Budget deficits and the term structure of interest rates

Evidence from Mauritius (1968-1999)

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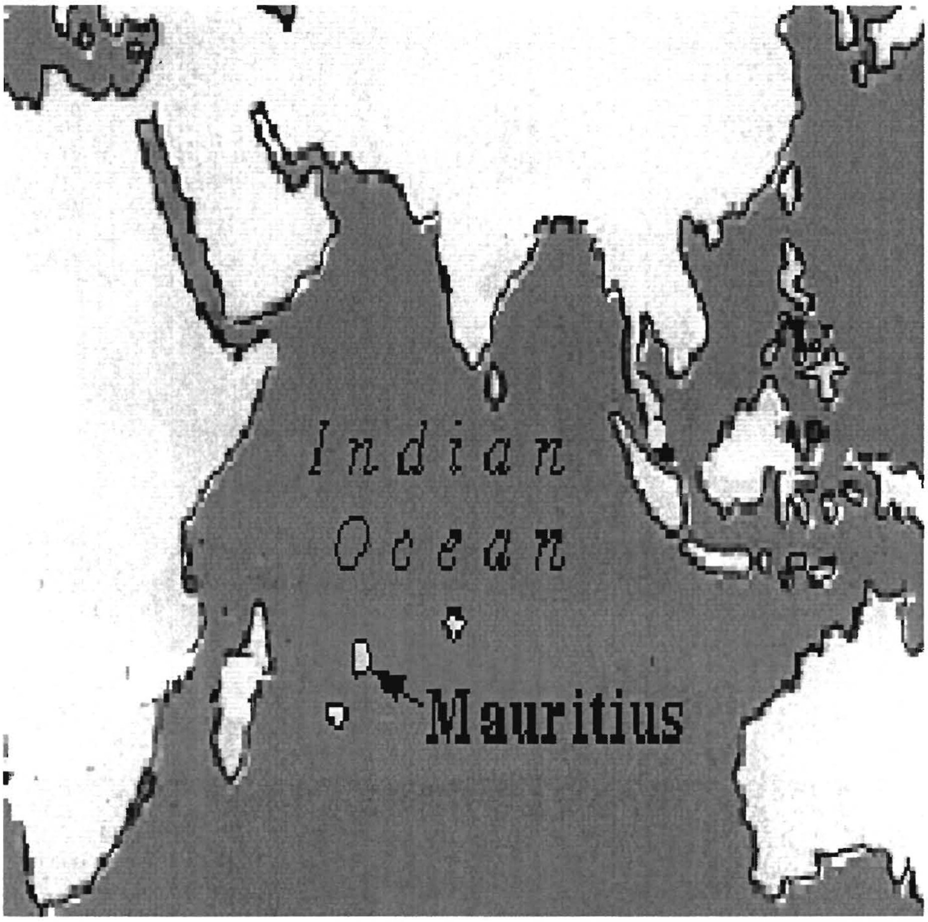
To Krishna



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TERMS OF REFERENCE

This paper was compiled for the School of Economics of the University of Cape Town in partial fulfilment of the requirements of the Master of Commerce degree in Economics.

The objective of the paper is to investigate about a possible link between budget deficits and the term structure of interest rates in Mauritius.

ABSTRACT

The debate on the effects of larger budget deficits on the term structure of interest rates, is even today unresolved with proponents of the "conventional view" suggesting a positive relationship between budget deficits and interest rates, and supporters of the "Ricardian Equivalence hypothesis" arguing that there is no relationship between those variables. This paper investigates the possible link between budget deficits and the term structure of interest rates in Mauritius, using annual data from 1968 to 1999.

The theoretical link between budget deficits and interest rates is analysed using three different approaches, namely the IS/LM, the loanable funds, and the term structure approaches. Hence three different models are derived, and tested using the 2SLS regression technique (to avoid simultaneous equations bias which arises from the endogeneity of some of the variables used). The empirical evidence presented in this paper provides divergent answers for the different methodologies and models used. When using 'level' variables, most of the regression results reject the Ricardian view. This inference (which is similar to that obtained in the literature) is criticised as possibly being unreliable on the basis of spuriousness of the level regression results. The problem of possible spuriousness is circumvented in the paper, by using the 'differenced' variables in 2SLS regressions. The latter are found to generate insignificant coefficients for the deficit variables, hence implying the absence of any relationship between budget deficits and long-term interest rates. This inference is criticised in the paper, on the basis that long-run properties of the variables used might have been lost while making the variables stationary because the model in differences may not have a long run solution. The Granger-causality tests performed in the paper is used as an arbitrator in the above empirical conflict. However the Granger-causality tests performed, do not provide overwhelming evidence in the sense that they yield a unique case of unidirectional causality in which it is observed that increases in the budget deficit raise the term structure of interest rates. Nevertheless, they help us not to reject the conclusions reached while using 'level' variables.

From the above, one could hesitantly conclude that there might be a positive relationship between budget deficits and the term structure of interest rates. This suggests that larger budget deficits would force private investors to borrow in short-term markets for funds, hence reducing private long-term capital spending. Those adverse effects of a steeper yield curve caused by larger budget deficits, may thus hinder long-term economic growth if the Mauritian government does not maintain budget deficits to a reasonable level.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Page

Tables

Graphs

LIST OF SYMBOLS

2SLS	Two Stage Least Squares
ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
CAPGNP	Net capital inflows as a percentage of GNP
DBM	Development Bank of Mauritius
DEF1GNP	Overall budget deficit including grants as a percentage of GNP
DEF2GNP	Change in net claims on central Government as a percentage of GNP
DEF3GNP	Net domestic financing of the budget deficit as a percentage of GNP
EPZ	Export Processing Zone
FΔINFL	Forecasted changes in inflation using the autoregressive model of ΔINFL
FRN	Floating Rate Notes
g	Real GDP annual growth
GDFCF	Gross Domestic Fixed Capital Formation
GDP	Gross Domestic Product
GDS	Gross Domestic Savings
GNP	Gross National Product
GOVGNP	Government Consumption as a percentage of GNP
I(1)	Integrated of the first order
I(2)	Integrated of the second order
IFS	International Financial Statistics
IMF	International Monetary Fund
INFL	Actual inflation rate variable
LR1	The rate on 12-24 months deposit account with commercial banks
LR2	The rate on 24-36 months deposit account with commercial banks
LR3	The rate on (greater than) 48-months deposit account with comm. banks
M1GNP	Money supply M1 as a percentage of GNP
M2GNP	Money supply M2 as a percentage of GNP
MHC	Mauritius Housing Company Ltd
MLC	Mauritius Leasing Company
NPF	National Pensions Fund
OTC	Over-the-Counter

P^e	Expected Inflation
POSB	Post Office Savings Bank
r_{s1}	Ex-Ante Real Short-term Rate 1 = SR1 - P^e
r_{s2}	Ex-Ante Real Short-term Rate 2 = SR2 - P^e
r_{s3}	Ex-Ante Real Short-term Rate 3 = SR3 - P^e
RMGNP	Reserve money as a percentage of GNP
RMP	Reserve Money Programme
Rs	Mauritian Rupees
SDR	Special Drawing Right
SEM	Stock Exchange of Mauritius
SEMDEX	Stock Exchange of Mauritius main index
SIC	State Investment Corporation Ltd
SICOM	State Insurance Company of Mauritius Ltd
SIFB	Sugar Insurance Fund Board
SMC	Secondary Market Cell
SR1	Bank rate
SR2	The rate on 3-months deposit account with commercial banks
SR3	The rate on 6-months deposit account with commercial banks
t	Personal income tax rate
TS11	Yield spread between LR1 and SR1
TS12	Yield spread between LR1 and SR2
TS13	Yield spread between LR1 and SR3
TS21	Yield spread between LR2 and SR1
TS22	Yield spread between LR2 and SR2
TS23	Yield spread between LR2 and SR3
TS31	Yield spread between LR3 and SR1
TS32	Yield spread between LR3 and SR2
TS33	Yield spread between LR3 and SR3
TSE	Time Series Explorer
UK	United Kingdom
US$	American Dollar
USA	United States of America
WDI	World Development Indicators

XINFL	Unadjusted expected inflation variable
ΔCAPGNP	First difference of the variable CAPGNP
ΔDEF1GNP	First difference of the variable DEF1GNP
ΔΔDEF1GNP	Second difference of the variable DEF1GNP
ΔDEF2GNP	First difference of the variable DEF2GNP
ΔDEF3GNP	First difference of the variable DEF3GNP
Δr_{s1}	First difference of the variable r_{s1}
Δr_{s2}	First difference of the variable r_{s2}
Δr_{s3}	First difference of the variable r_{s3}
ΔP^e	First difference of the variable P^e
Δg	First difference of the variable 'g'
ΔGOVGNP	First difference of the variable GOVGNP
ΔINFL	First difference of the inflation variable
ΔLR1	First difference of the variable LR1
ΔLR2	First difference of the variable LR2
ΔLR3	First difference of the variable LR3
ΔM1GNP	First difference of the variable M1GNP
ΔM2GNP	First difference of the variable M2GNP
ΔRMGNP	First difference of the variable RMGNP
ΔSR1	First difference of the variable SR1
ΔSR2	First difference of the variable SR2
ΔSR3	First difference of the variable SR3
Δt	First difference of the variable 't'
ΔTS11	First difference of the variable TS11
ΔTS12	First difference of the variable TS12
ΔTS13	First difference of the variable TS13
ΔTS21	First difference of the variable TS21
ΔTS22	First difference of the variable TS22
ΔTS23	First difference of the variable TS23
ΔTS31	First difference of the variable TS31
ΔTS32	First difference of the variable TS32
ΔTS33	First difference of the variable TS33

CHAPTER 1

INTRODUCTION

There has been widespread concern about larger budget deficits mainly because of the adverse effects caused by the accompanying rise in interest rates. The resulting crowding-out of private capital expenditure would generate a smaller future private capital stock which would lower future output and hence lower future real incomes and consumption. This threat of a drop in living standards is the reason why increasing attention is being given to understanding the possible link between budget deficits and interest rates, so that effective policies can be devised and implemented to counter this potential threat. The paper investigates any possible relationship between budget deficits and the term structure of interest rates in Mauritius.

This chapter gives an overview of the Mauritian economy with the objective of identifying the key variables influencing the determination of budget deficits and the term structure of interest rates in Mauritius.

1.1 Introduction to the Mauritian economy

After independence on the 12th of March 1968, Mauritius initially witnessed the harsh realities of economic stagnation faced by many developing countries through serious balance of payments crises, but the country resurfaced with the help of the International Monetary Fund's (IMF) stabilisation programs backed by the Mauritian government's growth enhancing policies in the mid 1980's.

The Mauritian economy was initially a monocrop economy, almost entirely dependent on the sugar industry. In the 1970's however, the Mauritian government attempted to reduce the high unemployment rate of about 20% by promoting labour-intensive manufacturing activities via the Export Processing Zone (EPZ). As Dabee explains, "A generous package of incentives was proposed to investors in the EPZ Act of

1970"[1] which eventually attracted local and foreign investment into the EPZ.

The Mauritian economy however went into a crisis in the late 1970's mainly due to a failure to maintain the competitiveness of the Rupee, and to keep inflation low. The sugar boom of the mid-1970's had led to increases in real wages and increased demand for imports due to the appreciating Rupee. The real wage increase, coupled with the appreciating Rupee led to a slowdown of the EPZ exports, which resulted in the deterioration of the balance of payments and in the depletion of the foreign exchange reserves. Furthermore, the tourism and sugar industries slowed down considerably because of the international fuel price hike of 1973-1974 and adverse climatic conditions respectively. The latter slashed the sugar harvest by about 20% in 1979.[2]

After a consequent depreciation of the Rupee, which was prescribed by the 1981 stabilisation programmes of the IMF and World Bank, the Mauritian exports rose dramatically with the help of increased demand coming from the United States and Europe. Better climatic conditions also benefited the sugar industry. Furthermore, the political uncertainty in Hong Kong led to capital flowing from there to the Mauritian EPZ[3] which helped Mauritius recover even quicker. Since then, an active policy of diversification based on export oriented industries has followed in the EPZ. The textile industry in particular, experienced a major expansion and today plays a major role in the EPZ, having overtaken sugar as the island's main export.[4] The tourism industry which is considered to be the third pillar of the Mauritian economy after the EPZ and the sugar industry, has also developed into a major foreign exchange generator.

The Mauritian government is presently aiming at developing the country into a regional financial & business centre, and to making the financial sector the fourth pillar of the Mauritian economy. Towards that objective, the offshore business centre and the freeport have been set up.

[1] Dabee, 1998: 2
[2] Dabee, 1998: 3
[3] Dabee, 1998: 4
[4] Maurel, 1995: 22

Generous incentives are available to foreign companies that are established in the freeport. These companies are able to use the country as a platform for their operations in Africa and as a commercial bridge between Asia and Africa. The services offered include transshipment and re-exportation, offshore banking and other financial services, light manufacturing, and information technology.[5]

In 1992, Mauritius became the first offshore financial centre in the southern hemisphere. About 1500 offshore international companies have been incorporated since then. Those incorporations were facilitated by the Mauritian government through the latter's ratification of double taxation agreements with Botswana, Canada, China, France, Germany, Greece, India, Indonesia, Italy, Luxembourg, Madagascar, Malaysia, Pakistan, Singapore, South Africa, Swaziland, Sweden, United Kingdom and Zimbabwe.[6]

1.2 Overview of the Mauritian economy

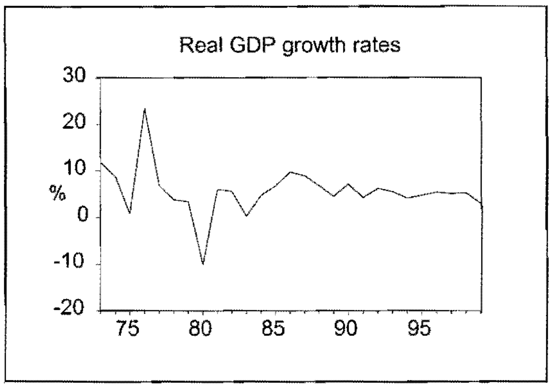
An overview of the key components of the Mauritian economy, namely the country's national income & production, the labour market, and external trade & balance of payments is given in this section. A more detailed discussion of two other key components of the Mauritian economy namely 'money & banking' and 'government finance' is provided in *Sections 1.3* and *1.4* respectively, because of their immediate relevance to the objectives of this paper, which is to understand the possible link between budget deficits and the term structure of interest rates in Mauritius.

1.2.1 National Income and Production

Mauritius has achieved high growth rates of output and employment over the past ten years, and in 1998 the country had a GNP per capita of about US$ 3,400.[7]

[5] http://lcweb2.loc.gov/frd/cs/mutoc.html
[6] http://www.mauritius-online.com/coopers/mm_politic.htm
[7] http://www.mauritius-online.com/coopers/mm_politic.htm

Graph 1.1 (TSE source: IFS)

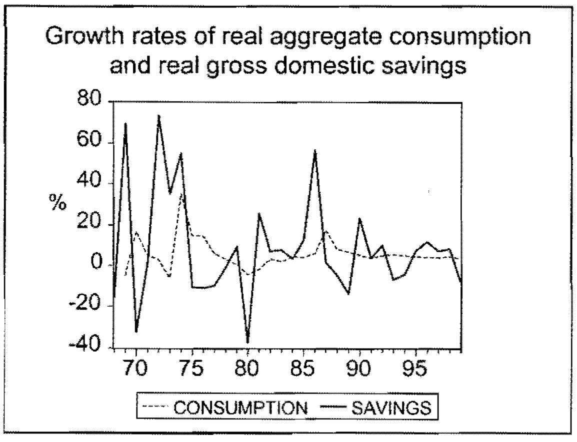


Growth rates of real GDP have remained stable over the past 15 years, as shown in *Graph 1.1*. The sugar boom allowed GDP real growth rate to peak in the mid-1970's. However, the economic crisis of the late 1970's, resulted in a sharp drop in real GDP growth. The currency devaluations and the IMF/World Bank's stabilisation programmes allowed the economy to recover in 1981, and economic growth have remained relatively stable since then.

The success of the country's manufacturing sector has made possible an annual average economic growth rate of about 5.5% over the period 1990 to 1997.[8] The growth rate of real GDP amounted to 5.4% in 1998 (5.2% in 1997)[9] and is expected to be 2.5% for 1999.[10]

The agricultural sector consists mostly of sugar cane, tea and foodcrops production, and accounts for about 9% of GDP, with sugar exports accounting for 22.6% of total exports in 1998 as compared to 40.5% in 1987. This declining trend is likely to continue with the growing importance of the other sectors of the economy.[11]

Graph 1.2 (TSE source: IFS)



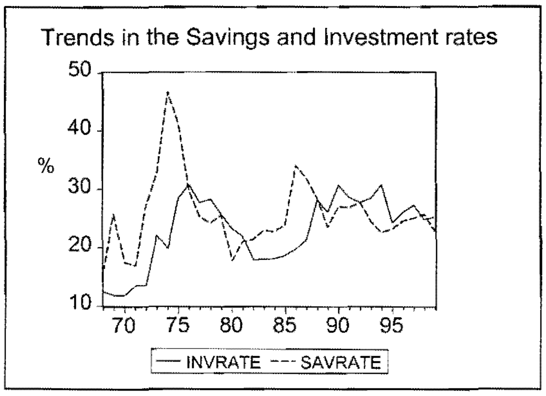
The growth rate of real aggregate consumption expenditure has been stable since 1968, as shown in *Graph 1.2*. Real gross domestic savings growth rate has however been volatile throughout the 1970's. This volatility can be partly explained as resulting from the sugar boom period of the mid-1970's and the recessionary period of the late 1970's.

[8] Bank of Mauritius, 1999: 12
[9] Bank of Mauritius, 1998: 23
[10] Bank of Mauritius, December 1999: 7
[11] Bank of Mauritius, 1999: 15

Aggregate consumption expenditure increased in real terms by 4.4% whereas real gross domestic savings grew by 8.3% in 1998 (7.1% in 1997). Gross domestic fixed capital formation (GDFCF) (excluding irregular investments such as the purchase of aircrafts & marine vessels) increased by 5.6% in real terms in 1998 (contracted by 1.5% in 1997), and is expected to rise further to 7.1% in 1999.[12]

Trends in the savings rate (the ratio of Gross domestic savings to GDP at market prices) and the investment rate (the ratio of Gross domestic fixed capital formation to GDP at market prices) are shown in *Graph 1.3.*

Graph 1.3 (TSE source: IFS)



The mid-1970's sugar boom period saw the investment rate peaking to about 31% and the savings rate starting a steady decline mainly due to a drop in business confidence. The latter lead to both the investment and savings rate falling after 1975, and this largely contributed to the economy going into a recession at the end of the 1970's. The economic recovery sparked by the currency devaluations and the IMF/World Bank's stabilisation programme in 1981, resulted in both the savings and investment rates picking up after 1981.

The savings rate rose to 25.1% in 1998 (24.3% in 1997) but is expected to drop to 23.3% in 1999. The investment rate dropped to 23.2% in 1998 (27.2% in 1997) and is expected to rise to about 26.5% in 1999.[13]

The course of the 'National income and Production' variables since 1968, is displayed in *Table 1.1.*

[12] Bank of Mauritius, 1999: 9
[13] Bank of Mauritius, 1999: 12

Average for the years	1968-1972	1973-1977	1978-1982	1983-1987	1988-1992	1993-1997	1998-1999
Nominal GDP at market prices (Rs million)	1,323	4,018	8,906	17,533	39,036	70,249	101,315
Real GDP (Rs million)	17,523	25,880	32,406	38,858	53,959	69,453	81,561
Real GDP per capita (Rs)	21,631	30,109	34,796	39,374	52,343	62,955	69,706
Real GDP per capita growth (%)	3.07	9.20	-0.10	5.28	4.75	3.05	2.77
Real GDP growth (%)	2.05	10.40	1.73	6.13	5.78	4.94	4.1
Real consumption expenditure (Rs million)	12,910	20,294	25,356	29,071	41,987	52,892	60,750
Real consumption expenditure growth (%)	5.02	12.81	0.10	6.79	5.67	4.49	3.9
Real GDS (Rs million)	3,648	8,910	7,157	10,718	14,444	16,699	19,826
Savings rate (%)	20.64	35.22	22.01	27.12	26.74	24.01	24.33
GDFCF (Rs million)	168.6	1,065.6	2,020.6	3,412	11,058	19,144	25,424
GDFCF growth (%)	13.54	49.83	7.13	20.07	23.31	11.98	6.97
Investment rate (%)	12.65	25.80	23.43	19.17	28.27	27.38	25.08

Table 1.1 (Source: Time Series Explorer - WDI, IFS)[14]

1.2.2 The Labour Market

The population of Mauritius and the total labour force (including non-Mauritians) were estimated towards the end of December 1998 at about 1.17 million and 517,000 respectively, whereas total employment was about 487,600.[15] Unemployment affected nearly 20% of the economically active population in 1984 but was brought down to about 5% in 1989. Since 1991 the unemployment rate has been on an uptrend despite the steady growth of the economy. The Minister of Finance, Dr Vasant Bunwaree, termed this phenomenon as 'jobless growth'. In 1998 however, the unemployment rate dropped to 5.8% (from 5.9% in 1997). Labour productivity, which is the average amount of output generated per worker, increased by 2.6% in 1998 (+2.9% in 1997). This was lower than the average annual growth of 3.6% over the period 1990-1997.[16]

Trends in the above-mentioned variables are shown in *Table 1.2*.

