}DUM8090 - \underset{(-1.23)}{0.24}DUM92 + \underset{(2.49)}{0.24}DUM982 \qquad (6.41a)$$

$\bar{R}^2 = 0.57 \quad S.E. = 0.18 \quad T = 21\,(1980 - 2000)$

The Engle-Granger cointegration test was performed on the residuals of the long run equation, plotted below. According to the test, the null hypothesis of no cointegration is rejected and a conclusion that the variables in the long run equation are cointegrated is drawn.

Figure 6.38 Residuals for real currency cointegration equation



The estimation results of the ECM are given in equation (6.41b) and show that the short-run income elasticity of demand for real currency is slightly higher at 2.12. While the cost of holding money represented by the rate of inflation also affects real currency positively as expected, the influence is less significant in statistical terms. In addition, political instability appears to induce a highly significant rise in the demand for transactions balances. This is shown by the coefficients of DUM86 and DUM98.

$$\Delta LRCUR = \underset{(5.52)}{2.12}\Delta LRGNP + \underset{(1.495)}{0.1}\Delta LINFL1 - \underset{(-6.35)}{0.85}\hat{\varepsilon}_{-1} + \underset{(3.61)}{0.27}DUM83$$
$$+ \underset{(2.88)}{0.10}DUM86 - \underset{(-4.67)}{0.25}DUM9192 + \underset{(5.09)}{0.39}DUM98 \qquad (6.41b)$$

$$\bar{R}^2 = 0.89 \quad S.E. = 0.07 \quad T = 19\ (1982 - 2000)$$

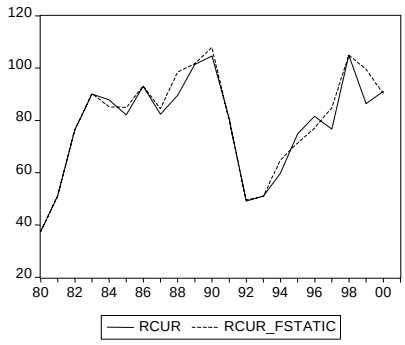
Table 6.21 Diagnostic tests: Real currency demand

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.757140	0.415377
Serial Correlation	Ljung Box Q	Q(12)	10.832	0.543
	Breusch-Godfrey	$N*R^2(2)$	0.200814	0.904469
Homoscedasticity	ARCH LM	$N*R^2(1)$	1.081250	0.298418
	White	$N*R^2(1)$	5.859204	0.826950
Misspecification	Ramsey RESET	LR(2)	0.509095	0.775267
Parameter Stability	Recursive Estimates			

An evaluation of the test results of the diagnostic tests performed on the residuals of the ECM shows that the residuals satisfy all the classical OLS assumptions. In turn, figure

6.39 shows that a plot of the actual real currency series against the series derived from the solution of the individual currency demand model is relatively satisfactory.

Figure 6.39 Static solution of real currency



6.4.4.2 Real demand deposits

The estimation results of the real demand deposits long run equation are displayed in equation (6.42a). As with the demand for currency, real national economic activity is the major driver of the demand for real demand deposits. Although the influence of the real Treasury bill rate is negligible, both in magnitude and in the statistical sense, its coefficient appears with the correct sign.

$$\underset{}{LRDD} = \underset{}{-13.24} + \underset{(-10.02)}{2.3}\,LRGNP - \underset{(-0.94)}{0.004}\,RTBRATE1 + \underset{(2.02)}{0.09}\,DUM86$$
$$- \underset{(-2.39)}{0.19}\,DUM90 + \underset{(3.0)}{0.12}\,DUM982 \qquad (6.42a)$$

$$\bar{R}^2 = 0.95 \quad S.E. = 0.08 \quad T = 20\ (1981 - 2000)$$

A plot of the residuals from the long run estimation shows that they are stationary. This is confirmed by the Engle-Granger cointegration test.