Average for the years	1968-1972	1973-1977	1978-1982	1983-1987	1988-1992	1993-1997	1998-1999
Population (million)	0.810	0.858	0.932	0.986	1.030	1.102	1.170
Labour force (million)	0.251	0.293	0.346	0.388	0.430	0.474	0.529
Labour force annual growth (%)	2.49	3.48	3.20	1.91	1.94	2.19	4.59

Table 1.2 (Source: Time Series Explorer - WDI, IFS)

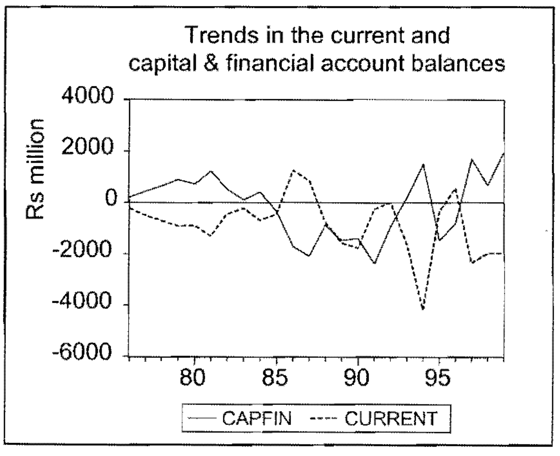
[14] All "Real" aggregates in *Table 1.1* were calculated at 1995 prices
[15] Bank of Mauritius, 1999: 22
[16] Bank of Mauritius, 1999: 23

1.2.3 External Trade and Balance of Payments

The European Union and the USA are the main export markets for Mauritius. On the import side, France, the United Kingdom, Japan, South Africa, West Germany and China are the major suppliers of durables, capital equipment and raw materials, whereas Kuwait and Bahrain are the main suppliers of oil to Mauritius.

The country's geographic isolation, reliance on imported fuel, food, and manufactured goods, and its limited export base have combined to create persistent balance of trade deficits in the late 1980s and early 1990s. The country's chronic trade deficits are normally offset by surpluses in the services accounts (tourism and other services).[17] These chronic trade deficits led to current account deficits over most of the period 1973 to 1999 as shown in *Graph 1.4*. The current account deficits are financed by surpluses on the capital and financial accounts.

Graph 1.4 (TSE source: IFS)



Hong Kong has been the leading investor in Mauritius, followed by France. The drop in foreign direct investment since the early 1980's (when many Hong Kong textile manufactures relocated for quota reasons) led to the aggregate balance on the capital & financial accounts to fall steadily, as shown in *Graph 1.4*. This decline was reinforced by slower growth in the Export Processing Zone (EPZ) and hotel construction which discouraged foreign direct investment in those sectors. Foreign direct investment in the EPZ fell significantly from an annual average of US$12 million over the period 1987-1990 to US$4.6 million in 1993 and US$3 million in 1994. It increased exceptionally to US$20 million in 1995, following the takeover of two large ailing textile companies in the EPZ sector by Indian investors, but fell back to US$6 million in 1996.[18]

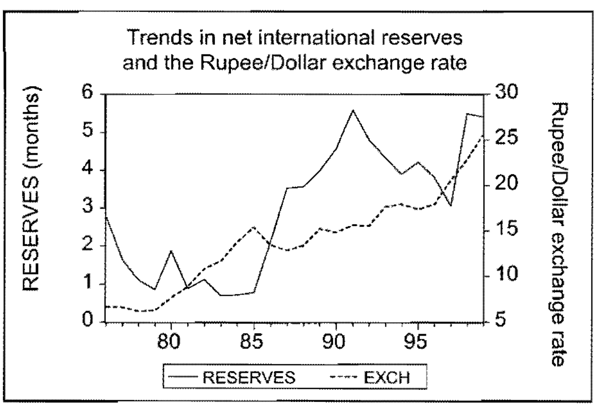
[17] http://lcweb2.loc.gov/frd/cs/mutoc.html
[18] http://lcweb2.loc.gov/frd/cs/mutoc.html

Most recent foreign direct investment has gone into information technology, printing and publishing, pharmaceuticals, light engineering, high-quality garments, and jewellery. Currently, the main sources of investment in Mauritius are from India, UK, France, Germany and South Africa.[19]

The devaluations of 1979 and 1981 helped to achieve a depreciation of the real exchange rate in Mauritius[20] and hence improved the competitiveness of Mauritian exports. The current account improvements compensated for the decrease in capital & financial account balance in the period 1981 to 1987, as shown in *Graph 1.4*. The current account for the financial year ended 30 June 1999 registered a deficit of Rs1.98 billion (1.9% of GDP), as compared to the deficit of Rs2.7 billion (3.0% of GDP) in 1998. The improvement in the current account was mainly due to an increase in the surplus on the services account to Rs 5.68 billion (Rs 4.36 billion in 1998).[21]

The Bank of Mauritius intervenes in the foreign exchange market to dampen large exchange rate fluctuations. However, the Rupee has been allowed to depreciate consistently since 1968 (as shown in *Graph 1.5*) to maintain the competitiveness of the country's exports.

Graph 1.5 (TSE source: IFS)



The variation of net international reserves and the Rupee/Dollar exchange rates since 1973, are shown in *Graph 1.5*. The depletion of foreign exchange reserves in the late 1970's was the result of the economic crisis prevailing at that time. The two currency devaluations in 1979 and 1981 helped to boost exports and reserves, and the latter rose rapidly (*Graph 1.5*) in the boom periods of 1985 to 1990.

[19] http://lcweb2.loc.gov/frd/cs/mutoc.html
[20] Edwards, 1989: 95
[21] Bank of Mauritius, 1999: 10-11

Import cover from the reserves fell over the period 1990 to 1997 (as shown in *Graph 1.5*) mainly due to high depreciation rate of the Rupee in that period, but it rose again in 1998 with the help of a larger surplus on the services account.

Net international reserves (made up of net foreign assets of the banking system, the foreign assets of the government, and Mauritius' reserve position in the IMF) rose to Rs 22.58 billion at 30 June 1999 (Rs 21.35 billion at 30 June 1998). With the devaluation of the Rupee, import coverage dropped from 5.5 months at the end of June 1998 to 5.4 months at the end of June 1999.[22]

The course of the 'External Trade and Balance of Payments' variables since 1968, is displayed in *Table 1.3*.

Average for the years	**1973-1977**	**1978-1982**	**1983-1987**	**1988-1992**	**1993-1997**	**1998-1999**
Current Account (% of GDP)	-7.23	-10.12	0.10	-2.50	-2.38	-2.45
Current Account (Rs million)	-375	-860	144	-873.8	-1,591.2	-2,340
Capital & Financial account (Rs million)	321.7	799.2	-724.3	-1,409.3	238.2	1,319
Reserves (months of imports)	2.2	1.2	1.6	4.5	3.9	5.5

Table 1.3 (Source: Time Series Explorer - WDI, IFS)

1.3 Money, Banking and Price developments

This section gives a brief introduction to the Mauritian banking system. It relates the history and the present direction of Monetary Policy in the country. Monetary aggregates such as money supply and reserve money and trends are discussed.

1.3.1 The Mauritian banking system

The Mauritian banking environment consists of 4 major groups of players, namely commercial banks, offshore banks, non-bank financial intermediaries and of course the (Central) Bank of Mauritius which regulates and supervises the banking environment in Mauritius.

[22] Bank of Mauritius, 1999: 10-11

The Bank of Mauritius

The Bank of Mauritius was established in 1967 just prior to the country becoming independent. It is the sole issuer of reserve money (currency in circulation and deposit balances with the Central Bank) in Mauritius and presently uses indirect instruments like open market operations, reserve requirements and lending facilities, to influence the liquidity conditions in the Mauritian financial system.[23] Its operations department is presently organised in different units namely, Operations, Currency, Public Debt Management, Banking and clearing house, which all provide services to the banking community, the Mauritian government and to the public.

- The Operations Unit is responsible for the implementation of decisions regarding the management of foreign exchange reserves and weekly auctions of Treasury Bills. It deals with the sales and purchases of foreign currencies, the release of sugar proceeds to the banking sector, lending to commercial banks & other financial institutions, issuance of government treasury bills, and enforcing the minimum cash balance.[24]
- The Currency Unit deals with the safekeeping and management of the stock of local currency.[25]
- The Public Debt Management Office is responsible for the issue and redemption of Government Stocks, Mauritius Development Loan Stocks and other securities. It also administers the daily settlement of funds in respect of transactions carried out on the Stock Exchange by participants (stockbrokers and custodian banks) in the Central Depository and Settlement System.[26]
- The Banking Unit operates current accounts for Government, commercial banks, and international financial institution. It also deals with the sale of industrial gold to manufacturers of jewellery and of Dodo Gold coins[27] to the public. The daily selling prices of industrial gold are based on the international gold price.[28]

[23] Bank of Mauritius, 1998: 51

[24] In accordance with section 22 of the Bank of Mauritius Act, all commercial banks are required to maintain cash balances, consisting of balances with the Bank of Mauritius and of notes and coins in their vaults, of not less than 5.5 per cent of their total deposit liabilities.

[25] Bank of Mauritius, 1999: 91-92

[26] Bank of Mauritius, 1999: 92-93

[27] The Dodo Gold coins (which are legal tender) are also marketed overseas by the Royal Mint of the United Kingdom. The daily selling prices of the coins are based on their gold content and on the international gold market prices.

[28] Bank of Mauritius, 1999: 92-93

Commercial Banks

The Bank of Mauritius lends at its discretion to commercial banks (in terms of both rate and volume) as a lender of last resort, to ease temporary liquidity constraints on the market. At the end of June 1999, Mauritius had ten commercial banks (operating 149 branches) among which three were local banks, two were foreign-owned banks incorporated locally and five were branches of foreign banks. Ten offshore banks also currently operate in the Mauritian financial sector.[29]

Interbank transactions occur among commercial banks for call (overnight), short notice (up to 7 days) and term money (more than 7 days). During financial year 1999, interbank transactions were made mainly on the call money market. Interbank interest rates fluctuated within a wider and higher range of 7.50-18.00% as compared to a range of 5.75-12.00% in 1998. Following the upward trend in the overall weighted average yield on Treasury Bills at primary auctions, the weighted average interbank interest rate rose to 9.87% (8.11% in 1998).[30]

The spread between the weighted average term deposits interest rate and the weighted average lending rate in 1999 was about the same as in fiscal year 1998. The unchanged spread "tends to indicate that the level of competition in the banking sector in 1999 has remained the same as in 1998."[31]

Offshore banking sector

The offshore banking sector was established in line with the Government's strategy to "enhance and facilitate the provision of international financial services and to develop Mauritius into a full-fledged international financial centre."[32] Presently, offshore banks provide a variety of services (in currencies other than the Mauritian Rupee) which include deposit-taking, foreign exchange dealing, lending, trade financing, fund management, offshore trust and securities custodial services. In 1999, the offshore banking sector continued its sustained growth in business with the placement of funds with other banks totalling US$1.62 billion, i.e an increase of US$896 million.

[29] Bank of Mauritius, 1999: 34
[30] Bank of Mauritius, 1999: 39
[31] Bank of Mauritius, 1999: 45-46
[32] Bank of Mauritius, 1999: 84

Furthermore, total assets of offshore banks increased by 152% (44% in 1998) to US$2.57 billion.[33]

Non-Bank Financial Intermediaries

- The **Development Bank of Mauritius (DBM)** (which provides financial assistance to various sectors of the economy including the manufacturing, agricultural, tourism, construction, transport, educational and health sectors) increased its investments in Treasury Bills to Rs153 million in 1999 (Rs24 million in 1998).
- The **Mauritius Housing Company Ltd (MHC)** provides housing loans to individuals.
- The **Mauritius Leasing Company (MLC)** provides financial leases to both companies and individuals.
- The **National Pensions Fund (NPF)** (which consists of contributions made to the National Pensions Scheme by employees and employers both in the public and private sectors) raised its investments in government securities to Rs9.6 billion in 1999 (Rs7.1 billion in 1998).[34]
- The **Post Office Savings Bank (POSB)** mobilises savings (primarily from small depositors in the country) which are invested in short and long term government papers and also in a mutual fund which provides loans and financial assistance to civil servants.
- The **State Investment Corporation Ltd (SIC)** manages the investment portfolio of the government in the private sector and offers a wide range of services including financing of enterprises and joint venture arrangements with local and foreign entrepreneurs.
- The **State Insurance Company of Mauritius Ltd (SICOM)** generates its resources through the collection of life & general insurance premium and medical & pension schemes.
- The **Sugar Insurance Fund Board (SIFB)** provides insurance cover to all sugar producers, and it invested Rs326 million in government securities in 1999[35].

[33] Bank of Mauritius, 1999: 83-84
[34] Bank of Mauritius, 1999: 47
[35] Bank of Mauritius, 1999: 47-48

Regulation and supervision of the banking system

Under the provisions of the Banking Act of 1988 and the Bank of Mauritius Act, the Bank of Mauritius is responsible for the regulation and supervision of banks and deposit-taking activity of non-bank financial institutions. Furthermore, in accordance with the provisions of the Foreign Exchange Dealers Act of 1995, the Bank of Mauritius regulates and supervises operations of foreign exchange dealers. Supervisory activity at the Bank of Mauritius is geared towards ensuring safe and sound operations of financial institutions and the protection of depositors' interests in those institutions.

The Bank of Mauritius reviews the performance of financial institutions based on five main items namely: risk weighted capital adequacy ratio, foreign exchange exposure, concentration of risk and large exposures, non-performing advances, and profitability.[36]

The minimum risk weighted capital adequacy ratio is presently set at 10%. As for foreign exchange exposure, banks are required to observe a daily overall foreign exchange exposure limit not exceeding 15% of Tier 1 capital. Furthermore, the Bank of Mauritius monitors on a monthly basis the maturity pattern of foreign currency assets and liabilities of banks. The Bank of Mauritius stated positively in its 1999 annual report: "Data indicate that the banks are not unduly exposed to short-term capital mismatch and are, in general, managing their foreign currency positions in a prudential way".[37]

Section 21 of the Banking Act of 1988 allows the Bank of Mauritius to monitor the concentration of risk and large exposures by requiring banks to report on a quarterly basis to the Bank of Mauritius about credit facilities extended to any one customer or group of closely related customers where such facilities exceed 15% of their capital base.

[36] Bank of Mauritius, 1999: 77
[37] Bank of Mauritius, 1999: 81

Credit concentration in the domestic banking sector was again high in 1999, with total credit facilities beyond the threshold of 15% of a bank's capital base totalling Rs23.97 billion. This represents 32% (29% in 1998) of the overall on and off-balance sheet commitments of domestic banks.[38]

As for non-performing advances, the 'Guidelines on Income Recognition and Classification of Loans and Advances for Provisioning Purposes' require that banks maintain a minimum general provision of not less than 1% in respect of their performing advances. This is supported by specific minimum criteria based on the number of days the instalments of principal and/or interest are overdue. Finally to assess profitability of financial institutions, the Bank of Mauritius uses measures such as pre-tax profits or the return on average assets of domestic banks.[39]

Various legislative and regulatory changes are currently under way to enhance efficiency of banks' operations and also to modernise the legal framework governing financial institutions with the aim to enhance the safety and soundness of financial institutions' operations and protect depositors' interests.[40]

1.3.2 Monetary Policy in Mauritius

The history of Mauritian Monetary Policy is briefly related and the present situation concerning Monetary Policy in Mauritius, is also discussed below.

History of Monetary Policy in Mauritius

The Bank of Mauritius has conducted monetary policy conservatively in the 1970's and over most of the 1980's but changed in the late 1980's to promote financial liberalisation in line with world trends. This is illustrated by the change from direct monetary controls in the 1970's and 1980's, to the abolishment of exchange controls, promotion of offshore banking, and the shift to indirect monetary controls in the 1990's.

[38] Bank of Mauritius, 1999: 81
[39] Bank of Mauritius, 1999: 82
[40] Bank of Mauritius, 1999: 78

At its inception in 1967, the Bank of Mauritius fixed the bank rate at 5.5% and took over the administration of exchange control. In 1969, the Bank of Mauritius became the sole manager of Government debt and in the same year it started to implement expansionary monetary policy. The first issue of Government stocks was made in April 1970. In July 1972, the Bank ended its expansionary monetary policy. The minimum cash ratio was raised from 5% to 8% in July 1973 and then to 12% in July 1974. After the two successive devaluations of the Rupee (as prescribed by the World Bank/IMF) in 1979 and 1981, the Rupee was delinked from the Special Drawing Right (SDR) and pegged to a trade-weighted basket of currencies in February 1983. In the same month, the minimum cash ratio was brought down to 10%.[41]

In January 1989, the Banking Act of 1971 was replaced by the Banking Act of 1988. The latter "provides a comprehensive and modern legal framework for a sound domestic banking system and the basis for the development of a reputable offshore banking sector in Mauritius."[42] The first offshore banking licence was offered in July 1989, and since then nine more were granted. In July 1992, the Bank of Mauritius started expansionary monetary proceedings by abolishing ceilings on bank credit to priority sectors (and also to non-priority sectors in July 1993) and by reducing bank rate from 11% to 8%.[43]

The Secondary Market Cell (SMC) was set up by the Bank of Mauritius in February 1994 to trade in Treasury Bills.[44] In June 1994, the bank rate was linked to the overall weighted average yield on Treasury Bills. In the 1990's the Bank of Mauritius switched from direct to indirect monetary control i.e it tried to move away from directives, controls and subsidies and instead move in the direction of increased reliance on market forces, economic liberalisation and deregulation. Exchange controls were suspended in July 1994 and the interbank foreign exchange market was set up.[45]

[41] Bank of Mauritius, 1998: 13
[42] Bank of Mauritius, 1998: 13
[43] Bank of Mauritius, 1998: 14
[44] Bank of Mauritius, 1998: 52
[45] Bank of Mauritius, 1998: 15

The Bank of Mauritius established the Reserve Money Programme and a liquidity forecasting framework in July 1996 to formulate Monetary Policy, and in the same month the minimum cash ratio was reduced to 8%. The latter was further reduced to 6% in July 1997 (and to 5.5% in July 1998) and in that month the Bank agreed to the full release by the Mauritius Sugar Syndicate of foreign currency receipts (from sugar proceeds) to the interbank foreign exchange market.[46]

During the fiscal year 1997-1998, the Secondary Market Cell (SMC) started trading medium and long-term government securities (in addition to the Treasury Bills it was already trading) and this allowed secondary market activities to expand in that year.[47] The Bank of Mauritius started the auctioning of Treasury Bills with maturities of 30 and 728 days during 1998-1999, thus increasing the number of maturities at primary auctions from three to five. The Treasury Bill with a maturity of 728 days (i.e 2 years) was introduced with a view to providing banks, non-bank institutions and the public with a longer term financial instrument.[48]

The Bank of Mauritius directed monetary policy in 1998-99 towards achieving price stability and maintaining a stable exchange rate of the Rupee, while maintaining its policy of financial liberalisation. To achieve those objectives the Bank maintained its use of the Reserve Money Programme and liquidity forecasting framework as a basis for intervention on the money and foreign exchange markets.[49]

The Reserve Money Programme

Since July 1996, the Bank of Mauritius has been using the Reserve Money Programme (RMP) and the liquidity forecasting framework to formulate Monetary Policy.

The RMP focuses on controlling the liquidity of commercial banks. It initially makes the projection of demand for money (that is consistent with the inflation target and economic growth forecast). The Bank of Mauritius then equalises demand and supply

[46] Bank of Mauritius, 1998: 15-17
[47] Bank of Mauritius, 1998: 52
[48] Bank of Mauritius, 1999: 27
[49] Bank of Mauritius, 1999: 26

of reserve money at a level that is consistent with the money supply M2 (which is the intermediate target). It does this by choosing and gauging the instruments to fill that gap between commercial banks' demand and supply of reserve money. To achieve that, the Bank of Mauritius withdraws free reserves of commercial banks through the auctioning to them of an optimum volume of Treasury & Bank of Mauritius Bills each week, thereby controlling their ability to extend credit.[50] The RMP helped the Bank of Mauritius to contain inflation rate in 1999 within the target of 8%.[51]

Open market operations & the money market

The Bank of Mauritius engages in open market operations through the issue of government or central bank paper in the primary market; outright transactions in the secondary market; repos and reverse repos against domestic currency assets (i.e purchases or sales of assets denominated in domestic currency reversed at some point in the future); repos and reverse repos against foreign currency assets (i.e purchases or sales of assets denominated in foreign currency reversed at some point in the future); operations in the interbank market through the collection of deposits and lending. These are usually used to stabilise short-term interest rates and/or reduce the excess liquidity in the financial market.[52] The Bank of Mauritius also intervenes in the foreign exchange market by buying and selling US Dollars, so as to dampen large exchange rate fluctuations.

Treasury Bills issued at primary auctions come in the form of five maturities (30, 91, 182, 364, 728 days). Once issued they are tradable at the Secondary Market Cell (SMC) of the Bank of Mauritius. To boost secondary market activities further, the Bank of Mauritius started in December 1998 to sell Government Treasury Bills over the counter to individuals and non-financial corporations on a first come first served basis.[53] During 1999, participants in the primary market maintained a preference for short maturities with Treasury Bills of 30-day and 91-day maturities accounting for 57.4% of total bids received.[54]

Non-bank institutions were the most active on the primary market with their share of

[50] Bank of Mauritius, 1998: 51
[51] Bank of Mauritius, 1999: 26
[52] http://www.bankofmauritius.co.uk/annual/1997/
[53] Bank of Mauritius, 1999: 44

total bids received rising to 50.5% (28.4% in 1998) whereas the share of commercial banks in total bids received declined to 49.5% (71.6% in 1998). This disinvestment from Treasury Bills by commercial banks arose after the Bank of Mauritius reduced the non-cash liquid assets ratio from 20% to 0%, shifting the burden of deficit financing to the central bank. Hence, the fiscal factor significantly influenced monetary developments in 1999 with about 58% of the deficit being financed by the central bank.[55]

The Capital Market

The Stock Exchange of Mauritius (SEM) started operations in July 1989 with five listed companies (with a market capitalisation of Rs1.1 billion). At the end of June 1999, the SEM had 47 companies listed on its official market (market capitalisation of Rs38.4 billion). Capitalisation grew from $55 million in July 1989 to $1.8 billion in June 1997.[56] The stock market index (SEMDEX) rose from 381.47 at the end of June 1997 to 418.87 at the end of June 1999.[57]

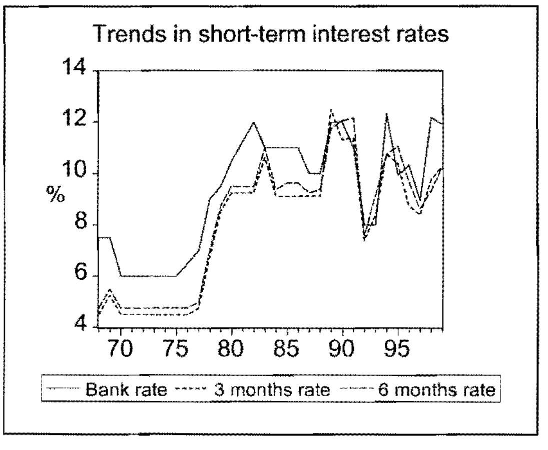
The SEM was only opened to foreign investors as from 1995, and the latter are only allowed to make a limited amount of transactions. Hence the Mauritian Rupee is not heavily influenced by speculative foreign capital flows.[58] During financial year 1999, there was a net outflow of Rs345.9 million of foreign investment on the SEM (net inflow of Rs1.25 billion in 1998). This might be due to "an increase in risk aversion among foreign investors towards emerging markets in the wake of the Asian crisis and the financial crisis in Russia".[59] The SEM is expected to bounce back with new regulations (on employee share schemes, a new framework for share buy-back operations and tax deduction for small investors buying shares on the stock market) being announced in the 1999-2000 budget to boost stock market activity.[60]

Interest rates, domestic credit, and inflation rate in Mauritius

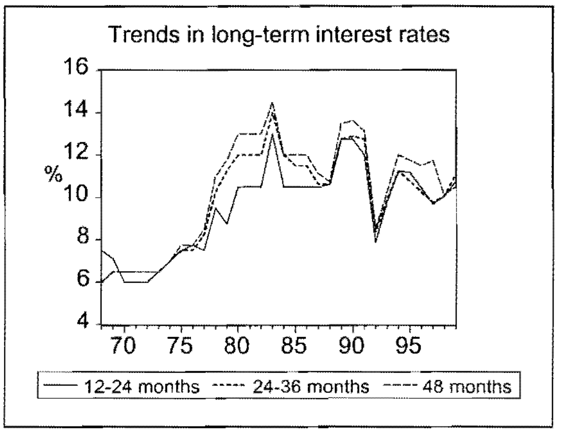
[54] Bank of Mauritius, 1999: 42
[55] The rise in central bank claims on Government was reflected in higher levels of reserve money. The impact of the resulting increase in reserve money on money supply, on the exchange rate of the rupee and, ultimately, on the price level, was however dampened by higher yields on Treasury Bills (Bank of Mauritius, 1999: 26)
[56] http://lcweb2.loc.gov/frd/cs/mutoc.html
[57] Bank of Mauritius, 1999: 46
[58] Bundhoo & Dabee, 1998: 10
[59] Bank of Mauritius, 1999: 47
[60] Bank of Mauritius, 1999: 46

The trends in short-term and long-term interest rates are shown in *Graph 1.6* and *Graph 1.7* respectively. The graphs show the course of the bank rate and the deposit rates with commercial banks.

Graph 1.6 (TSE source: IFS)



Graph 1.7 (TSE source: IFS)



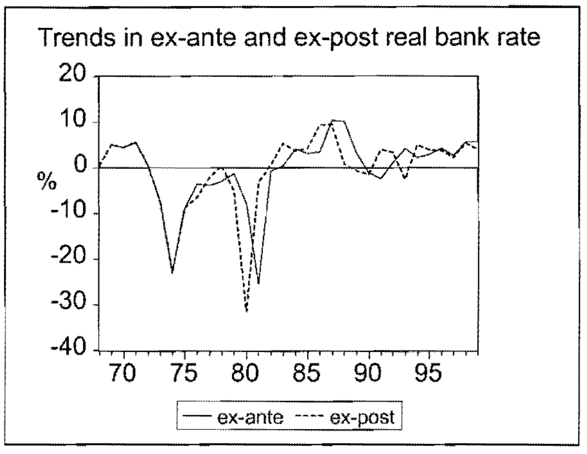
The Bank of Mauritius continued to pursue tight monetary policy stance in 1999 to curb inflationary pressures in the economy and stabilise the Rupee exchange rate. This was reflected by the rising weighted average yield on Treasury Bills of various maturities. The overall weighted average yield on Treasury Bills increased to 11.76% in 1999 (from 8.82% in 1998). Accordingly, the Bank Rate (which is equivalent to the weighted average yield on Treasury Bills accepted at primary auctions, excluding the 728-day Treasury Bill) rose to 12.61% (from 9.22% in 1998). Furthermore, the weighted average interest rate on the interbank money market rose by 1.6% in 1999. [61]

Real interest rate is calculated ex-post (i.e nominal rate minus inflation) and ex-ante (i.e nominal rate minus expected inflation as derived in *Section 3.5.1*), and trends for both ex-post and ex-ante real interest rate are shown in *Graph 1.8*. Trends in the inflation rate and the growth rate of domestic credit are shown in *Graph 1.9*.

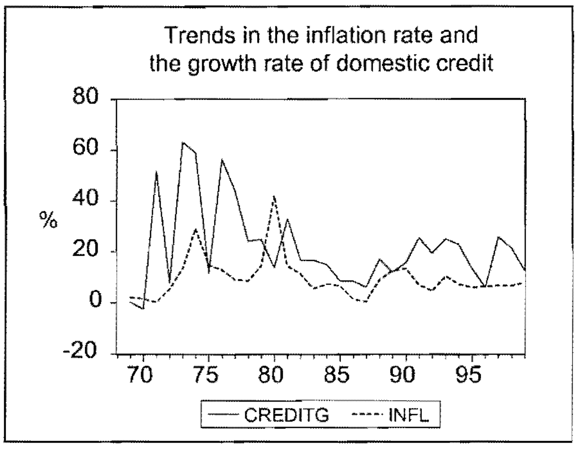
[61] Bank of Mauritius, 1999: 43-44

Graph 1.8 indicates the stance of Monetary Policy in Mauritius since 1968. Expansionary monetary policy which was in effect since 1968 was ended in July 1972 mostly because of fear of inflation arising from the excessively high growth rate in domestic credit the previous year.

Graph 1.8 (TSE source: IFS)



Graph 1.9 (TSE source: IFS)



As shown in *Graph 1.9*, this did not stop the growth in domestic credit which, after falling in 1972, grew excessively in 1973 and 1974. This credit growth coupled with the international fuel price hike, led to inflation rising to 29% in 1974 (*Graph 1.9*), and hence resulted in the real bank rate plummeting to -23% in 1974, as shown in *Graph 1.8*.

The Bank of Mauritius temporarily succeeded in controlling the growth rate in domestic credit by raising the minimum cash ratio from 5% in 1973 to 12% in 1974. This helped the inflation rate to drop consistently from 1975 to 1978 (*Graph 1.9*) and in real interest rates recovering, despite remaining negative (*Graph 1.8*).

Just as real interest rates were heading towards positive territory, Mauritius had to devalue its currency in 1979 and again in 1981 in line with the IMF/World Bank's stabilisation programme. Rising inflation was the immediate effect since the country was still heavily dependent upon imports. Inflation rose to above 40% in 1980 (*Graph 1.9*) and this caused a sharp drop of the real interest rates in 1980, as shown in *Graph 1.8*.

Despite the minimum cash ratio being brought down to 10% by the Bank of Mauritius in 1983 in an attempt to stimulate the economy, domestic credit growth kept falling over the period 1981 to 1987 (*Graph 1.9*). This allowed the inflation rate to drop consistently to reach its lowest level (below 1%) in 1987 (*Graph 1.9*). Hence, real interest rates, after 1981, rose continually to become positive in 1983. Since then, real interest rates have remained positive, except for the years 1989 and 1990 during which the inflation rate rose to above 12.5%.

The reduction of the minimum cash ratio to 8% in 1996 allowed the domestic credit growth to rise above 20% in both 1997 and 1998 (*Graph 1.9*). The effect of this credit expansion on the inflation rate was subdued (*Graph 1.9*), and real interest rates continued to rise. The ex-post real bank rate reached 4% in 1999 (*Graph 1.8*).

It can be observed from *Graph 1.9* that growth in domestic credit and the inflation rate move together. Total domestic credit rose by 13.0% in 1999 (26.1% in 1998) due to an increase of 20.4% in credit to the private sector that was partly offset by a drop of 7.7% in net credit to Government (from a 10.2% increase in 1998). Indeed, the year 1999 was the first time in 4 years that Mauritius had witnessed a decline in net credit to the government by the banking system.[62] In absolute terms, domestic credit went up to Rs76.73 billion at the end of June 1999 (Rs67.93 billion at the end of June 1998). Net credit to Government by the Bank of Mauritius increased by 86.6% (202.3% in 1998) to Rs4.58 billion (from Rs2.45 billion in 1998) which partly offset the decline in commercial bank credit to the Government. Credit offered by commercial banks to the private sector increased by 20.4% in 1999 (32.3% in 1998) to Rs60.11 billion.[63]

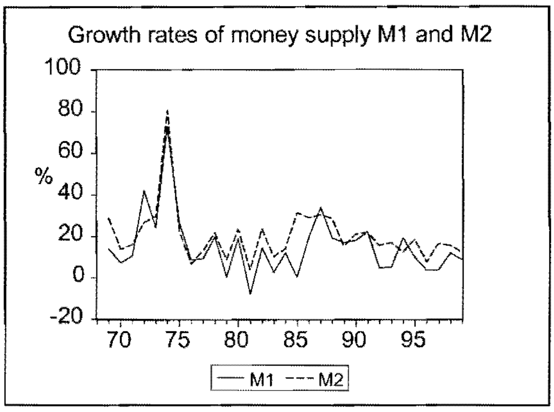
As indicated in *Graph 1.9*, the inflation rate increased to 7.9% in 1999 (from 5.4% in 1998) which, according to the Bank of Mauritius, resulted from the high rate of monetary expansion in the previous year, coupled by other factors such as the implementation of the public sector pay award, the introduction of the value-added tax and the lagged impact of the depreciation of the Rupee.[64]

[62] Bank of Mauritius, 1999: 10
[63] Bank of Mauritius, 1999: 26
[64] Bank of Mauritius, 1999: 10

1.3.3 Monetary aggregates

M1 and M2

Graph 1.10 (TSE source: IFS)



The real growth rates of money supply measures M1 and M2 are shown in *Graph 1.10*. Except for the year 1974 during which domestic credit was excessively high and the oil shocks helped raise inflation rate to above 29%, real money growth has remained relatively stable since 1968.

Aggregate monetary resources (i.e money supply M2) went up by 13.2% (17.4% in 1998) to Rs80.20 billion at the end of June 1999 (Rs70.88 billion at end-June 1998), hence reflecting increases in both net foreign assets of the banking system and total domestic credit. Both components of money supply M2 (M1 and quasi-money) grew in 1999 with M1 expanding by 7.4% (14.4% in 1998) to Rs10.91 billion at the end of June 1999 (from Rs10.15 billion at end-June 1998) and quasi-money (which consists of savings, time, and foreign currency deposits) expanding by 14.1% (17.9% in 1998) to Rs69.30 billion at the end of June 1999 (from Rs60.73 billion at end-June 1998).[65] The average money multiplier for money supply was 1.12 during financial year 1999 (1.13 in 1998) for M1 and 7.96 for M2 (7.79 in 1998).[66]

Reserve money

Reserve Money (which is the currency in circulation plus private demand deposits with the Bank of Mauritius) went up by 20.5% (decline of 23.4% in 1998) to Rs10.35 billion at the end of June 1999 (Rs8.58 billion at end-June 1998). The increase in both central bank credit to Government and net foreign assets of the Bank of Mauritius in 1999, resulted in higher levels of reserve money. [67]

[65] Bank of Mauritius, 1999: 30-31
[66] Bank of Mauritius, 1999: 32
[67] Bank of Mauritius, 1999: 32

Income Velocity of Circulation of Money

The income velocity of circulation (which is a measure of the speed at which money circulates in order to support a given volume of transactions) has been rising since 1993, and it registered 15.08 in 1999 (14.91 in 1998). The income velocity of circulation of M1 increased to 9.55 (9.35 in 1998) whereas that of M2 decreased to 1.35 (1.36 in 1998).[68]

Trends in the 'Money and banking' variables since 1968, are given in *Table 1.4*.

Average for the years	1968-1972	1973-1977	1978-1982	1983-1987	1988-1992	1993-1997	1998-1999
Bank rate (%)	6.60	6.30	10.45	10.80	10.60	9.91	12.06
Rate on 3-months deposit (%)	4.65	4.55	8.60	9.42	10.34	9.33	10.25
Rate on 6-months deposit (%)	4.90	4.80	8.85	9.78	10.58	9.85	10.25
Rate on 12-24 months deposit (%)	6.52	7.25	9.95	11.00	11.20	10.46	10.75
Rate on 24-36 months deposit (%)	6.40	7.35	11.50	11.93	11.48	10.38	11.07
Rate on 48-months deposit (%)	6.40	7.50	12.35	12.33	11.90	11.45	10.50
M1 (Rs million)	255.04	908.90	1,585.61	2,350.87	5,529.01	9,194.11	12,054.24
M1 (% of GNP)	19.00	22.40	18.80	14.00	14.20	13.20	12.00
M2 (Rs million)	478.7	1,769.7	3,746.2	8,788.1	25,415.4	53,287.3	82,994.2
M2 (% of GNP)	35.40	43.40	43.40	50.60	64.60	75.80	84.00
Domestic Credit (Rs million)	289.8	1,395.4	4,849.0	9,994.0	19,076.6	46,313.4	80,109.4
Domestic Credit (% of GDP)	21.73	33.19	53.68	58.37	48.43	65.40	79.01
Inflation rate (%)	2.39	15.89	18.18	4.37	9.39	7.45	7.36

Table 1.4 (Source: Time Series Explorer - WDI, IFS)

1.4 Government Finance

While the successive governments in Mauritius have differed on issues such as social welfare spending, labour policy, and privatisation, they had the common objective of strengthening the national economy by passing budgets and promoting policies aimed at sustainable growth.

[68] Bank of Mauritius, 1999: 34

1.4.1 Fiscal policy in Mauritius

Faced with growing budget deficits in the late 1970's, Mauritius implemented the IMF/World Bank's structural adjustment programme in 1979-1980. The programme was successful in helping the country recover from the economic crisis. Indeed, budget deficits fell from 12.6% of GDP in 1982 (year during which the sales tax was introduced) to below 2% of GDP in the early 1990's[69], and in May 1991 Mauritius paid all its debt to the IMF ahead of schedule.[70]

In 1993 the government was set to reform the tax system in order to widen the tax base and reduce tax evasion. In April 1993, the government released a development plan which emphasised the role of the private sector and of the free market as opposed to public sector bodies and state controls. An overall annual growth rate of 6% was the target set out in the plan. The 1993-1994 budget set the emphasis on health by allocating Rs1.2 billion to this sector. The budget for fiscal year 1994-1995 aimed at encouraging investment and savings, by abolishing foreign currency controls and eliminating the tax on sugar products. Government spending in 1994-1995 also included, among others, Rs2.4 billion for education (almost double the 1991-1992 amount) and Rs208 million to train middle management (compared with Rs90 million the previous year).[71]

During the fiscal year 1996-1997, government revenue rose with the help of the higher sales tax rate, but the high expenditure growth of 19.8% (over the previous year) kept the budget deficit at relatively high levels (4.5% of GDP). In 1998 the sales tax was replaced by the Value-Added Tax (VAT) which covers a broader range of goods and services. Budget deficits for the fiscal year 1997-1998 dropped to 3.7% of GDP, more as a result of drastic cuts in government spending than from improved revenues.[72]

The Mauritian government directed fiscal policy in 1998-1999 at the improvement of revenue collection and control of recurrent expenditure in line with the process of

[69] Exceptionally however, during the years 1988 and 1989, budget deficits rose to above 30% of GDP mainly because of increases in government salaries (http://lcweb2.loc.gov/frd/cs/mutoc.html)
[70] http://lcweb2.loc.gov/frd/cs/mutoc.html
[71] http://lcweb2.loc.gov/frd/cs/mutoc.html
[72] Bank of Mauritius, 1998: 57

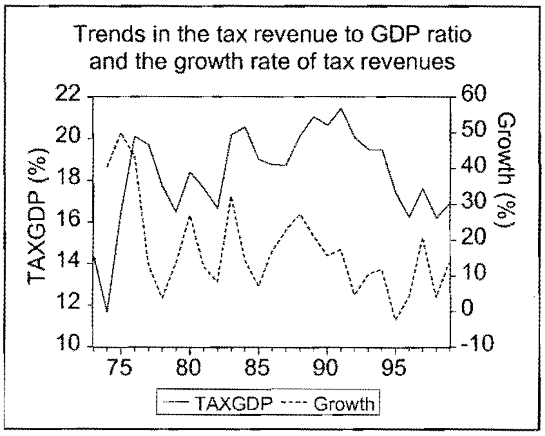
fiscal adjustment which has been set in a medium-term framework. These measures were highly successful as during the financial year ended 30 June 1999, overall budget deficit dropped to 3.6% of GDP mainly due to the higher revenue generated by the replacement (made in 1998) of the 8% sales tax with the 10% value-added tax.[73]

1.4.2 Fiscal aggregates

Revenue and Grants

Growth rates of tax revenue and the tax revenue to GDP ratio have moved together over time, as shown in *Graph 1.11*.

Graph 1.11 (TSE source: IFS)



Some of the highlights of tax policy include the introduction of the sales tax in 1982 which helped tax revenue to grow by over 32% in 1983 (8.3% growth in 1982). Also, a raise in the sales tax rate in 1996 increased tax revenue by 20.8% in 1997 (4.2% growth in 1996), as shown in *Graph 1.11*. Tax revenue grew by over 14% in 1999 (4% growth in 1998) mostly due to the introduction of the Value-Added Tax in the previous year. The ratio of tax revenue to GDP has been declining since 1991 (*Graph 1.11*) but picked up in 1999 with the VAT receipts.