Figure 6.39 Residuals of the real demand deposits cointegration equation

Estimation results of the ECM in equation 6.55 show that the short run income elasticity of demand for real demand deposits is much smaller, at 0.35, than its long run counterpart. The influences of both national income and the rate of interest are however statistically insignificant in this equation.

$$\Delta LRDD = \underset{}{0.11} + \underset{(4.03)}{0.35}\Delta LRGNP - \underset{(0.93)}{0.004}RTBRATE1 - \underset{(0.082)}{1.1}\hat{\varepsilon}_{-1} - \underset{(-3.29)}{0.22}DUM83 - \underset{(2.56)}{0.27}DUM87 - \underset{(-3.16)}{0.22}DUM90 - \underset{(-2.61)}{0.16}DUM99 \quad (6.42b)$$
$$(-2.62)$$

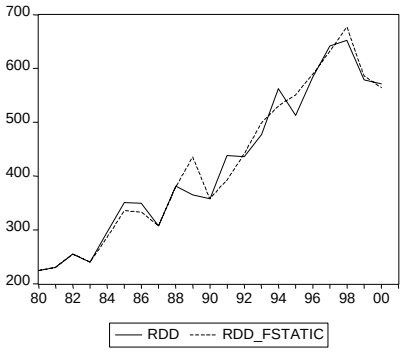
$$\bar{R}^2 = 0.57 \quad S.E. = 0.08 \quad T = 19\ (1982 - 2000)$$

Table 6.22 Diagnostic tests: Real demand deposits

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	10.55997	0.005093*
Serial Correlation	Ljung Box Q	Q(12)	10.044	0.612
	Breusch-Godfrey	N*R^2(2)	2.977960	0.225603
Homoscedasticity	ARCH LM	N*R^2(1)	0.603385	0.437289
	White	N*R^2(1)	9.345114	0.499694
Misspecification	Ramsey RESET	LR(2)	0.077017	0.962224
Parameter Stability	Recursive Estimates			

Diagnostic tests on the residuals reveal that they satisfy all assumptions of OLS regression analysis except for that of normality of the distribution. Figure 6.40 shows that the estimated series of real demand deposits tracks the actual series fairly closely.

Figure 6.40 Static solution of demand deposits



6.4.4.3 Real time and saving deposits

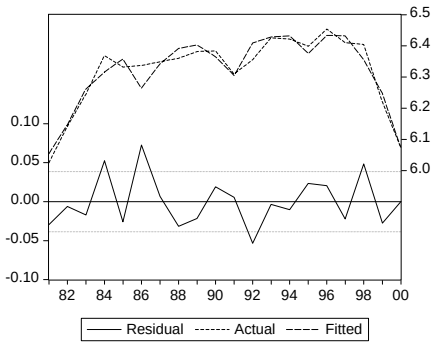
Estimation results of real time and saving deposits reveal that though with a smaller elasticity, national income is the major variable that explains changes in the real time and savings deposits. The sign of its coefficient follows theoretical predictions. In turn, the nominal Treasury bill rate positively and significantly influences the demand for this monetary aggregate.

$$LRTSD = \underset{(1.13)}{1.76} + \underset{(2.98)}{0.56}LRGNP + \underset{(3.98)}{0.009}RTBRATE1 - \underset{(3.86)}{0.147}DUM8084 - \underset{(-3.30)}{0.11}DUM9020 - \underset{(-2.81)}{0.07}DUM97 - \underset{(-3.57)}{0.17}DUM20 \qquad (6.43a)$$

$$\bar{R}^2 = 0.90 \quad S.E. = 0.04 \quad T = 20\ (1981 - 2000)$$

Residuals derived from the long run estimation are presented in the graph below. The Engle-Granger conitegration test was used to confirm the existence of cointegration between the variables included in the long run estimation, hence the estimation of the ECM in equation (6.43b).