Total derived revenue (excluding grants) increased by 15.1% in 1999 (5.0% in 1998) to Rs 21.04 billion (Rs 18.28 billion in 1998) mainly due to higher growth in both tax and capital revenue. Despite the decline of grants received by Government to Rs135 million (Rs217 million in 1998), total derived revenue and grants increased by 20.6% (20.2% in 1998).[74]

[73] Bank of Mauritius, 1999: 49
[74] Bank of Mauritius, 1999: 49

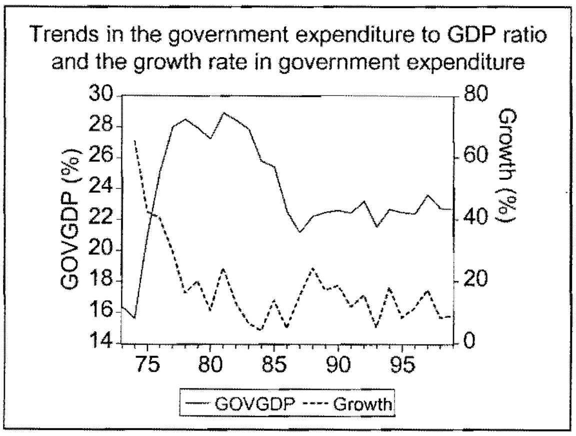
The share of direct taxes in tax revenue in 1999 continued to drop to reach 22.5% (23.0% in 1998). Income tax revenue (comprising individual income taxes and corporate tax) grew by 12.1% in 1999 (5.3% in 1998) with income tax from individuals rising by 10.1% (1.5% in 1998) and corporate tax increasing by 14.2% (9.7% in 1998). The share of indirect taxes in tax revenue in 1999 grew to 77.5% (77.0% in 1998), with revenue from sales tax/value-added tax increasing by 70.2% in 1999 (11.5% in 1998).[75]

Non-tax revenue (which consists mainly of receipts from public services, interest, royalties and other property income), fell to Rs2.08 billion (Rs2.13 billion in 1998), and the share of non-tax revenue in total derived revenue (exclusive of grants) dropped to 9.9% (11.7% in 1998).[76]

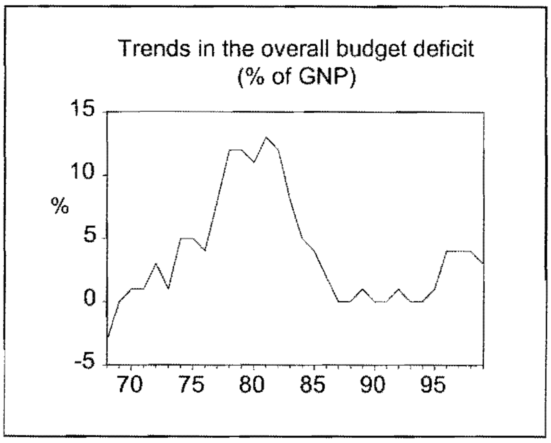
Government Expenditure

The growth rates of government expenditure and the ratio of government expenditure to GDP tend to move together over time, as shown in *Graph 1.12*.

Graph 1.12 (TSE source: IFS)



Graph 1.13 (TSE source: IFS)



The **overall budget deficit (as a % of GNP)** is one of the two budget deficit measures used in the regression analysis carried out in this paper (it is referred to as **DEF1GNP** in *Chapters 3* and *4*). The course of the overall budget deficit (as a % of GNP) since 1968 is shown in *Graph 1.13*.

[75] Bank of Mauritius, 1999: 50

[76] Bank of Mauritius, 1999: 50

Even before the IMF/World Bank's stabilisation programme of 1981, the Mauritian government was trying to control the country's budget deficit (even though they were unsuccessful at doing so, as shown in *Graph 1.13*) by reducing growth of government expenditure (*Graph 1.12*). Even by reducing the growth in government spending, government expenditure (as a percentage of GDP) was still relatively high in that 1978-1983 period (*Graph 1.12*) mainly as a result of the slowing down of the economy (i.e falling real GDP as shown in *Graph 1.1*).

The two currency devaluations and the implementation of the IMF/World Bank's stabilisation programme resulted in positive real GDP growth (*Graph 1.1*) and hence allowed government expenditure (as a percentage of GDP) to drop to more sustainable levels in 1987, as shown in *Graph 1.12.* The consistent drop of the government expenditure growth rate since 1981, has allowed government expenditure (as a percentage of GDP) and the overall budget deficit to fall after 1981.

The higher tax revenues resulting from the replacement of the sales tax with VAT in 1998, allowed government to reduce the budget deficit as a % of GDP in 1999 as shown in *Graph 1.13* despite a rise in the growth rate of government expenditure in that year (*Graph 1.12*).

As a percentage of GDP, total derived expenditure and lending minus repayments rose by 24.1% (23.9% in 1998). Derived recurrent expenditure grew by 14.4% (11.6% in 1998). Indeed, "Government efforts to curtail the growth of expenditure were mitigated by the large increase in salary stemming from the implementation of the public sector pay award" during financial year 1999. The share of expenditure on subsidies and other current transfers in derived recurrent expenditure, increased by 31.8% (30.4% in 1998).[77]

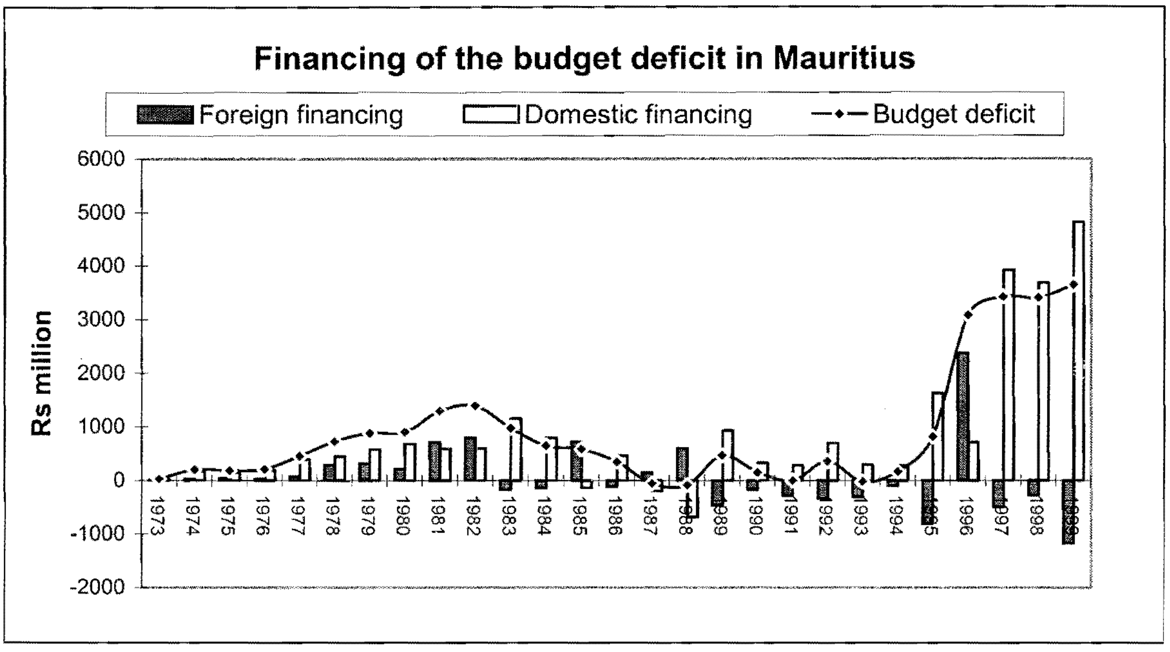
[77] Bank of Mauritius, 1999: 52

Interest payments grew at 8.9% (21.5% in 1998) to Rs3.83 billion (Rs3.52 billion in 1998), but the share of interest payments in derived recurrent expenditure fell to 17.4% (18.3% in 1998). Derived capital expenditure increased by 7.1% (decline of 25.8% in 1998).[78]

Budgetary operations & financing the deficit

Since 1968, the budget deficit has been financed mostly from domestic sources as shown in *Graph 1.14*.

Graph 1.14 (TSE source: IFS)



	Mean	Standard error	Standard deviation	Sample variance
Domestic financing	841	246.0549	1278.539	1634662
Foreign financing	54.689	123.9543	644.0853	414845.9

This observation is important with regard to the objective of this paper, in the sense that if the contrary was true (i.e if Mauritius was having recourse to external financing for its budget deficit) there would be no reason to expect a positive influence of budget deficits on domestic interest rates. This issue is explained in *Section 3.4.1.*

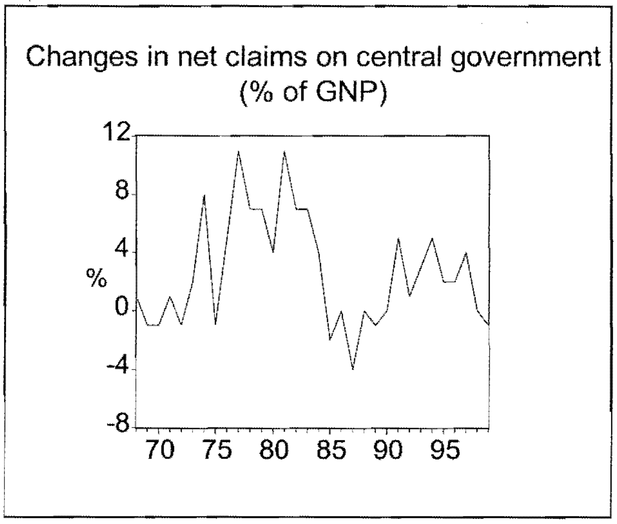
[78] Bank of Mauritius, 1999: 52-53

The overall budget deficit was Rs3.65 billion in 1999 (Rs 3.41 billion in 1998) which represented 3.6% of GDP (3.7% in 1998) as shown in *Graph 1.13*. Just as in 1998, the deficit in 1999 was financed exclusively from domestic sources. Net domestic financing of the deficit amounted to Rs4.82 billion in 1999 whereas net foreign financing was negative at Rs1.17 billion mainly due to repayments of loans (inclusive of the partial redemption of the Floating Rate Note (FRN) for an amount of US$33 million). Also in 1999, the non-bank sector provided a net amount of Rs5.72 billion, and the Bank of Mauritius made available Rs2.12 billion (of which Rs1.70 billion were advances) to finance the deficit. However, deficit financing by commercial banks in 1999 was negative at Rs3.47 billion.[79]

__Central Government debt__

The **changes in net claims on central government (as a % of GNP)** is the second budget deficit measure used in the regression analysis carried out in this paper (it is referred to as **DEF2GNP** in *Chapters 3* and *4*). Changes in net claims on central government (as a % of GNP) are shown in *Graph 1.15*.

Graph 1.15 (TSE source: IFS)



Changes in net claims on Central Government (as a % of GNP) peaked to 11% in 1977 and again in 1981 (*Graph 1.15*). Indeed, during this period of economic crisis, the Mauritian government attempted to finance the high budget deficits (*Graph 1.13*) by borrowing locally and in international markets.

The magnitude of deficit financing fell after 1981 as the economy recovered, and so did changes in net claims on central government (as a % of GNP). Since then, changes in net claims on central government (as a % of GNP) has remained below the 5% level, as shown in *Graph 1.15*.

[79] Bank of Mauritius, 1999: 54-55

During 1999, central Government debt increased to 50.3% of GDP (49.6% in 1998). Total internal debt of the Government by June 1999 increased to 40.4% of GDP (37.8% in 1998). Short-term Government debt grew by 34.8% in 1999 to Rs27.26 billion (Rs20.22 billion in 1998) with treasury bills accounting for 88.4% of the short-term debt (92.8% in 1998). The share of short-term Government debt in total internal debt, rose to 66.5% (58.4% in 1998). Medium and long-term debt dropped by 4.8% to Rs13.72 billion at end-June 1999. The share of medium and long-term debt in total internal debt, decreased to 33.5% (41.6% in 1998). Also in 1999, total government external debt dropped to Rs10.03 billion (Rs10.75 billion in 1998).[80]

Trends in the 'Government Finance' variables since 1968, are displayed in *Table 1.5* below.

Average for the years	**1968-1972**	**1973-1977**	**1978-1982**	**1983-1987**	**1988-1992**	**1993-1997**	**1998-1999**
Government expenditure (Rs million)	268.1	898.3	2,516.0	4,213.3	8,840.1	15,892.2	23,009.5
Government expenditure (% of GDP)	20.27	21.23	28.22	24.58	22.59	22.54	22.71
Tax revenue (% of GDP)	-	16.48	17.39	19.45	20.68	18.06	16.55
Budget deficit (Rs million)	6.6	216.1	1,037.5	499.8	179.0	1,494.6	3,607.5
Budget deficit (% of GDP)	0.50	4.82	11.60	3.44	0.44	1.88	3.57
Central government debt (Rs million)	379.2	986.1	3,916.1	11,545.3	18,985.8	29,576.2	48,185.9
Central government debt (% of GDP)	28.66	25.54	50.85	60.76	39.19	33.92	45.53
Domestic financing of deficit (Rs million)		181.90	574.90	410.94	308.82	1364.44	3231.00
Domestic financing of deficit (% of GDP)		4.01	6.64	3.03	0.65	1.76	3.67
Foreign financing of deficit (Rs million)		34.20	462.64	87.22	-129.86	130.12	-722.50
Foreign financing of deficit (% of GDP)		0.80	4.96	0.40	-0.21	0.12	-0.82

Table 1.5 (Source: Time Series Explorer - WDI, IFS)

[80] Bank of Mauritius, 1999: 55

CHAPTER 2

THEORY AND LITERATURE REVIEW

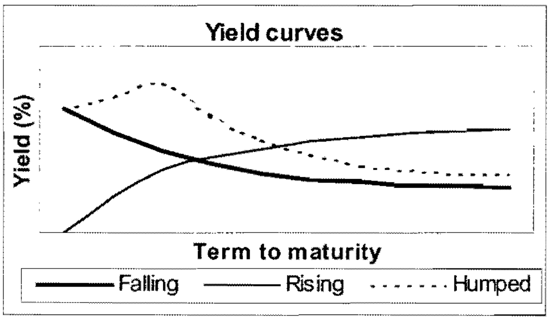
The literature in macroeconomic theory is even today plagued with controversies when it comes to analysing the effects of larger budget deficits on the term structure of interest rates. On the one hand are proponents of the conventional view who posit a positive relationship between budget deficits and interest rates. On the other are proponents of the Ricardian Equivalence hypothesis who argue that there is no relationship between budget deficits and interest rates.

This chapter initially looks at the various theories of the term structure of interest rates and later deals with the conventional versus Ricardian debate surrounding the issue of the effects of budget deficits on interest rates.

2.1 The term structure of interest rates

The term structure of interest rates, more commonly known as the yield curve, shows the relationship between short-term and longer-term interest rates for securities of the same risk class.

Graph 2.1 (Source: Blake, 1990: 102)



A yield curve can be rising, falling or humped as shown in *Graph 2.1.* Three main theories attempt to explain the shape of the yield curve, namely the expectations theory, the liquidity preference theory and the preferred habitat theory.

The expectations theory

The shape of the yield curve is explained by the expectations theory on the basis of investor's expectations about future interest rates.

Given that both long and short-term bonds sell at equal yields, and if expectations are that interest rates are unsustainably high (and will therefore drop in the future), investors will find long-term bonds more attractive than short-term bonds. This is because long-term bonds will allow investors to earn what they believe to be unusually high rates over a longer period of time than short-term bonds, while investors choosing short-term bonds expose themselves to the risk of having to reinvest their funds at the lower expected yields in the future.[81]

Another reason for investors preferring long-term bonds (given expectations that interest rates would drop in the future), is that long-term bonds are likely to appreciate in value if the expectations of a drop in yields indeed materialise. The expectations theory relates short and long-term rates by suggesting that the long-term rate is an average of current and future (expected) short-term rates.[82]

Hence a falling (rising) yield curve is explained by investors expecting short-term rates to be lower (higher) in the future. A humped yield curve is explained by the expectations theory, to result from a situation where investors expect short-term rates to rise and long-term rates to drop.[83]

The liquidity preference theory

In 1939, Hicks proposed the liquidity preference theory of the term structure of interest rates by arguing that the yield on longer-term issues ought to be higher than that on short-term issues by the amount of a risk premium.

[81] New Palgrave: 629
[82] New Palgrave: 629
[83] Blake, 1990: 101

This is because long-term issues are more risky (as reflected by wide swings in their prices due to unanticipated changes in interest rates) than short-term issues which are very liquid and hence can be quickly converted to cash with minimal loss in the event of rates changing unexpectedly. Hicks thus concluded that, when inflation is expected to remain constant over time, the yield curve would normally be upward sloping as the risk premium would be embedded in the higher long-term rates (to induce investors to hold them). This is in contrast to the expectations theory which predicts a flat yield curve under constant inflationary expectations.[84]

The preferred-habitat theory

The preferred-habitat theory is also known as the hedging-pressure theory or even the segmentation theory. It argues that the bond market is segmented by maturity range and the yield is determined by demand and supply in each market segment, independently of conditions in other market segments.

Investors would therefore opt for bonds whose maturity is appropriate to their 'preferred habitat'. For instance, short-term bonds are demanded by commercial banks whereas life insurance companies and pension funds would prefer long-term bonds so as to hedge against risks of interest rate fluctuations (hence the term 'hedging-pressure' theory).[85]

The preferred-habitat theory therefore explains the shape of the humped yield curve as resulting from high demand for short and long-term bonds (hence high price and low yields) and small demand for medium-term bonds (hence low price and high yields for medium-term bonds).[86]

[84] New Palgrave: 629
[85] New Palgrave: 630
[86] Blake, 1990: 102

Other influencing factors: Government and Central Bank policies

The yield curve is also influenced by government and central bank policies. For instance an increase in the borrowing requirement by the government is expected to raise the yield at all maturities, hence affecting the shape of the yield curve. Similarly, Central Bank's open market operations might influence the shape of the yield curve by tilting the yield curve either upwards or downwards in the short-term, and influencing inflationary expectations in the long-term (by changing money supply).

2.2 The conventional view of the effects of budget deficits

Until the mid-1970's, the neoclassical synthesis was considered as the ruling school of economic thought and was accordingly referred to as the conventional view. It adopts both the Keynesian and neoclassical postulates and concludes that larger budget deficits can stimulate aggregate demand through the multiplier, with the resulting higher real interest rates and partial crowding out.

The theory implicitly assumes that government would borrow to finance the deficit (e.g by issuing government bonds), and this would reduce desired national savings. Hence, the real interest rate has to rise to restore equality between desired national savings and investment demand. The resulting rise in real interest rates crowds out some of the expansion.[87]

Another implicit assumption of the conventional view is that households are deceived into believing that the larger stock of bonds (resulting from the debt-financed spending) need not be repaid through larger future taxes, and hence they would treat those government bonds as wealth. These bond holders would therefore feel wealthier and spend more. These wealth effects arising from the holding of government bonds domestically by private individuals (which provide income through interest gained) coupled with the income effects arising from a reduction in taxes (which raise permanent disposable income), increase aggregate demand with the resulting higher real interest rates.

[87] Barro, 1989: 38

The conventional view of the effects of increased budget deficits can be summarised using the IS/LM framework. The IS curve shifts right due to the increased budget deficit and the LM curve shifts left (if the increase in budget deficits positively affects money demand as national income rises) which results in higher interest rates and output. The higher interest rate crowds out investment and hence offsets part of the expansion brought about by the multiplier.

2.3 The Ricardian Equivalence Hypothesis

In 1821 David Ricardo developed a theory that postulated the equivalence of tax-financed and bond-financed budget deficits when it comes to their (lack of) effects on the economy. Robert Barro revived this idea in 1974 through his paper "Are government bonds net wealth?" in which he argued that changes in the size of the budget deficits do not affect economic activity.

He emphasised the idea of intergenerational transfers, i.e. consumers will change their saving/consumption behaviour today to prepare for tax liabilities and debt in the future which might be borne by (transferred to) their children. This New Classical perspective makes the assumption that individual spending is based on an infinitely long time horizon.

Barro used this idea of intergenerational transfers to argue that agents do not consider government bonds as net wealth (as opposed to Keynesian beliefs) because they expect to pay higher taxes in the future to service the government's interest payments on this debt. Agents would thus respond to larger budget deficits (resulting from a lump sum tax cut or increase in government transfers[88]) by saving more for their anticipated larger future tax payments.

Hence the increase in budget deficit would result in unchanged consumption and also unchanged desired national saving (since the government dissaving is compensated by increased savings from private individuals). This means that the real interest rate does not have to rise to maintain the balance between desired national savings and

[88] Barth & Iden & Russek, 1985b: 82

investment demand, and hence there is no crowding out.[89]

In summary, a rise in the budget deficit would not increase aggregate demand and hence there is no multiplier effect. Indeed, "changes in private saving have offset the change in public debt, interest rates remain unchanged and no crowding out takes place."[90]

2.4 Empirical evidence

The effects of changes in budget deficits on the term structure of interest rates make up a controversial topic which has become so, mainly due to a multitude of conflicting empirical evidence. The latter's non-convergence result from the different data frequency, different dependent (and independent) variables used, different definitions of the deficit, different statistical techniques used or even different methodologies used by researchers. Indeed, "empirical results appear to be quite sensitive to the time period examined, the choice of dependent and independent variables, and the measurement of the deficit or debt variable."[91]

Studies which rejected a significant connection between budget deficits and interest rates include among others Dwyer (1982), Plosser (1982, 1987), Mascaro and Meltzer (1983), Makin (1983), Dewald (1983), Hoelscher (1984), Evans (1985, 1987) and Ostrosky (1990). On the other hand, Hutchinson and Pyle (1984), Tanzi (1985), Tanzi and Lutz (1991), Hoelscher (1986), Cebula (1988, 1990a, 1990b, 1991, 1993, 1997a, 1997b), Cebula and Belton (1993), and Spiro (1990) all found a significant connection between budget deficits and interest rates.

Correira-Nunes and Stemitsiotis observed that studies which rejected such a connection have 2 main features, namely (i) they test short-term interest rates, and (ii) they use quarterly or monthly data in regressions. Furthermore, they find that those studies which found a positive relationship between budget deficits and interest rates are those that use annual data to test the impact on long-term rate (and not short-term

[89] Barro, 1989: 39
[90] Standish & Beelders, 1991: 2
[91] Barth & Iden & Russek, 1985b: 89

rate).[92]

In summary, the empirical evidence tend to show that budget deficits have no influence on short-term interest rates, but have significant positive influence on long-term interest rates.

Possible explanations for the empirical evidence of a positive relationship between budget deficits and the term structure of interest rates

- The empirical evidence can be explained by the fact that short-term government borrowing is usually small relative to the total value of short-term liquid assets, which means that "only a small portion of short-term assets needs to be shifted to cover the short-term government borrowing".[93] Hence short-term interest rates are not sensitive to changes in short-term government borrowing.
- The uncertainty about inflation rate results in long-term savers shifting their portfolios towards short-term lending. This shift in preference for short-term securities magnifies the effect of long-term government borrowing on long-term rates.[94]
- Given that long-term foreign investments are regarded as more risky (by foreign investors) than short-term foreign investment, one would expect that the supply of short-term foreign funds have a higher interest elasticity than the supply of long-term foreign funds.[95] This might lead to long-term interest rates being more responsive than short-term interest rates, to changes in budget deficits.
- Anticipated debt levels are expected to rise in line with the larger deficits, resulting in anticipated future short-term rates which are higher than the current short rates. Hence long-term rates immediately rise in anticipation of future high short-term rates, and the term structure of interest rates changes.[96]

[92] Correira-Nunes & Stemitsiotis, 1995: 427
[93] Hoelscher, 1986: 16
[94] Hoelscher, 1986: 16
[95] Hoelscher, 1986: 16
[96] Correira-Nunes & Stemitsiotis, 1995: 427

2.5 Approaches used in previous research

The available empirical evidence is based on either the conventional approach or the loanable funds approach to test the hypothesis that there is a relationship between changes in budget deficits and interest rates.

The conventional IS/LM approach analyses the effect of changes in budget deficits on interest rates using linkages through the goods and money markets. This method makes use of the IS/LM framework to obtain a single equation or a reduced-form model to test the hypothesis.

The loanable funds approach uses the linkages through the asset markets, and the market yield is determined by supply and demand for loanable funds. An equation with interest rate as the dependent variable is obtained by equating demand and supply for loanable funds.

Both approaches are used in this paper in an attempt to check for the robustness of any empirically tested link between budget deficits and interest rates.

CHAPTER 3

DATA AND METHODOLOGY

This chapter starts by reviewing the data to be used in the analysis and then gives a brief description of the models and variables to be used in the econometric analysis. The econometric methodology is also described, to set the stage for the empirical testing of the relationship between budget deficit and interest rates in *Chapter 4*.

3.1 Data source

The data used in this paper was obtained from the Bank of Mauritius, and the Time Series Explorer (TSE) database. The World Development Indicators (WDI) and the International Financial Statistics (IFS) were the two main sources of data from the database TSE.

3.2 Periodicity of data used

Correira-Nunes & Stemitsiotis (1995) suggested that annual data is preferable in an analysis of the effects of budget deficits on interest rates for two main reasons.

- Annual data is less likely to be distorted by transitory shocks. Hence the interest rate variable, which is highly sensitive to those shocks, will be less distorted if its data periodicity is annual rather than monthly. More emphasis is therefore placed on fundamental factors if annual data is used. [97]
- Since the budget deficit is an annual concept, the "timing between actual government expenditure and receipts or deficit financing may not closely correspond in shorter periods."[98]

[97] Correira-Nunes & Stemitsiotis, 1995: 427
[98] Correira-Nunes & Stemitsiotis, 1995: 427

These two reasons might explain why some studies based on quarterly or monthly data, have rejected the relationship between budget deficits and interest rates, while most studies based on annual data have not.

For the above reasons, annual data (ranging from the year 1968 to 1999) is used in this paper. Only year-end annual data was obtained for Mauritius, and this is reasonable given the fact that the Mauritian economy has been experiencing economic stability over most of the time period studied (as shown in *Chapter 1*).

3.3 The models

The link between budget deficits and interest rates must be analysed within a framework where the main determinants of interest rates would include expected inflation, the term structure of interest rate, macroeconomic policies and world capital linkages among others. As shown in *Chapter 2* the available empirical evidence in testing this hypothesis (that there is a link between budget deficits and interest rates) is based on either the conventional IS/LM approach or the loanable funds approach. Both approaches are used below to derive a single equation model in each case. A third approach, namely the term structure model, is also used in this paper to model the term structure of interest rates using budget deficit as one of the explanatory variables.

3.3.1 The IS/LM model

An open IS/LM model is used to represent the small open economy that is Mauritius. The IS/LM model is as follows: $\mathbf{i = i\ (D, P^e, M, G, t, f)}$

i = nominal interest rate
D = budget deficit
P^e = expected inflation
M = nominal money stock
G = government expenditure
t = tax rate
f = net capital inflows

Hence the IS/LM econometric model used in this paper is written as:

$$\mathbf{i} = \alpha_0 + \alpha_1 \mathbf{D} + \alpha_2 \mathbf{P}^e + \alpha_3 \mathbf{M} + \alpha_4 \mathbf{G} + \alpha_5 \mathbf{t} + \alpha_6 \mathbf{f} + \varepsilon$$

where ε is the stochastic error term.

The hypothesised sign on the partial derivatives for the above equation (in line with theory) are as follows: $i_D > 0$, $i_{P^e} > 0$, $i_M < 0$, $i_G > 0$, $i_t < 0$, $i_f < 0$.

- $i_D > 0$ is hypothesised (according to the conventional view as discussed in *Section 2.2*) because of the upward pressure generated on interest rates resulting from the government attempting to attract funds to finance the deficit.
- $i_{P^e} > 0$ implies that nominal interest rate is an increasing function of the expected inflation because the supply of bonds increases and the demand for bonds drops (resulting in a drop in bond price and hence in higher bond yields) with rising expected inflation.[99]
- $i_M < 0$ is hypothesised because of the expected offsetting of the effects of government borrowing by the Central Bank purchases of government securities[100] (i.e money supply drops and interest rates rise).
- $i_G > 0$ is hypothesised because larger government expenditures would cause an income effect (higher consumption and lower savings) resulting in higher interest rates.
- $i_t < 0$ is hypothesised because a rise in tax rates would presumably reduce government's bond issues, resulting in lower interest rates.
- $i_f < 0$ is hypothesised because the larger the net capital inflows are, the lower will be the upward pressure on the nominal interest rate since "the capital in question acts to absorb newly issued debt."[101]

[99] Cebula, 1988: 338
[100] Cebula, 1988: 338
[101] Cebula & Belton, 1993: 190

The above model is obtained from the simple IS/LM model[102] for a closed economy which is as follows: i = i (M, G, T, P^e) , where i = nominal interest rate, M = nominal money stock, G = Government expenditure, T = tax revenue, and P^e = expected inflation. For an open economy this simple IS/LM model is expanded to: i = i (M, G, T, P^e, f), where f = net capital inflows.

According to Barth et al., the failure to consider the effects of the flow of new debt separately from the transactions effects of government purchases and taxes may be the cause of the confusion in the literature over the differential effects of deficits versus debt on interest rates. Furthermore, "when testing for the interest rate effects of federal deficits, one may have to perform joint instead of separate tests of the significance of estimated coefficients. If one includes the deficit variable [rather than having tax revenues (T) and government expenditures (G) separately entered in the regression equation], then one should also include 'G' to capture differences in coefficients".[103]

A tax rate variable (t) is chosen over tax revenue (which is endogenous), "because the use of an income tax rate is in conformity with the strict interpretation of the IS/LM model (which) expressly adopts an income tax rate as a fiscal policy measure, rather than the level of tax collections."[104]

3.3.2 The loanable funds model

The advantage of this approach is that is allows government borrowing to be included as a direct determinant of interest rates.[105] This paper uses very similar demand and supply functions for loanable funds as those used in Hoelscher (1986), Cebula (1988), and Correira-Nunes & Stemitsiotis (1995).

[102] Barth & Iden & Russek, 1985a: 556
[103] Barth & Iden & Russek, 1985a: 557-558
[104] Cebula & Belton, 1993: 192
[105] Hoelscher, 1986: 3

The loanable funds model used is as follows: $\mathbf{i_L = i_L (D, P^e, r_S, g, f)}$

i_L = nominal long-term interest rate
D = budget deficit
P^e = expected inflation rate
r_S = ex-ante real short-term interest rate
g = annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)[106]
f = net capital inflows

The loanable funds econometric model is therefore written as:

$$\mathbf{i_L = \beta_0 + \beta_1 D + \beta_2 P^e + \beta_3 r_S + \beta_4 g + \beta_5 f + \varepsilon}$$

where ε is the stochastic error term.

The hypothesised sign on the partial derivatives for the above equation (in line with theory) are as follows: $i_D > 0$, $i_{P^e} > 0$, $i_{rs} > 0$, $i_g > 0$, $i_f < 0$.

- $i_{rs} > 0$ is hypothesised on the basis that the higher the ex-ante (or expected) real short-term interest rate, the lower will be the demand for long-term deposits and bonds. Hence, as the ex-ante real short-term rate (r_S) rises, the expected future real return on short-term lending also rises. This leads to investors substituting short-term bonds for longer-term bonds in their portfolios. The drop in demand for longer-term bonds raises the yield on those long bonds. Hence, as 'r_S' rises, one would expect long-term rates also to rise.[107]
- $i_g > 0$ is hypothesised because as the growth rate rises, the demand for credit in the business sector would also increase, and hence the real supply of bonds offered by the private sector would rise[108], i.e price of bonds would drop and yields would rise.
- $i_D > 0$, $i_{P^e} > 0$ and $i_f < 0$ were explained in the previous section.

[106] Correira-Nunes & Stemitsiotis, 1995: 431
[107] Cebula, 1988: 341
[108] Cebula, 1988: 338

The above loanable funds model is obtained by equating the supply (S_L) and demand (D_L) functions of loanable funds (which are mainly long-term in nature), to obtain a single equation model as shown below:

$S_L = S_L\ (i_L, r_S, P^e, D)$

$D_L = D_L\ (i_L, r_S, P^e, D, g)$

Therefore, $i_L = i_L\ (D, P^e, r_S, g)$

Given that Mauritius is an open economy, this fact can be represented in the model by the inclusion of net capital inflows (f).

3.3.3 The term structure model

A term structure model similar to that derived by Thomas and Abderrezak (1988), is used in this paper. It is based on the loanable funds model for short-term and long-term funds respectively.

The supply of long-term funds is a positive function of both long-term interest rate and the growth rate of money supply (i.e the liquidity provided by the Central Bank) and a negative function of expected inflation and budget deficits. On the other hand, demand for long-term funds is an increasing function of both expected inflation and budget deficits (since a rise in budget deficits would raise future expected yields and would therefore increase the demand for long-term funds) and a decreasing function of the long-term interest rate and a cyclical proxy (g).[109]

The supply and demand for long-term funds are equated to obtain the single equation long-term interest rate model: $i_L = i_L(D, P^e, M, g)$.

Similar arguments apply to supply and demand of short-term funds, and the supply and demand for short-term funds are equated to obtain the single equation short-term interest rate model: $i_S = i_S(D, P^e, M, g)$.

The yield differential (or term structure, TS) is obtained by subtracting the short-term interest rate equation from the long-term interest rate equation.

[109] Thomas & Abderrezak, 1988: 151

Hence the term structure model used in this paper is as follows: **TS = TS (D, P^e, M, g)**

TS = term structure

D = budget deficit

P^e = expected inflation

M = nominal money stock

g = annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)

The term structure econometric model used in this paper is therefore written as:

$$TS = \delta_0 + \delta_1 D + \delta_2 P^e + \delta_3 M + \delta_4 g + \varepsilon$$

where ε is the stochastic error term.

The yield differential is therefore influenced by an expectations variable (P^e), liquidity forces (M), cyclical forces (g), and also by the budget deficit (D). These variables are consistent with the various theories of the term structure of interest rates as discussed in *Section 2.1* of this paper.

The partial derivative $TS_D > 0$ is hypothesised on the available empirical evidence that budget deficits raise long-term rates and have negligible effects on short-term rates.

3.4 Variables used in the analysis

The three models above make use of the following variables, namely budget deficit, government expenditure, money stock (supply), net capital inflows, interest rates, expected inflation, tax rate, and the growth in annual real GDP. The first four variables mentioned above, are analysed as a percentage of Gross National Product (GNP) and are thus divided by GNP at market prices in line with the argument advanced in the literature, that "ideally, government purchases, the government budget deficit, and open market operations ...... should all be judged relative to the size of the economy".[110]

[110] Cebula & Belton, 1993: 190

To be consistent with the literature, budget deficit (D), money stock (M), government expenditure (G) and net capital inflows (f) variables are all analysed as a percentage of GNP. The variables used are individually discussed below.

3.4.1 Budget deficit

Even today there is no consensus about the proper measure of government budget deficit. The reason being the number of budget deficit measures and their varied implications as explained in Eisner (1984).[111] One of those implications, is the impact of inflation on budget deficits. Indeed in an inflationary environment, the real value of outstanding government debt would depreciate (i.e. a wealth transfer from bondholders to bond issuers) hence reducing the deficit.

Some economists refer to this inflation-induced wealth transfer to government (the bond-issuers) as seignorage or government revenue. However, this can be considered as government revenue only when inflation is anticipated, i.e. when the resulting depreciation in government debt is also anticipated. Hence the true measure of budget deficit if inflation is anticipated would be the change in the real value of government debt. If inflation is unanticipated, the measure of budget deficit should be the real deficit reported from the National Income Accounts. The real value of government debt and the real deficit reported from the National Income Accounts would only coincide under zero inflation.[112]

Once a deficit variable is chosen to be included as an explanatory variable in a regression equation (which analyses the impact of deficits on interest rates), another major problem surfaces. An aggregate budget deficit measure would include two components, namely a cyclical component and a structural component. The former is that portion of aggregate budget deficit which automatically varies over the course of the business cycle.[113]

[111] Eisner, 1984: 138
[112] Hoelscher, 1986: 3
[113] Cebula, 1990a: 799

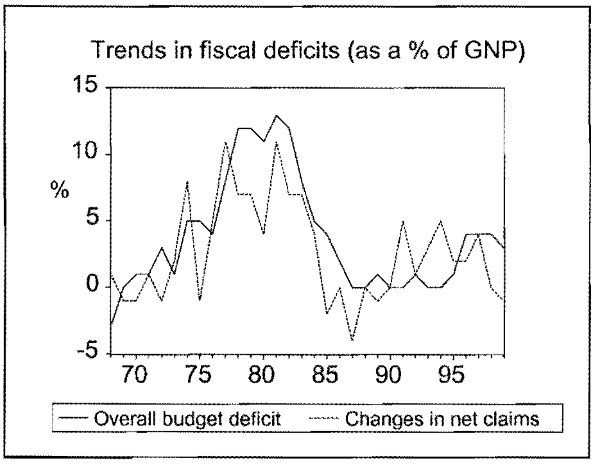
For instance, tax receipts rise (fall) and government transfers fall (rise) during a cyclical upturn (downturn). Hence cyclical deficit is by nature the endogenous component of aggregate budget deficit, whereas the structural deficit (which is the difference between aggregate and cyclical deficit) is the exogenous component.[114] Structural deficit (which directly reflects discretionary fiscal policy) is also partly endogenous because policymakers may respond to rising unemployment by using discretionary fiscal policies thereby raising budget deficits.[115]

The major problem is the endogeneity of this portion of aggregate deficit which introduces simultaneous-equation bias.[116] The methodology section below explains the problem of simultaneous equations bias and describes the two-stage least squares regression technique (2SLS) which is used in this paper to overcome it.

Budget deficit variables used

In order to provide a broad interpretation of the deficit variable, three measures of the budget deficit variable are used in this paper, namely (i) **DEF1GNP** (Overall budget deficit including grants/GNP), (ii) **DEF2GNP** (change in net claims on central Government/GNP), and (iii) **DEF3GNP** (net domestic financing of the deficit/GNP).

Graph 3.1 (TSE source: IFS)



Graph 3.1 shows the trends of the deficit variables **DEF1GNP** and **DEF2GNP**. The positive figures refer to budget deficits and the negative figures refer to budget surpluses. The course of those budget deficit variables since 1968, was explained in *Section 1.4.2.*

It might be argued that domestic interest rates are influenced by domestic financing and not by the foreign financing of the deficit. Mauritian budget deficits have been

[114] Cebula, 1990a: 799
[115] Cebula, 1997b: 42
[116] Cebula, 1990a: 799

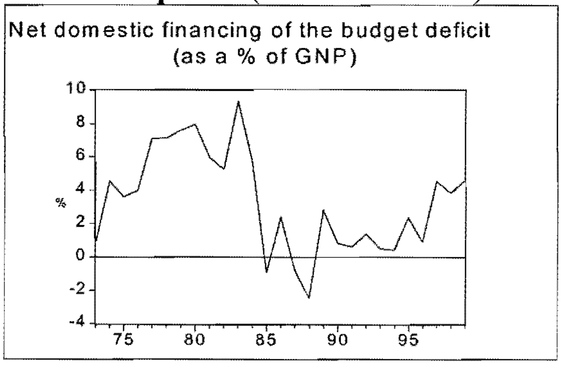
financed from both domestic and foreign sources (as shown by *Graph 1.14* in *Section 1.4.2*), and hence the budget deficit variables 'overall budget deficit' (DEF1GNP) and 'changes in central government debt' (DEF2GNP) might be inappropriate in the analysis of the effects of budget deficits on interest rates because foreign financing is embedded in those variables.

Nevertheless, both DEF1GNP and DEF2GNP are used in regression analysis to be consistent with the literature (which used mostly aggregate budget deficit variables and not the domestic portion of the budget deficit). However, the results generated from the DEF1GNP and DEF2GNP budget deficit variables, are compared to the results generated from the budget deficit variable 'net domestic financing of the budget deficit/GNP' **DEF3GNP** in *Section 4.5*. These *test* regressions (i.e the regressions using DEF3GNP) are made to assess the reliability of the conclusions reached while using the budget deficit variables DEF1GNP and DEF2GNP. In that regard, the variable **DEF3GNP** is considered in this paper as a ***test*** budget deficit variable.

If the results obtained from using DEF1GNP and DEF2GNP do not differ significantly from those obtained while using DEF3GNP, this would mean that it is legitimate to use any of DEF1GNP and DEF2GNP in the analysis.

Data for the budget deficit variable **DEF3GNP** was available only for the period 1973 to 1999. The course of the (test) budget deficit variable 'net domestic financing of the deficit/GNP' **DEF3GNP** is shown in *Graph 3.2*.

Graph 3.2 (TSE source: IFS)



3.4.2 Interest rates

Most of the studies which rejected the connection between budget deficits and interest rates used short-term interest rate data. Conventional macroeconomics imply that long-term interest rates (and not short-term rates) transmit the effects of budget deficits to the real side of the economy, and hence long-term rates should be preferred in empirical work. Cebula (1990b) explains that "interest-sensitive components of private sector spending such as business outlays on plant and equipment and new construction are most sensitive to variations in long-term rates."[117]

Interest rate variables used

Three long-term rates are used in this paper and three short-term rates are also analysed for completeness. The short-term rates used are: The bank rate (**SR1**), the rate on 3-months deposit account with commercial banks (**SR2**), and the rate on 6-months deposit account with commercial banks (**SR3**).

Since long bond rates were unavailable for most of the period under study, the rate on long-term deposit account with commercial banks is used in this paper as a proxy for long bond rates. This is based on the fact that in South Africa for instance, the bond market rates are correlated to long-term deposit rates with commercial banks (*Appendix 9*).

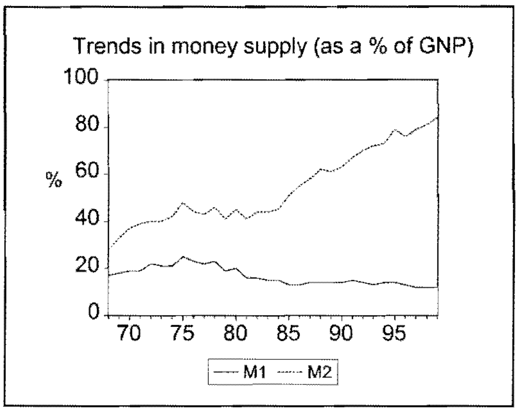
The long-term rates used are: the rate on 12-24 months deposit account (**LR1**), the rate on 24-36 months deposit account (**LR2**), and the rate on (greater than) 48-months deposit account (**LR3**). Furthermore, the real short-term interest rate variable (r_s) in the loanable funds econometric model is calculated ex-ante e.g $\mathbf{r_{s1} = SR1 - P^e}$ (i.e ex-ante real short-term rate 1 = Short-term rate 1 - Expected inflation). *Graph 1.6* and *Graph 1.7* show the trends in the selected short-term and long-term interest rate variables respectively.

[117] Cebula, 1990b: 804

3.4.3 Monetary Policy variable

The term structure of interest rate is clearly influenced by monetary policy carried out by the (Central) Bank of Mauritius. To reflect monetary policy, the variable **M2GNP** is included as one of the explanatory variables. **M2GNP** is simply the money supply measure M2 expressed as a percentage of GNP at market prices.