Figure 6.41 Residuals for the real time and saving deposits cointegration equation



$$\Delta LRTSD = \underset{(2.42)}{0.41}\Delta LRGNP + \underset{(1.83)}{0.031}RTBRATE1 - \underset{(-2.18)}{0.57}\hat{\varepsilon}_{-1} + \underset{(2.53)}{0.04}DUM8086$$

$$- \underset{(-1.29)}{0.034}DUM97 - \underset{(-2.26)}{0.10}DUM99 \qquad (6.43b)$$

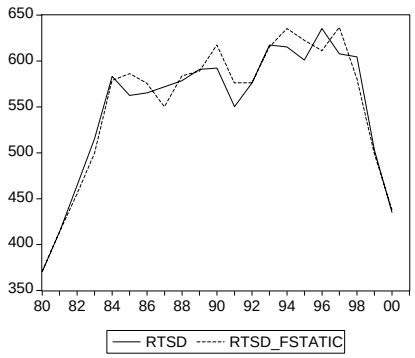
$$\bar{R}^2 = 0.80 \quad S.E. = 0.04 \quad T = 19\ (1982 - 2000)$$

Table 6.23 Diagnostic tests: Real time and saving deposits

Purpose of Test	Test	d.f.	Test Statistic	Probability
Normality	Jarque-Bera	JB(2)	1.224500	0.542130
Serial Correlation	Ljung Box Q	Q(12)	9.6730	0.645
	Breusch-Godfrey	$N*R^2(2)$	0.002249	0.998876
Homoscedasticity	ARCH LM	$N*R^2(1)$	0.032749	0.856394
	White	$N*R^2(1)$	13.31377	0.206654
Misspecification	Ramsey RESET	LR(2)	3.011547	0.221846
Parameter Stability	Recursive Estimates			

Diagnostic tests performed on the residuals of the ECM estimation show that they conform to the OLS assumptions. A solution of the equations for the real time and saving deposits is shown in figure 6.42.

Figure 6.42 Static solution of real time and saving deposits



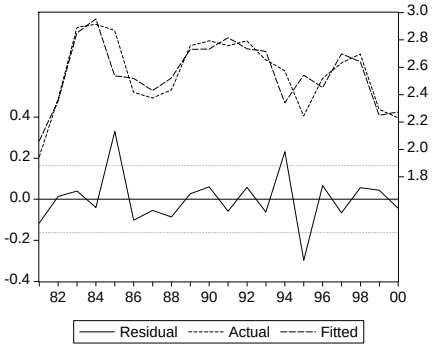
6.4.4.4 Nominal Treasury bill rate

Long run estimation results of the nominal Treasury bill rate show that the Treasury bill rate is related positively and significantly to real national output, the government budget balance and the rate of inflation.

$$\begin{aligned} LTBRATE = &-16.195 + 2.09LRGNP + 0.001RGOVBAL + 0.58LINFL1 \\ &\quad (-3.67) \quad (4.27) \quad (1.33) \quad (2.50) \\ &+ 0.73DUM8384 - 0.34DUM95 - 0.19DUM9697 - 0.34DUM99 \\ &\quad (4.36) \quad (-2.39) \quad (-1.28) \quad (-1.55) \end{aligned} \tag{6.44a}$$

$\bar{R}^2 = 0.62 \quad S.E. = 0.16 \quad T = 20\ (1981 - 2000)$

Figure 6.43 Residuals for the nominal Treasury bill rate cointegration equation



In addition to the real government budget balance, the nominal Treasury bill rate is influenced positively and significantly by a one period lagged real national output, its own lagged values, the foreign (SA) short-term interest rate, and a one period lagged inflation rate in the error correction equation.

$$\begin{aligned} LTBRATE = &\ 1.67\Delta LRGNP_{-1} + 0.84LTBRATE_{-1} \\ &\quad (3.096) \quad (20.45) \\ &+ 0.028RF + 0.21\Delta LINFL1_{-1} - 0.74\hat{\varepsilon}_{-1} - 0.097DUM95 \\ &\quad (3.76) \quad (-2.596) \quad (-3.69) \quad (-1.51) \end{aligned} \tag{6.44b}$$

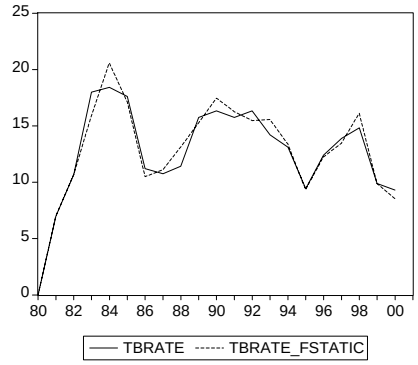
$\bar{R}^2 = 0.86 \quad S.E. = 0.10 \quad T = 19\ (1982 - 2000)$