Graph 3.3 (TSE source: IFS)



To demonstrate the robustness of the empirical results, an alternative measure of monetary policy is used in this paper, namely the money supply M1 also expressed also as a percentage of GNP at market prices (**M1GNP**). *Graph 3.3* shows the trends in the selected money supply variables.

3.4.4 Expected inflation

Since it is the ex-ante interest rates that determine private investment, this paper looks at the effect of deficits on nominal interest rates using expected inflation (**P^e**) as one of the regressors. In all 3 models used in this paper, the nominal interest rate and the expected inflation rate are entered separately in the regression equation (instead of having one 'lumped' real interest rate variable) to allow for possible departures from the full Fisher effect (which predicts a unity coefficient for regressor P^e).[118]

In a model testing the impact of budget deficits on interest rates, theoretical difficulties and econometric problems arise while attempting to include expected inflation as a variable in the analysis, since P^e is not directly observed. The literature contains various methods for constructing proxies for inflationary expectations. One of those methods is described in the methodology section below and it is used in this paper to proxy for expected inflation.

[118] Correira-Nunes & Stemitsiotis, 1995: 432

The 'expected inflation variable' is considered as endogenous in the models presented, because causality between interest rates and expected inflation is bi-directional, i.e each variable is influenced by each other.

3.4.5 Other variables used

Net capital inflows

Data for net capital inflows is used in the paper. The variable **CAPGNP** is net capital inflows expressed as a percentage of GNP at market prices. The 'net capital flows' variable is considered as endogenous in the models presented, because causality between interest rates and net capital inflows is bi-directional.

Government expenditure

The variable **GOVGNP** is the national accounts Government Consumption expressed as a percentage of GNP at market prices.

Tax rate

The personal income tax rate, **t**, is used in this paper. The tax rate for the income bracket 'less than or equal to Rs30,000' is chosen because the majority of the population falls in this category.

Growth in Real GDP

The capital-output ratio could be used to proxy for the accelerator effects of the business cycle on investment and consumption of durables. However, to be consistent with the literature, the derived national accounts GDP annual growth, **g**, is used.

3.5 Methodology

3.5.1 Finding a proxy for expected inflation

Swamy et al. (1990) use a distributed lag on actual price inflation in the regression equation to account for expected inflation.[119] Cebula (1997b) uses this idea to generate a series for expected inflation and the same methodology is used in this paper.

[119] Swamy et al., 1990: 1013

The first difference of the inflation time series (INFL) is taken to obtain the stationary ΔINFL. Only one differencing process was necessary because the inflation time series showed that the variable has a single unit root (*Appendix 1*). The variable ΔINFL is then modelled as follows:

$$\Delta INFL_t = \alpha_0 + \sum_{j=1}^{r} \beta_j \, \Delta INFL_{t-j} + \varepsilon_t$$

The lag length r, is determined from the Akaike Information Criterion (AIC). The above equation is estimated for 6 lags (since the value of 'r' which minimises the AIC was found to be equal to 6) and the results displayed as follows, with the probability values in brackets:

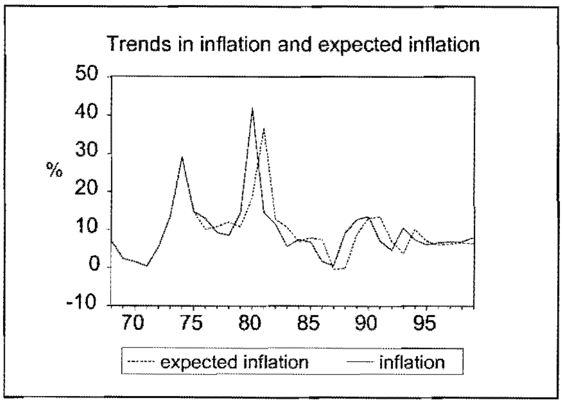
$$\Delta INFL_t = -0.79 - 0.50\,\Delta INFL_{t-1} - 0.42\,\Delta INFL_{t-2} - 0.40\,\Delta INFL_{t-3} - 0.27\,\Delta INFL_{t-4} - 0.20\,\Delta INFL_{t-5} + 0.13\,\Delta INFL_{t-6}$$

(0.6385) (0.0236) (0.0613) (0.0780) (0.2320) (0.3427) (0.5139)

$R^2 = 0.395464$ AIC = 4.446364 DW = 1.928962

The above equation is used to forecast changes in inflation, i.e a new time series FΔINFL is obtained for the same period under study. The 'unadjusted' expected inflation time series (XINFL) is then generated in line with Cebula (1997b) [as $XINFL_t = INFL_{t-1} + F\Delta INFL_t$]. The 'adjusted' expected inflation rate time series ($\mathbf{P^e}$) was then derived from the above XINFL series, by multiplying the latter by a constant to get its mean to equal that of the INFL time series.[120]

Graph 3.4 (TSE source: IFS)



Graph 3.4 shows that the derived expected inflation graph closely lags the actual inflation trends. This is an expected result of using such a methodology, i.e the derivation of expected inflation rate from lags of actual inflation rate.

[120] Cebula, 1997b: 41

3.5.2 Simultaneous equations bias and the 2SLS regression technique

As mentioned in *Section 3.4.1* above, simultaneous-equation bias arises from the endogeneity of aggregate budget deficit. An option to avoid the simultaneous-equation bias is to use the two stage least squares (2SLS) technique.[121]

The problem of simultaneous equations bias

When there are endogenous variables on the right side of the regression equation, those variables are correlated with the error term of that equation. This is because the endogenous variable has a systematic component (which is determined by the other exogenous variables in the equation), and a stochastic component which creates the dependence of the endogenous variable with the error term of the equation.[122]

This correlation between the endogenous explanatory variable and the disturbance term is a violation of the classical linear regression model because the endogenous variable is not distributed independently of the error term. Thus ordinary least squares estimation would be biased and inconsistent, i.e the estimators do not converge to their true population values (whatever the size of the sample used).[123]

The two stage least squares regression (2SLS) technique

The two-stage least squares technique involves using a variable (known as an instrument) that is uncorrelated with the disturbance of the equation. The instrument should be (i) highly correlated with the endogenous variable and therefore should systematically explain the endogenous explanatory variable and (ii) uncorrelated with the error terms in the equation.[124]

The first stage regression (for each endogenous variable on the right side of the equation) uses the instrument to find the component of an endogenous variable that is attributable to the instrument. The second stage of the procedure is to use the first-stage fitted values (which replaces the endogenous variable) to run a regression on the original equation. So doing, the stochastic endogenous variable is purified of the

[121] Koutsoyiannis, 1992: 384
[122] Koutsoyiannis, 1992: 385
[123] Gujarati, 1995: 647
[124] Koutsoyiannis, 1992: 376

influence of the error term in the equation.[125]

Problems arising when using non-stationary variables in 2SLS regressions

The 2SLS regressions performed in the existing literature [Cebula (1988, 1990a, 1990b, 1991), Ostrosky (1990), Cebula & Belton (1993), Correira-Nunes & Stemitsiotis (1995)] were on level variables. 'Level' variables used in the literature and in this paper, are mostly non-stationary. The problem arising from the use of 'level' variables in the 2SLS regression analysis is that spurious regression results might be produced when a non-stationary variable is regressed on other non-stationary variables. In other words, the regression results might not reflect the "true degree of association between the (non-stationary) variables but simply the common trend present in them."[126]

However, regression results (from non-stationary variables) may not be spurious if the non-stationary variables are econometrically shown to be cointegrated (explained in *Chapter 4*). Hence the implicit assumption made by the authors in the literature, is that the 'level' variables are cointegrated. Regression analysis is also performed on the 'level' (non-stationary) variables in this paper and furthermore, an attempt is made in *Section 4.3.5* to check for the existence of cointegration in those level regressions in order to assess the reliability of the regression results.

The problem of spuriousness of regression results can be eliminated by making the variables stationary by taking first differences, prior to performing regression analysis. Regression analysis is also performed using 'differenced' (stationary) variables in this paper, and the results compared to those of 'level' regressions.

125 Gujarati, 1995: 688
126 Gujarati, 1995: 722

3.5.3 Regression on 'level' variables

Two stage least squares regression is performed on the 'level' variables to handle the problem of simultaneous equations bias caused by the endogeneity of explanatory variables such as budget deficit (**DEF1GNP**, **DEF2GNP**, and **DEF3GNP**), expected inflation (**P^e**), and net capital inflows (**CAPGNP**). The Cochrane-Orcutt two-step procedure is also applied to correct the 2SLS estimates for serial correlation.[127]

<u>Instrument variables used in regression on 'level' variables</u>

Instrument variable allowing for endogeneity of budget deficit

The 1-year lag of government expenditure [**GOVGNP(-1)**] is used as an instrument for both "overall budget deficit as a % of GNP" (DEF1GNP) and "net domestic financing of the budget deficit as a % of GNP" (DEF3GNP). The 1-year lag of net capital inflows [**CAPGNP(-1)**] is used as instrument for the budget deficit variable "changes in net claims on Central Government as a % of GNP" (DEF2GNP). The reason for using such instruments is that they systematically explain the respective budget deficit variables (relatively high correlation in *Appendix 8*), and they are uncorrelated with the error term of the estimating equation.

Instrument variable allowing for endogeneity of expected inflation

The 1-year lag of the inflation rate [**INFL(-1)**] is used as a second instrumental variable in the analysis, because it systematically explains expected inflation P^e (relatively high correlation in *Appendix 8*) and it is uncorrelated with the error term of the estimating equation.

Instrument variable allowing for endogeneity of net capital inflows

The 1-year lag of variable M1GNP [**M1GNP(-1)**] is used as a third instrumental variable in the analysis, because it systematically explains CAPGNP (relatively high correlation in *Appendix 8*) and it is uncorrelated with the error term of the estimating equation.

[127] Gujarati, 1995: 432

3.5.4 Regression on 'stationary' variables

It can be observed from the information given by *Appendix 1* that, except for DEF1GNP, all the variables used are stationary in their 'first difference' form [i.e these variables are integrated of order one, I(1)]. All the variables used (except for DEF1GNP which is differenced twice) are differenced once and the variables preceded by the notation Δ. For instance the deficit variable "change in net claims on central government as a percentage of GNP" (DEF2GNP) being I(1), was differenced once to become ΔDEF2GNP. The variable "overall budget deficit including grants as a percentage of GNP" (DEF1GNP) is I(2) and was therefore differenced twice to become the stationary variable ΔΔDEF1GNP. This differencing process is made to ensure that all the variables used in regression analysis are stationary, and hence would not produce spurious regression results.

Two stage least squares regression is performed on the 'stationary' variables to handle the problem of simultaneous equations bias caused by the endogeneity of explanatory variables such as budget deficit (**ΔΔDEF1GNP**, **ΔDEF2GNP**, and **ΔDEF3GNP**), expected inflation (**ΔP^e**), and net capital inflows (**ΔCAPGNP**). The Cochrane-Orcutt two-step correction (for serial correlation) on the 2SLS estimates, is <u>not</u> required (as explained in *Section 3.5.5* below) while using differenced variables in this paper.

<u>Instrument variables used in regression on 'stationary' variables</u>

Instrument variable allowing for endogeneity of budget deficit

The 1-year lag of variable Δt [**Δt(-1)**] and the 2-year lag of variable ΔTS12 [128] [**ΔTS12(-2)**] are used as instruments for budget deficit variables ΔΔDEF1GNP and ΔDEF2GNP respectively. The 2-year lag of variable ΔM1 [**ΔM1(-2)**] is used as instrument for the budget deficit variable ΔDEF3GNP. The reason for using such instruments is that they systematically explain ΔΔDEF1GNP, ΔDEF2GNP and ΔDEF3GNP respectively (relatively high correlation in *Appendix 8*), and they are uncorrelated with the error term of the estimating equation.

[128] ΔTS12 is the first difference of the yield spread between the rate on 12-24 months deposit account with commercial banks (LR1) and the rate on 3-months deposit account with commercial banks (SR2).

Instrument variable allowing for endogeneity of expected inflation

The 1-year lag of the variable ΔINFL (first difference of the inflation rate) is used as a second instrumental variable in the analysis, because it systematically explains ΔP^e (relatively high correlation in *Appendix 8*) and it is uncorrelated with the error term of the estimating equation.

Instrument variable allowing for endogeneity of net capital inflows

The variable ΔRMGNP (the first difference of "reserve money as a % of GNP") is used as a third instrumental variable in the analysis, because it systematically explains ΔCAPGNP (relatively high correlation in *Appendix 8*) and it is uncorrelated with the error term of the estimating equation.

3.5.5 Autocorrelation, Multicollinearity, and Heteroscedasticity

The presence of autocorrelation, multicollinearity, and/or heteroscedasticity in regression analysis results in unreliable t-statistics and F-statistics, and also in inefficient estimated coefficients. Empirical study carried out in the literature however only remedied for autocorrelation (by using Cochrane-Orcutt two step procedure) but neglected to correct for multicollinearity and heteroscedasticity. Hence, these studies implicitly assumed that the regression output generated were devoid of multicollinearity and heteroscedasticity.

Autocorrelation

The presence of high autocorrelation yields inefficient estimators (variance is not minimised) and hence the t-statistic and F-statistic are unreliable.[129] Autocorrelation is a major problem in this paper because the data used is time-series data. To be consistent with the literature, the two-step Cochrane-Orcutt procedure is used to correct for autocorrelation in this paper. This two-step Cochrane-Orcutt correction is appropriate since autocorrelation is of first-order[130] in the regressions carried out in this paper.

[129] Gujarati, 1995: 411

[130] The disturbances u_t are generated by the first-order autoregressive scheme: $u_t = \rho\, u_{t-1} + \varepsilon_t$ (Gujarati, 1995: 421)

The two-step Cochrane-Orcutt correction for serial correlation is not required in regressions using stationary (differenced) variables because first-order autocorrelation is eliminated after taking first differences.[131]

Multicollinearity

The presence of high multicollinearity yields large variances and covariances for the ordinary least squares estimators, hence widening the confidence intervals. This means that the null hypothesis (that the true coefficient of a regressor is zero) is less likely to be rejected, i.e the t-statistic is more likely to be insignificant. Because of this imprecision in estimation, the t-statistic and F-statistic are therefore unreliable under high multicollinearity.[132]

A regression equation having a high R^2 but few significant t-statistics (high probability values), coupled by the fact that the regressors have high pair-wise correlations [in excess of 0.8 as suggested by Gujarati (1995)], allows one to detect the presence of multicollinearity.[133]

The R^2 's obtained from regression exercises (*Appendix 3 & 4*) and the correlation tests among regressors (*Appendix 5.1 & 5.2*) show that ***multicollinearity is not a major problem*** in the regressions carried out in this paper using either level or stationary variables. Indeed, the regression equations using either level or stationary variables had most of their regressors having low pairwise correlations, even for those equations with high R^2 values.

Multicollinearity is not likely to be a problem in regressions using stationary (differenced) variables. The reason being that "first difference regression models often reduce the severity of multicollinearity because, although the levels (of the regressors) may be highly correlated, there is no a priori reason to believe that their differences will also be highly correlated."[134] This is confirmed by the low pairwise correlations of differenced (stationary) variables as shown in *Appendix 5.2*.

[131] Gujarati, 1995: 428
[132] Gujarati, 1995: 327
[133] Gujarati, 1995: 335
[134] Gujarati, 1995: 342

Heteroscedasticity

Heteroscedasticity also yields large variances and covariances for the ordinary least squares estimators, hence widening the confidence intervals and making the t-statistic and F-statistic unreliable.

The White's test is used in this paper to detect the presence of heteroscedasticity in the residuals of the regression equations. The White's test statistic is computed by an auxiliary regression where the squared residuals are regressed on the original regressors, their squared values and all possible cross products of the regressors. The White's test statistic is the product: (sample size $\times$ R^2) and it is asymptotically distributed as a chi-square with degrees of freedom equal to the number of regressors (excluding the constant) in the auxiliary equation.[135] The White's test is a test of heteroscedasticity or specification error or both.[136] Hence, an insignificant White's test statistic would imply that the regression equation is correctly specified, has homoscedastic residuals which are also independent of regressors.

The White's test statistic and probability values are shown in *Appendix 6* for the residuals of each 'level' regression equation of each model used in this paper. The results show that ***heteroscedasticity is not a major problem*** since the White's test statistics were mostly insignificant.

Given that heteroscedasticity is not a problem in level regressions, it is highly unlikely that it is a significant problem in regressions using stationary (differenced) variables and hence, regressions carried out in this paper on differenced variables are assumed to generate homoscedastic residuals.

It is important to note that the regression equations with insignificant White's test statistics, imply that ***these regressions are free from simultaneous equations bias*** because the residuals are also independent of regressors.

[135] Gujarati, 1995: 379
[136] Gujarati, 1995: 380

CHAPTER 4

ECONOMETRIC ANALYSIS

The econometric analyses performed in the literature make use of the 2SLS regression technique to test the relationship between budget deficits and interest rates. From the information derived in *Chapter 3*, econometric techniques such as causality tests and 2SLS regressions are performed in this chapter in an attempt to find a possible link between budget deficits and interest rates.

Before attempting any causality tests or regression analyses, the variables used in the analysis are first tested for their order of integration using the unit root test.

4.1 The unit root tests of stationarity

The unit root test of stationarity is used to determine whether a time series is stationary or not.[137] The Augmented Dickey-Fuller (ADF) test is used to check for the presence of unit roots in all of the variables used. The unit root test is applied to each variable to check for the latter's order of integration. The results of the ADF tests on each of the variables used are displayed in *Appendix 1*. The results in *Appendix 1* indicate that all the variables used [except the variable DEF1GNP which is I(2)] are integrated of order 1 [i.e they are all first-difference stationary, I(1)] at the 1% level of significance.

4.2 The Granger causality tests between budget deficit and term structure variables

4.2.1 Description of the Granger-causality tests

The standard Granger-causality test constructs an F-statistic which tests the null hypothesis of the joint insignificance of the coefficients on the lagged deficit variables. If the null hypothesis is rejected (i.e if the F-statistic is significant, with a

[137] Gujarati, 1995: 718

low probability value) then one could infer that budget deficit helps predict the term-structure of interest rates.[138]

The Granger-causality model is estimated at lag lengths of 2, 4, 6 and 8 as follows:

$$\Delta TS_t = \alpha_0 + \sum_{t=i}^{p} \alpha_i \, \Delta TS_{t-i} + \sum_{t=j}^{q} \beta_j \, \Delta DEFICIT_{t-j} + \varepsilon_t$$

where TS is the term-structure variable, DEFICIT is the deficit variable, Δ refers to the first difference operator, and ε_t is the stochastic error term. Only the deficit and term structure variables which are integrated of order 1 [i.e variables which are I(1)] are used, and hence DEF1GNP is excluded from the analysis. Indeed from *Appendix 1* it can be observed that all the variables used are stationary in their 'first difference' form, except for DEF1GNP.

4.2.2 Results of the Granger-causality tests

The results show that tests of reverse causation, i.e from term-structure to deficits are insignificant as shown by the relatively large probability values in the third column of each table in *Appendix 2* (*Appendices 2.1 to 2.9*). Hence, it is clear that term structure does not Granger-cause budget deficits in Mauritius.

On the other hand, the low probability values in the second column of *Appendix 2.4* clearly imply that the direction of causality runs from the "change in net claims of central government as a percentage of GNP" (DEF2GNP) to the "yield spread between the rate on 24-36 months deposit account with commercial banks and the Bank rate" (TS21). The fact that the sum of the coefficients on the lagged values of ΔDEFICIT was positive in each case (in *Appendix 2.4*) shows that an increase in the deficit widens the term-structure of interest rate.

The Granger causality test does not however, provide clear cut proof of the influence of budget deficits on the term structure in Mauritius. The exercises carried out in *Appendix 2* provided a unique case (as observed in the second column of *Appendix 2.4* which shows highly significant F-statistics) in which the budget deficit seemed to

[138] Ewing & Yanochik, 1999: 200

cause a widening of the yield spread between long and short term rates. This brings further proof that the results of such an empirical investigation (on the effects of budget deficits on the term structure of interest rates) would depend upon the definition of the budget deficit, long-term rate and short-term rate variables.

It is therefore difficult to generally state the effects of budget deficits on the term-structure of interest rates in Mauritius, by using the Granger causality tests. However, the latter tests allow one to positively state (for Mauritius) that increases in net claims on central government Granger-causes a widening of the yield spread between the rate on 24-36 months deposits and the Bank rate.

4.3 Regression analysis using 'level' variables

Previous empirical work in the literature on the relationship between budget deficits and interest rates, made use of regression analysis on 'level' variables. This means that the variables used (which are mostly non-stationary) were not made stationary before being used in regression analysis. The same methodology as that used in the literature is followed in this section, i.e regression analysis is made using 'level' variables.

4.3.1 Description of regression analysis using 'level' variables

As mentioned in *Section 3.5.3*, two stage least squares regression is performed to handle the problem of simultaneous equations bias caused by the endogeneity of explanatory variables such as budget deficit (DEF1GNP, DEF2GNP, and DEF3GNP), expected inflation (P^e), and net capital inflows (CAPGNP). Furthermore, as explained in *Section 3.5.5*, the Cochrane-Orcutt two step procedure is used to remedy autocorrelation.

The IS/LM and loanable funds models are used to obtain the 2SLS estimates of the regression of interest rate on the appropriate explanatory variables (discussed in *Chapter 3*) for the each of the (dependent) interest rate variables SR1, SR2, SR3, LR1, LR2, and LR3.

The 2SLS estimates of the regression of the term structure of interest rate on the appropriate explanatory variables are also obtained for the term structure model.

For the IS/LM and loanable funds models, regressions are initially run while excluding the net capital inflows variable (CAPGNP). However 'CAPGNP' is included in another set of regression exercises, and the results compared with the first set of regression estimates to infer about the effects of the 'CAPGNP' variable in the analysis.

4.3.2 The IS/LM model

The IS/LM model shown in *Section 3.3.1* is expressed as follows:

$$\mathbf{i} = \alpha_0 + \alpha_1 \mathbf{D} + \alpha_2 \mathbf{P^e} + \alpha_3 \mathbf{M} + \alpha_4 \mathbf{G} + \alpha_5 \mathbf{t} + \alpha_6 \mathbf{f} + \varepsilon$$

where **i** is the nominal interest rate dependent variable, and ε is the stochastic error term.

Nominal interest rate dependent variables used in the IS/LM model	
SR1	Bank rate
SR2	The rate on 3-months deposit account with commercial banks
SR3	The rate on 6-months deposit account with commercial banks
LR1	The rate on 12-24 months deposit account with commercial banks
LR2	The rate on 24-36 months deposit account with commercial banks
LR3	The rate on (greater than) 48-months deposit account with commercial banks

Explanatory variables used in the IS/LM model	
D	Deficit variable used ["overall budget deficit as a % of GNP" (DEF1GNP) or "Changes in net claims on Central Government as a % of GNP" (DEF2GNP)]
$\mathbf{P^e}$	Expected inflation variable
M	Money supply variable used (M1GNP or M2GNP)
G	Government expenditure variable (GOVGNP)
t	Tax rate variable
f	Net capital inflows variable (CAPGNP)

The results of 2SLS regressions (with Cochrane-Orcutt correction) using the IS/LM model, are shown in *Appendix 3.1*.

Implications of the results for the IS/LM model

The regression results in *Appendix 3.1* (*Appendices 3.1.1 to 3.1.6*) show that most of the variables have insignificant coefficients. However, the few variables which have significant coefficients proved to have the same sign as hypothesised in *Section 3.3.1.* Indeed, in *Appendices 3.1.1 to 3.1.6*, the significant coefficients of the variables **M1GNP** and **t** are negative and those of **GOVGNP** and $\mathbf{P^e}$ are positive as hypothesised.

The 2SLS Cochrane-Orcutt estimates for the regression of short-term nominal interest rate variables (SR1, SR2 and SR3) on the appropriate explanatory variables in *Appendices 3.1.1 to 3.1.3*, produce highly insignificant estimates. These results are consistent with the existing literature about the non-influence of budget deficits on short-term interest rates.

However, the highly insignificant estimates generated from the regressions of long-term nominal interest rate variables (LR1, LR2 and LR3) on the appropriate explanatory variables in *Appendices 3.1.4 to 3.1.6*, are unexpected and do not blend with much of the existing literature about the positive influence of budget deficits on long-term interest rates.

Given that all the regression equations in *Appendices 3.1.1 to 3.1.6* produce insignificant coefficients for the deficit variables [whether "overall budget deficit as a % of GNP" (DEF1GNP) or "changes in net claims on central government as a % of GNP" (DEF2GNP) was used], one might be tempted to conclude that there is no relationship between budget deficits and interest rates (whether short rates or long rates are analysed) in Mauritius.

It is interesting to note however, that the coefficients of the deficit variable "overall budget deficit as a % of GNP" (DEF1GNP) become less and less insignificant (i.e the probability values got smaller and smaller) as the nominal interest rate dependent variable changed from very short-term (*Appendix 3.1.1*) to very long-term (*Appendix 3.1.6*). This indicates that if there was indeed a relationship between budget deficits and interest rate in Mauritius, it is more likely that long-term rates (rather than short-term rates) would be related to deficits. However, the bottom line is that the IS/LM methodology does not provide substantial proof of any possible relationship between budget deficits and interest rates in Mauritius.

4.3.3 The loanable funds model

The loanable funds model shown in *Section 3.3.2* is expressed as follows:

$$\mathbf{i_L} = \beta_0 + \beta_1 \mathbf{D} + \beta_2 \mathbf{P^e} + \beta_3 \mathbf{r_S} + \beta_4 \mathbf{g} + \beta_5 \mathbf{f} + \varepsilon$$

where $\mathbf{i_L}$ is the long-term nominal interest rate dependent variable, and ε is the stochastic error term.

Nominal long-term interest rate dependent variables used in the loanable funds model	
LR1	The rate on 12-24 months deposit account with commercial banks
LR2	The rate on 24-36 months deposit account with commercial banks
LR3	The rate on (greater than) 48-months deposit account with commercial banks

Explanatory variables used in the loanable funds model	
D	Deficit variable used ["overall budget deficit as a % of GNP" (DEF1GNP) or "Changes in net claims on Central Government as a % of GNP" (DEF2GNP)]
$\mathbf{P^e}$	Expected inflation variable
$\mathbf{r_S}$	Ex-ante short-term real interest rate used ($\mathbf{r_{S1}}$, $\mathbf{r_{S2}}$, or $\mathbf{r_{S3}}$)
g	Annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)
f	Net capital inflows variable (CAPGNP)

The results of 2SLS regressions (with Cochrane-Orcutt correction) using the loanable funds model, are shown in *Appendix 3.2*.

<u>Implications of the results for the loanable funds model</u>

The regression results in *Appendix 3.2* show that the coefficients of the deficit variable "overall budget deficit as a % of GNP" (DEF1GNP) become significant (with the ex-ante real short-term interest rate explanatory variable being either $\mathbf{r_{s2}}$ or $\mathbf{r_{s3}}$) as the nominal interest rate dependent variable becomes more and more long-term. For instance, when the "rate on 12-24 months deposit account with commercial banks" LR1 is used as the dependent variable, the DEF1GNP coefficients are insignificant (*Appendix 3.2.1*). However, the DEF1GNP coefficients become more significant (*Appendices 3.2.2 and 3.2.3* respectively) when the "rate on 24-36 months deposit account with commercial banks" LR2 or the "rate on (greater than) 48-months deposit account with commercial banks" LR3 are used as dependent variable.

In each of the equations where the "overall budget deficit as a % of GNP" (DEF1GNP) coefficient is significant, the latter has a positive sign ($i_D > 0$ was hypothesised in *Section 3.3.2*). These findings are consistent with the existing literature in that budget deficits do not influence short-term interest rates, but they clearly indicate that there is indeed a positive relationship between "overall budget deficit as a % of GNP" (DEF1GNP) and the long-term interest rate in Mauritius. However, the fact that coefficients for "overall budget deficit as a % of GNP" (DEF1GNP) are mostly significant while coefficients for "changes in net claims on central government as a % of GNP" (DEF2GNP) are mostly insignificant (with only few exceptions), emphasises the point made in *Section 2.4* that different definitions of the budget deficit might lead to different conclusions about the effects of budget deficits on interest rates.

In all of the regressions in *Appendix 3.2* (*Appendices 3.2.1 to 3.2.3*), the coefficients of the expected inflation variable are highly significant as indicated by their probability values of about zero. These significant expected inflation coefficients are also found to be positive (hence confirming the hypothesis made in *Section 3.3.2* that $i_{P^e} > 0$) and less than unity in all those regressions. This departure from the full Fisher effect (which predicts a coefficient equal to one for expected inflation) highlights the importance of specifying the model with nominal interest rate and expected inflation entered separately (rather than making the assumption that the coefficient is equal to one and hence having one 'lumped' real interest rate variable in the model).

The correct specification of the model in this paper (nominal interest rate and expected inflation separately entered), allows us to avoid the bias that might have been caused by the failure of the full Fisher effect on a model specifying one 'lumped' real interest rate variable.[139]

The significance and signs of both the budget deficit variable (DEF1GNP) and the expected inflation variable (P^e) when the dependent variables LR2 and LR3 are used, imply that budget deficits help raise not only the nominal long-term interest rate in Mauritius, but also the real long-term interest rate.

The regression equations all produce insignificant coefficients for the accelerator term (**g**). This can be explained by the fact that "the link between real investment and the long-term debt issues is too loose to cause a direct and significant impact on interest rates."[140] The net capital inflows (CAPGNP) coefficients are also insignificant in all these regression equations which might indicate that net capital inflows in Mauritius are relatively small and hence have no significant impact on interest rates.

The coefficients of the real short-term interest rate ($\mathbf{r_s}$) are significant in all these regression equations, and their positive signs indicate a significant co-movement between the short-term and long-term interest rates. Hence factors which raise short-term interest rates would also raise long-term rates indirectly.[141] These results are consistent with the theoretical predictions in *Section 3.3.2* of a positive relationship between ex-ante short-term interest rates and nominal long-term interest rates ($i_{rs} > 0$).

4.3.4 The term structure model

The term structure model shown in *Section 3.3.1* is expressed as follows:

$$\mathbf{TS} = \delta_0 + \delta_1 \mathbf{D} + \delta_2 \mathbf{P^e} + \delta_3 \mathbf{M} + \delta_4 \mathbf{g} + \varepsilon$$

where **TS** is the term structure of interest rate dependent variable, and ε is the stochastic error term.

[139] Correira-Nunes & Stemitsiotis, 1995: 432
[140] Hoelscher, 1986: 9
[141] Hoelscher, 1986: 9

Term structure of interest rate dependent variables used in the term structure model	
TS11	The spread between the "rate on 12-24 months deposit account with commercial banks" (LR1) and the "bank rate" (SR1)
TS12	The spread between the "rate on 12-24 months deposit account with commercial banks" (LR1) and the "rate on 3-months deposit account with commercial banks" (SR2)
TS13	The spread between the "rate on 12-24 months deposit account with commercial banks" (LR1) and the "rate on 6-months deposit account with commercial banks" (SR3)
TS21	The spread between the "The rate on 24-36 months deposit account with commercial banks" (LR2) and the "bank rate" (SR1)
TS22	The spread between the "The rate on 24-36 months deposit account with commercial banks" (LR2) and the "rate on 3-months deposit account with commercial banks" (SR2)
TS23	The spread between the "The rate on 24-36 months deposit account with commercial banks" (LR2) and the "rate on 6-months deposit account with commercial banks" (SR3)
TS31	The spread between the "The rate on (greater than) 48-months deposit account with commercial banks" (LR3) and the "bank rate" (SR1)
TS32	The spread between the "The rate on (greater than) 48-months deposit account with commercial banks" (LR3) and the "rate on 3-months deposit account with commercial banks" (SR2)
TS33	The spread between the "The rate on (greater than) 48-months deposit account with commercial banks" (LR3) and the "rate on 6-months deposit account with commercial banks" (SR3)

Explanatory variables used in the term structure model	
D	Deficit variable used ["overall budget deficit as a % of GNP" (DEF1GNP) or "Changes in net claims on Central Government as a % of GNP" (DEF2GNP)]
P^e	Expected inflation variable
M	Money supply variable used (M1GNP or M2GNP)
g	Annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)

The results of 2SLS regressions (with Cochrane-Orcutt correction) using the term structure model, are shown in *Appendix 3.3*.

Implications of the results for the term structure model

The 2SLS Cochrane-Orcutt estimates for the regression of some term structure variables (TS11, TS12, TS13, TS21 and TS31) on the appropriate explanatory variables are highly insignificant and do not provide any information about likely relationships between term structure and budget deficits. However some significant deficit coefficients are generated when *particular* term structure variables are used.

The regression results in *Appendix 3.3* show that the deficit variables (DEF1GNP and DEF2GNP) are significant in almost all of the regression equations (excluding those where the dependent variable is any one of TS11, TS12, TS13, TS21 and TS31). The fact that those significant deficit variables have positive signs ($TS_D > 0$ was hypothesised in *Section 3.3.3*), clearly indicates that budget deficits increase the yield spread between *particular* long-term deposits and short-term deposits in Mauritius.

However, because of the insignificance of the estimates obtained while using any of TS11, TS12, TS13, TS21 and TS31 as dependent variable, one cannot generally conclude that budget deficits increase the yield spread between long-term deposits and short-term deposits in Mauritius. Rather, the findings allow one to positively state that budget deficits increase the yield spread between:

(i) "The rate on 24-36 months deposit account with commercial banks" (LR2) and either of "The rate on 3-months deposit account with commercial banks" (SR2) and "The rate on 6-months deposit account with commercial banks" (SR3), and

(ii) "The rate on (greater than) 48-months deposit account with commercial banks" (LR3) and either of "The rate on 3-months deposit account with commercial banks" (SR2) and "The rate on 6-months deposit account with commercial banks" (SR3).

The money supply variables (M1GNP and M2GNP) are significant in most of the regression equations. The accelerator term (**g**) is insignificant in all of the regression equations in *Appendix 3.3* (*Appendices 3.3.1 to 3.3.9*). Similar results for the variable '**g**' were obtained from the loanable funds model discussed above and a similar conclusion can be suggested, i.e the link between real investment and the long-term debt issues is too loose to cause a direct and significant impact on interest rates. The regression equations all produce insignificant coefficients for the expected inflation coefficients as well.

The fact that the net capital inflows variable (CAPGNP) is insignificant in all of the regressions performed (and on all 3 models), demonstrates that net capital inflows are too small to have any impact on interest rates in Mauritius.

As mentioned in *Chapter 3* the problem arising from the use of 'level' variables in the 2SLS regression analysis is that non-stationary variables might produce spurious regression results, hence making inference inaccurate.

4.3.5 Engle-Granger cointegration tests

As mentioned in *Section 3.5.2*, regression results (from non-stationary variables) may not be spurious if the non-stationary variables are econometrically shown to be cointegrated. Non-stationary variables are said to be cointegrated if they each follow a random walk, but they nevertheless trend together. In other words, their random walks move in unison.[142]

The Engle-Granger cointegration test is based on the idea that variables are cointegrated if the residuals of the multiple regression are I(0), i.e the residuals are stationary.[143] The hypotheses of the Engle-Granger cointegration tests are as follows:

H_0: The variables are <u>not</u> cointegrated (i.e regression results might be spurious)

H_1: The variables are cointegrated (i.e regression results are not spurious)

The residuals of the level regression are tested for stationarity by comparing the Augmented Dickey Fuller (ADF) statistic of the level residuals with the asymptotic critical values for cointegration tests[144] and the null hypothesis is either rejected or accepted based on those critical values.

If the regression residuals are found to be stationary (i.e high significance or low probability values of the ADF statistic and therefore the null hypothesis is rejected), the variables can be referred to as being cointegrated, meaning that the multiple regression results are not spurious. On the other hand, one could conclude that the

[142] Gujarati, 1995: 725
[143] Davidson & MacKinnon, 1993: 720
[144] Harris, 1995: 158

multiple regression results might be spurious and unreliable, should the regression residuals be found to be non-stationary (i.e low significance or high probability values of the ADF statistic and therefore the null hypothesis cannot be rejected).

The Engle-Granger cointegration tests are carried out in *Appendix 7* only on residuals generated from regressions using variables that are integrated of the first order.[145] The results indicate that most of the level regression equations are not cointegrated, meaning that most of those level regression equations generated results that might be spurious and unreliable.

4.4 Regression analysis using 'stationary' variables

In this section, regression analysis is made using stationary variables (i.e the variables in their differenced form), and the results compared to those of the 'level' regressions. As explained in *Section 3.5.2*, the above methodology using 'level' variables in regression analysis (extensively used in the literature) might produce spurious results, unless the researchers were to prove that the variables they used are cointegrated. If the 'non-stationary' variables are not cointegrated, the possibility of spuriousness of the regression results cannot be discarded and hence the standard t and F statistics may be unreliable.[146] This section of the paper makes use of stationary variables in regression analysis to avoid the problem of spuriousness and to generate results with more reliable t and F statistics.

4.4.1 Description of regression analysis using 'stationary' variables

As mentioned in *Section 3.5.4*, all the I(1) variables (according to *Appendix 1*) are differenced until they become stationary. The variables preceded by the notation Δ, illustrate the number of times the variable was differenced to become stationary. For instance the deficit variable DEF2GNP being I(1), was differenced once to become ΔDEF2GNP, and the variable DEF1GNP being I(2), was differenced twice to become the stationary variable ΔΔDEF1GNP. Two stage least squares regression is performed to handle the problem of simultaneous equations bias caused by the endogeneity of

[145] Hence, regressions using variable DEF1GNP are not tested because that variable is not I(1) as shown in *Chapter 4*.
[146] Gujarati, 1995: 725

explanatory variables such as budget deficit (ΔΔDEF1GNP, ΔDEF2GNP, and ΔDEF3GNP), expected inflation (ΔP^e), and net capital inflows (ΔCAPGNP).

The IS/LM and loanable funds models are used to obtain the 2SLS estimates of the regression of the first-differenced interest rate variable on the appropriate differenced explanatory variables (discussed in *Chapter 3*) for the each of the (dependent) interest rate variables SR1, SR2, SR3, LR1, LR2, and LR3. The 2SLS estimates of the regression of the first-differenced term structure variables on the appropriate differenced explanatory variables are also obtained for the term structure model.

4.4.2 The IS/LM model

The differenced version of the IS/LM model shown in *Section 3.3.1* is expressed as follows: $\Delta \mathbf{i} = \alpha_0 + \alpha_1 \Delta \mathbf{D} + \alpha_2 \Delta \mathbf{P}^e + \alpha_3 \Delta \mathbf{M} + \alpha_4 \Delta \mathbf{G} + \alpha_5 \Delta \mathbf{t} + \alpha_6 \Delta \mathbf{f} + \varepsilon$

where $\Delta \mathbf{i}$ is the differenced nominal interest rate dependent variable, and ε is the stochastic error term.

The differenced nominal interest rate dependent variables used in the IS/LM model	
ΔSR1	First difference of Bank rate
ΔSR2	First difference of the rate on 3-months deposit account with commercial banks
ΔSR3	First difference of the rate on 6-months deposit account with commercial banks
ΔLR1	First difference of the rate on 12-24 months deposit account with commercial banks
ΔLR2	First difference of the rate on 24-36 months deposit account with commercial banks
ΔLR3	First difference of the rate on (greater than) 48-months deposit account with commercial banks

Explanatory variables used in the IS/LM model	
ΔD	The differenced deficit variable used (ΔΔDEF1GNP or ΔDEF2GNP)
ΔP^e	The differenced expected inflation variable
ΔM	The differenced money supply variable used (ΔM1GNP or ΔM2GNP)
ΔG	The differenced government expenditure variable (ΔGOVGNP)
Δt	The differenced tax rate variable
Δf	The differenced net capital inflows variable (ΔCAPGNP)

The results of 2SLS regressions using the IS/LM model, are shown in *Appendix 4.1.*

Implications of the results for the IS/LM model

The regression results in *Appendix 4.1* show that all of the regression equations have insignificant F-statistics and hence the regression coefficients are insignificant.

4.4.3 The loanable funds model

The differenced version of the loanable funds model shown in *Section 3.3.2* is expressed as follows: $\Delta \mathbf{i}_L = \beta_0 + \beta_1 \Delta \mathbf{D} + \beta_2 \Delta \mathbf{P}^e + \beta_3 \Delta \mathbf{r}_S + \beta_4 \Delta \mathbf{g} + \beta_5 \Delta \mathbf{f} + \varepsilon$

where $\Delta \mathbf{i}_L$ is the differenced long-term nominal interest rate dependent variable, and ε is the stochastic error term.

The differenced long-term nominal interest rate dependent variables used in the loanable funds model	
ΔLR1	First difference of the rate on 12-24 months deposit account with commercial banks
ΔLR2	First difference of the rate on 24-36 months deposit account with commercial banks
ΔLR3	First difference of the rate on (greater than) 48-months deposit account with commercial banks

Explanatory variables used in the loanable funds model	
ΔD	The differenced deficit variables used (ΔΔDEF1GNP or ΔDEF2GNP)
$\Delta \mathbf{P}^e$	The differenced expected inflation variable
$\Delta \mathbf{r}_S$	The differenced ex-ante short-term real interest rate used ($\Delta \mathbf{r}_{S1}$, $\Delta \mathbf{r}_{S2}$ or $\Delta \mathbf{r}_{S3}$)
Δg	The differenced annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)
Δf	The differenced net capital inflows variable (ΔCAPGNP)

The results of 2SLS regressions using the loanable funds model, are shown in *Appendix 4.2*.

Implications of the results for the loanable funds model

The regression results in *Appendix 4.2*, show only a handful of the regression equations with significant F statistics. Those significant regression equations however yield insignificant coefficients for the deficit variables (ΔΔDEF1GNP and ΔDEF2GNP). This implies the absence of any relationship between budget deficits and long-term interest rates.

In those significant regression equations, the coefficients of the (differenced) expected inflation variable are also significant as indicated by their low probability values. These significant (differenced) expected inflation coefficients were also found to be positive (hence confirming the hypothesis made in *Section 3.3.2* that $i_{P^e} > 0$).