Table 6.24 Diagnostic tests: Nominal Treasury bill interest rate

Purpose of test	Test	d.f.	Test statistic	Probability
Normality	Jarque-Bera	JB(2)	0.745857	0.688714
Serial Correlation	Ljung Box Q	Q(12)	8.1344	0.775
	Breusch-Godfrey	$N*R^2(2)$	2.741060	0.253972
Homoscedasticity	ARCH LM	$N*R^2(1)$	2.206887	0.137396
	White	$N*R^2(1)$	16.83918	0.112724
Misspecification	Ramsey RESET	LR(2)	9.725337	0.007730*
Parameter Stability	Recursive Estimates		Indicative of Stability	

Diagnostic tests on the residuals show that they do not violate any of the assumptions of classical OLS analysis, except for the test for misspecification errors. Moreover, the estimated series does not deviate significantly from the actual series.

Figure 6.44 Static solution of the nominal Treasury bill rate



6.5 CONCLUSION

This chapter has presented the estimation and test results of the behavioural equations of the model. These results have been assessed to a large extent on theoretical and statistical grounds. This entailed, first and foremost, inspection of the signs and magnitudes of the estimated coefficients. The statistical properties involved the significance of the individual explanatory variables in equations, the overall statistical performance of the individual regressions and the assessment of conformity of the equations to OLS assumptions. Most of the equations have performed well, both theoretically and statistically in both the long-run and short-run estimations. All the long-run estimations

exhibit cointegration properties, as judged by the Engle-Granger cointegration test, thus permitting estimation of the ECMs. In turn, the adjustment terms in the latter estimations are large enough and statistically significant to allow for adjustment to long-run equilibria. The solutions of the individual models, consisting of the long-run and short-run dynamic estimations, almost invariably produce a satisfactory fit of the estimated series to the actual series, indicating a good performance of the individual models. Further tests on the forecasting accuracy of the endogenous variables of the models are carried out in the next chapter.

It is evident from the results that the real aggregate output depends on labour, capital and technological advancements. It is however noticeable that labour has a more pronounced impact on changes in real aggregate output than capital. Private investment is explained by real output and the real user cost of capital. In turn, changes in the level of employment are driven by changes in real aggregate output with changes in real wages playing a less prominent role. Real wages depend to a large extent on labour productivity.

One of the salient features that emerges from the estimations results is that a more daring specification of the consumption function, that includes some form of a wealth variable and the rate of interest, is suitable for the economy of Lesotho as opposed to the case in many developing economies. In the prices sector, changes in the producer prices, the level of excess demand and import prices explain consumer prices. The latter two variables attest to the influence of demand pressures and high import content, and variations in consumer prices. Changes in producer prices rely heavily on capacity utilization and factor costs while export and import prices both rely heavily on world prices and the nominal exchange rate.

It is evident that the demand for real exports of goods and services is influenced mainly by world demand while the demand for imports is determined primarily by the national level of economic activity as is expected from theory.

With regard to the government sector, nominal wages tend to perform well as a base for individual income tax revenue while the level of real economic activity plays a major role in explaining changes in other income tax and other tax receipts. In contrast, goods and services taxes depend on real private consumption and real exports of goods and services, while company taxes depend highly on real private investment. The levels of domestic and external government debt are highly and directly related to developments in the government budgetary operations and the nominal current account balance respectively as well as the nominal rate of interest.

In the monetary sector, the level of real economic activity plays an important role in explaining changes in the levels of both narrow and broad money, with the rate of inflation and the rate of interest partly explaining the former and the latter respectively, as opportunity cost variables. The nominal Treasury bill rate of interest is linked to national real economic activity, the government budget balance, the rate of inflation and the South African interest rate.

It is noteworthy that a number of events, economic and otherwise, that occurred in the economy had significant effects on economic variables. These include political instability, economic reforms and major policy changes, the inception and phasing out of major activities of the LHWP, structural adjustment programmes and others.

In principle, these results indicate that fairly standard and rather parsimonious specifications are suitable for the economy of Lesotho as is the case with many small developing economies.