The significant regression equations all produce insignificant coefficients for the differenced accelerator term (Δg). This result is similar to the one obtained using 'level' variables and is explained similarly, i.e the link between real investment and the long-term debt issues is too loose to cause a direct and significant impact on interest rates. The differenced net capital inflows (ΔCAPGNP) coefficients are also insignificant in all those significant regression equations which indicate that net capital inflows in Mauritius are too small to have a significant impact on interest rates.

The coefficients of the differenced real short-term interest rate (Δr_S) are significant in most of these significant regression equations, and their positive sign indicate a significant co-movement between the short-term and long-term interest rates. These results are consistent with the theoretical predictions in *Section 3.3.2* of a positive relationship between ex-ante short-term interest rates and nominal long-term interest rates ($i_{rs} > 0$).

4.4.4 The term structure model

The differenced version of the term structure model shown in *Section 3.3.1* is expressed as follows: $\mathbf{\Delta TS = \delta_0 + \delta_1\, \Delta D + \delta_2\, \Delta P^e + \delta_3\, \Delta M + \delta_4\, \Delta g + \varepsilon}$

where $\mathbf{\Delta TS}$ is the differenced term structure of interest rate variable, and ε is the stochastic error term.

Explanatory variables used in the term structure model	
ΔD	The differenced deficit variable used (ΔΔDEF1GNP or ΔDEF2GNP)
$\mathbf{\Delta P^e}$	The differenced expected inflation variable
ΔM	The differenced money supply variable used (ΔM1GNP or ΔM2GNP)
Δg	The differenced annual growth rate of real GDP (proxying for the accelerator effects of the business cycle on investment and consumption of durables)

The results of 2SLS regressions using the term structure model, are shown in *Appendix 4.3*.

Implications of the results for the term structure model

The regression results in *Appendix 4.3* show that all of the regression equations have insignificant F-statistics and hence the regression coefficients are insignificant.

4.5 Regressions using the (test) budget deficit variable DEF3GNP

Regression analysis using the (test) budget deficit variable DEF3GNP "net domestic financing of the budget deficit as a % of GNP" is also performed on all three models discussed and on both 'level' and 'stationary' variables. These *test* regressions (as explained in *Section 3.4.1*) are made to assess the reliability of the conclusions reached while using the budget deficit variables DEF1GNP and DEF2GNP.

The results from 'level' and 'stationary' models using the *test* explanatory budget deficit variable "net domestic financing of the budget deficit as a % of GNP" (DEF3GNP) are shown in *Appendix 10.1* and *Appendix 10.2* respectively. These results strongly support the conclusions reached while using budget deficit explanatory variables DEF1GNP and DEF2GNP. Based on the above, it is therefore legitimate to use DEF1GNP and DEF2GNP as budget deficit variables in the analysis.

4.6 Summary and implications of the empirical analyses

A comparison of the results obtained in *Section 4.3* (where regression analysis was performed on 'level' variables) and in *Section 4.4* [where regression analysis was performed on 'differenced' (i.e stationary) variables] reveals that different conclusions can be reached depending on the econometric methodology used.

The available literature on the subject, involves the use of regression analysis on 'level' variables. The same methodology as used in the literature was applied in *Section 4.3* of this paper, with very much the same conclusions as those obtained in previous work on the subject.

Model	**Main weakness**	**Evidence of a positive relationship between budget deficits and the term structure**	**Appendix (Pages)**
IS/LM with 'level' variables	Variables are not cointegrated and hence inferences may not be reliable	NO	3.1.1 - 3.1.6 (89-90)
Loanable funds with 'level' variables	Variables are not cointegrated and hence inferences may not be reliable	YES	3.2.1 - 3.2.3 (91-92)
Term structure with 'level' variables	Variables are not cointegrated and hence inferences may not be reliable	YES	3.3.1 - 3.3.9 (93– 94)
IS/LM with 'differenced' variables	Differencing may result in the loss of long-run properties of the variables and hence model may not have a long run solution	NO	4.1.1 - 4.1.6 (95- 96)
Loanable funds with 'differenced' variables	Differencing may result in the loss of long-run properties of the variables and hence model may not have a long run solution	NO	4.2.1 - 4.2.3 (97)
Term structure with 'differenced' variables	Differencing may result in the loss of long-run properties of the variables and hence model may not have a long run solution	NO	4.3.1 - 4.3.9 (98-99)
Granger causality tests	Only one out of the eight tests provided significant causality from deficits to the term structure of interest rates	YES	2.1 - 2.9 (87- 88)

The IS/LM approach did not allow for the rejection of the Ricardian Equivalence Hypothesis for Mauritius.

On the other hand, the empirical evidence presented in *Appendix 3.2 and 3.3* in the form of the loanable funds model and the term structure model clearly reject the Ricardian view. Indeed, the latter two approaches provide substantial evidence about the positive relationship between budget deficits and the term structure of interest rates in Mauritius (i.e the slope of the yield curve rises with larger budget deficits). This inference (which is similar to that obtained in the literature) is however criticised as possibly being unreliable on the basis of spuriousness of the level regression results. Indeed, the absence of cointegration among the level variables (as shown by the Engle-Granger cointegration tests carried out in *Section 4.3.5*) prevents us from discarding the possibility of spuriousness of the level regression results.

The problem of spuriousness of regression was circumvented by making the variables stationary in *Section 4.4* before making any regression analyses. The regressions on 'differenced' variables, produced mostly insignificant regression equations (low F statistics and high probability values) as shown in *Appendices 4.1 to 4.3.* The few significant regression equations all came from the loanable funds model, which however showed insignificant coefficients for the deficit variables hence implying the absence of any relationship between budget deficits and long-term interest rates. This inference contradicts the one made in *Section 4.3* where 'level' variables were used.

The problem with this 'differencing' methodology however, is that while applying first differences to the variables to make them stationary, long-run properties of those variables are lost because the model in differences may not have a long run solution.[147] This might explain the rejection of the relationship between budget deficits and long-term interest rates, when the 'differenced' variables are used in regression analysis in *Section 4.4.*

The Granger causality tests performed in *Section 4.2* might be used to arbitrate in the above empirical conflict. Those causality tests provide a unique case (of budget deficit causing the term structure of interest rates to rise) in which it is observed that increases in net claims on central government widen the yield spread between the rate on 24-36 months deposits and the Bank rate. The Granger tests also clearly show that causality does not run from term structure to budget deficits. This unique case (out of the eight Granger tests conducted on causality from budget deficits to term structure) show that the Granger causality test does not provide overwhelming evidence of the influence of budget deficits on the term structure in Mauritius. Indeed, the outcome of the Granger tests carried out here, depends upon the definition of the budget deficit, long-term rate and short-term rate variables. Hence the Granger causality test used here, is only a weak 'arbitrator' but it nevertheless helps us not to reject the conclusions of the analyses using 'level' variables.

[147] Charemza & Deadman, 1997: 122

CHAPTER 5

CONCLUSIONS

Theoretical predictions on the effects of budget deficits on the term structure of interest rates, show that long-term interest rates rise (and short-term rates remain unaffected) with an increase in the budget deficit. In other words, a rise in the budget deficit is expected to raise the term structure of interest rate and make the yield curve steeper.

The empirical evidence presented in this paper provide divergent answers for the different methodologies and models used in regression analysis, but one could conclude from this study that there might be a positive relationship between budget deficits and the term structure of interest rates in Mauritius.

When using 'level' variables all regression results, except those of the IS/LM model, reject the Ricardian view. Indeed the loanable funds and term structure models provide significant evidence of a positive relationship between budget deficits and the term structure of interest rates. This inference is criticised in this paper as possibly being unreliable on the basis of the absence of cointegration of all the 'level' variables used. This is supported by the Engle-Granger cointegration tests carried out in this paper, which indicate the absence of cointegration in the 'level' regression models.

The regression results using the 'differenced' variables produce only a handful of significant regression equations which however show insignificant coefficients for the deficit variables, hence implying the absence of any relationship between budget deficits and long-term interest rates. This inference, which is opposite to the one made using 'level' variables, is criticised in this paper on the basis that long-run properties of the variables used might have been lost while making the variables stationary, because the model in differences may not have a long run solution.

The 'arbitrator' in the above empirical conflict might well be the Granger causality tests. Those causality tests however only provide a unique case (out of the eight Granger tests conducted in this paper on causality from budget deficits to term structure) in which it is observed that increases in net claims on central government widen the yield spread between the rate on 24-36 months deposits and the Bank rate. Hence the Granger causality test used here, is only a weak 'arbitrator' but it nevertheless helps us not to reject the conclusions reached while using 'level' variables.

Hence, one could hesitantly conclude that there might be a positive relationship between budget deficits and the term structure of interest rates. In other words, larger budget deficits widen the term structure of interest rates and therefore makes the yield curve steeper. This conclusion, if correct, suggests that larger budget deficits would force private investors to borrow in short-term markets for funds, hence reducing private long-term capital spending. Those adverse effects of a steeper yield curve caused by larger budget deficits, may thus hinder long-term economic growth in Mauritius.

However, the overall budget deficit (as a percentage of GNP) in Mauritius has remained below 4% (which is relatively small by developing countries' standards) since 1985, which means that there is presently no real exposure to those adverse effects.

Nevertheless, should the Mauritian government lose control of budget deficits in the future, the accompanying rise in long-term interest rates might cause the crowding-out of private capital expenditure which would generate a smaller future private capital stock. Assuming that government capital expenditure is less efficient than private capital expenditure, the smaller future private capital stock would lower future output and hence lower future real incomes and consumption.

In summary, the threat of a drop in living standards might materialise if the Mauritian government does not maintain budget deficits to a reasonable level.

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International Financial Statistics (IFS)

South African Reserve Bank (RBQN)

World Development Indicators (WDI)

APPENDIX 1

ADF test results on each of the variables used in regression analysis

[Significance at the 5% level (*) and the 1% level (**) are based on the MacKinnon critical values]

Variables	Levels	First Differences
DEF1GNP	-1.649499	-2.879530
DEF2GNP	-2.174082	-5.319937**
DEF3GNP	-1.850258	-5.183304**
CAPGNP	-2.778368	-3.458135**
P^e	-3.280580	-5.467387**
INFL	-3.238912	-4.522321**
GOVGNP	-3.063431	-5.013951**
g	-3.483336	-6.528298**
LR1	-1.680237	-4.763946**
LR2	-1.843992	-4.455854**
LR3	-1.907924	-4.360047**
M1GNP	-0.439326	-3.789501**
M2GNP	0.519781	-4.384679**
RMGNP	-2.686870	-4.376062**
SR1	-1.404224	-4.448417**
SR2	-1.483486	-4.216481**
SR3	-1.517712	-4.252143**
t	-1.322957	-5.020953**
r_{S1} (SR1 - P^e)	-2.728550	-6.907902**
r_{S2} (SR2 - P^e)	-2.695770	-5.812913**
r_{S3} (SR3 - P^e)	-2.681035	-5.757176**
TS11 (LR1 - SR1)	-2.274782	-4.923086**
TS12 (LR1 - SR2)	-2.034063	-6.320596**
TS13 (LR1 - SR3)	-2.047460	-5.660297**
TS21 (LR2 - SR1)	-2.499789	-5.436363**
TS22 (LR2 - SR2)	-1.118360	-7.029065**
TS23 (LR2 - SR3)	-1.194756	-5.012564**
TS31 (LR3 - SR1)	-2.512214	-4.969414**
TS32 (LR3 - SR2)	-1.705981	-4.930586**
TS33 (LR3 - SR3)	-1.547250	-5.694829**

APPENDIX 2

Granger-causality test results: independent variable → dependent variable

Appendix 2.1

Lags	DEF2GNP → TS11 F-statistic (Probability)	TS11 → DEF2GNP F-statistic (Probability)
(2,2)	5.207085 (0.003646)	2.253147 (0.093202)
(4,4)	2.386769 (0.059762)	0.906370 (0.532410)
(6,6)	1.808889 (0.159041)	0.709404 (0.719389)
(8,8)	2.881294 (0.098650)	0.868663 (0.621285)

Appendix 2.2

Lags	DEF2GNP → TS12 F-statistic (Probability)	TS12 → DEF2GNP F-statistic (Probability)
(2,2)	1.477087 (0.240287)	4.855096 (0.005178)
(4,4)	1.645112 (0.180879)	2.331684 (0.064757)
(6,6)	1.525311 (0.237727)	1.971000 (0.127032)
(8,8)	1.348622 (0.375669)	2.790162 (0.105477)

Appendix 2.3

Lags	DEF2GNP → TS13 F-statistic (Probability)	TS13 → DEF2GNP F-statistic (Probability)
(2,2)	0.312701 (0.866634)	4.139093 (0.010879)
(4,4)	1.211993 (0.346422)	2.257365 (0.072211)
(6,6)	0.934344 (0.545853)	1.711274 (0.182446)
(8,8)	0.841288 (0.639090)	4.015971 (0.047345)

Appendix 2.4

Lags	DEF2GNP → TS21 F-statistic (Probability)	TS21 → DEF2GNP F-statistic (Probability)
(2,2)	5.340916 (0.003198)	1.951500 (0.134426)
(4,4)	4.393466 (0.004359)	1.038786 (0.444294)
(6,6)	4.214803 (0.009439)	0.719767 (0.711098)
(8,8)	4.696929 (0.032693)	0.866578 (0.622628)

Appendix 2.5

Lags	DEF2GNP → TS22 F-statistic (Probability)	TS22 → DEF2GNP F-statistic (Probability)
(2,2)	1.898176 (0.143473)	2.784743 (0.049507)
(4,4)	1.238476 (0.333204)	1.050182 (0.437239)
(6,6)	0.756599 (0.681683)	0.885880 (0.581407)
(8,8)	0.838503 (0.640923)	1.063180 (0.506425)

Appendix 2.6

Lags	DEF2GNP → TS23 F-statistic (Probability)	TS23 → DEF2GNP F-statistic (Probability)
(2,2)	0.325720 (0.857918)	2.227978 (0.096078)
(4,4)	0.325836 (0.945178)	0.940169 (0.508882)
(6,6)	0.293984 (0.978213)	0.844864 (0.612488)
(8,8)	0.188264 (0.996529)	0.664635 (0.760904)

Appendix 2.7

Lags	DEF2GNP → TS31 F-statistic (Probability)	TS31 → DEF2GNP F-statistic (Probability)
(2,2)	3.459549 (0.022848)	2.098028 (0.112459)
(4,4)	2.513403 (0.049767)	1.407401 (0.259091)
(6,6)	1.380157 (0.292733)	0.777856 (0.664803)
(8,8)	8.584505 (0.007049)	0.510284 (0.867811)

Appendix 2.8

Lags	DEF2GNP → TS32 F-statistic (Probability)	TS32 → DEF2GNP F-statistic (Probability)
(2,2)	1.821208 (0.157636)	3.266151 (0.028412)
(4,4)	1.535618 (0.213520)	1.355121 (0.280216)
(6,6)	1.096644 (0.437831)	0.933220 (0.546662)
(8,8)	0.943002 (0.574896)	0.699165 (0.736461)

Appendix 2.9

Lags	DEF2GNP → TS33 F-statistic (Probability)	TS33 → DEF2GNP F-statistic (Probability)
(2,2)	1.851924 (0.151821)	2.612084 (0.060674)
(4,4)	1.762650 (0.151365)	1.402770 (0.260900)
(6,6)	1.632707 (0.203945)	1.246088 (0.354630)
(8,8)	1.933218 (0.213133)	4.317668 (0.039962)

APPENDIX 3.1

2SLS Cochrane-Orcutt estimates (Probabilities in brackets) for the 'level' nominal interest rates using the IS/LM model

Appendix 3.1.1

2SLS Cochrane-Orcutt estimates for 'level' short-term nominal interest rate (SR1) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
15.22305	0.160790		0.054289	-0.391294		0.269601	-0.202456		0.682073	10.29781
(0.0041)	(0.1599)		(0.2034)	(0.0020)		(0.3591)	(0.2325)			(0.00002)
8.137505	0.158616		0.047707	-0.198631		0.262677	-0.269894	1.221915	0.449724	3.132871
(0.0207)	(0.2526)		(0.2689)	(0.1861)		(0.3879)	(0.1780)	(0.1435)		(0.02152)
8.628298	0.179971		0.060083		0.044981	0.197344	-0.393004		0.390588	3.076444
(0.1363)	(0.2085)		(0.1976)		(0.2776)	(0.5546)	(0.0568)			(0.02763)
8.032734	0.183640		0.060410		0.017586	0.197248	-0.395983	1.444759	0.411788	2.683591
(0.0990)	(0.1983)		(0.1699)		(0.6953)	(0.5288)	(0.0475)	(0.1089)		(0.04009)
7.965539		-0.15381	0.121566	-0.411113		0.757790	-0.111627		0.675122	9.974755
(0.0424)		(0.1346)	(0.0161)	(0.0012)		(0.0058)	(0.4696)			(0.00003)
6.647861		-0.12706	0.115011	-0.376126		0.742322	-0.099272	0.650226	0.663543	7.559892
(0.0959)		(0.2382)	(0.0240)	(0.0044)		(0.0078)	(0.5334)	(0.4023)		(0.00015)
4.706232		-0.11415	0.104044		0.034486	0.478352	-0.304088		0.314442	2.201591
(0.2641)		(0.2829)	(0.0515)		(0.4417)	(0.1163)	(0.1128)			(0.08752)
6.845957		-0.13965	0.155829		0.027121	0.825274	-0.386820	1.043812	0.584614	5.395034
(0.4944)		(0.3285)	(0.0143)		(0.5103)	(0.0240)	(0.0619)	(0.2725)		(0.00132)

Appendix 3.1.2

2SLS Cochrane-Orcutt estimates for 'level' short-term nominal interest rate (SR2) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
12.70516	0.065425		0.056787	-0.358678		0.237957	-0.261569		0.578591	6.590371
(0.0076)	(0.6122)		(0.2134)	(0.0118)		(0.4548)	(0.1825)			(0.00054)
7.927835	0.050471		0.049471	-0.239015		0.230531	-0.245184	1.045367	0.440312	3.015720
(0.0265)	(0.7194)		(0.2634)	(0.1237)		(0.4586)	(0.2309)	(0.2190)		(0.02526)
8.171282	0.085486		0.067157		0.052405	0.171235	-0.399677		0.403923	3.252652
(0.1719)	(0.5559)		(0.1635)		(0.2200)	(0.6185)	(0.0596)			(0.02208)
7.304809	0.084166		0.065459		0.030567	0.165948	-0.380447	1.247075	0.401920	2.576067
(0.1507)	(0.5618)		(0.1524)		(0.5098)	(0.6091)	(0.0643)	(0.1770)		(0.04668)
10.05690		-0.137353	0.105974	-0.378384		0.525033	-0.222233		0.622937	7.929957
(0.0087)		(0.1884)	(0.0417)	(0.0057)		(0.0634)	(0.1955)			(0.00016)
9.024671		-0.107519	0.101064	-0.343261		0.513467	-0.211288	0.701876	0.627257	6.450797
(0.0209)		(0.3281)	(0.0534)	(0.0157)		(0.0716)	(0.2230)	(0.4002)		(0.00043)
5.056925		-0.084438	0.091658		0.048862	0.313840	-0.321897		0.335824	2.427005
(0.2397)		(0.4260)	(0.0845)		(0.2761)	(0.2968)	(0.0946)			(0.06467)
12.70396		-0.100055	0.148794		0.018202	0.567681	-0.528496	1.165135	0.621395	6.291544
(0.1919)		(0.4817)	(0.0207)		(0.6662)	(0.1134)	(0.0149)	(0.2344)		(0.00051)

Appendix 3.1.3

2SLS Cochrane-Orcutt estimates for 'level' short-term nominal interest rate (SR3) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
12.29956	0.049889		0.056551	-0.363121		0.254374	-0.246054		0.574361	6.477161
(0.0079)	(0.6973)		(0.2099)	(0.0105)		(0.4196)	(0.2062)			(0.00061)
7.875493	0.026119		0.047346	-0.267041		0.255985	-0.217314	0.743763	0.431055	2.904280
(0.0267)	(0.8520)		(0.2825)	(0.0868)		(0.4098)	(0.2855)	(0.3767)		(0.02945)
8.016312	0.070379		0.067696		0.053092	0.189476	-0.389110		0.404976	3.266898
(0.1755)	(0.6248)		(0.1569)		(0.2108)	(0.5786)	(0.0642)			(0.02169)
6.830980	0.062751		0.065131		0.037941	0.188558	-0.357752	0.935840	0.380656	2.356013
(0.1770)	(0.6670)		(0.1561)		(0.4179)	(0.5631)	(0.0821)	(0.3096)		(0.06392)
10.11950		-0.113968	0.095353	-0.377453		0.479160	-0.214476		0.601449	7.243617
(0.0067)		(0.2678)	(0.0637)	(0.0063)		(0.0895)	(0.2143)			(0.00029)
9.425420		-0.095137	0.091719	-0.352647		0.470048	-0.208446	0.453287	0.598497	5.714134
(0.0139)		(0.3858)	(0.0789)	(0.0156)		(0.1014)	(0.2360)	(0.5908)		(0.00093)
4.711929		-0.058258	0.081084		0.052893	0.281999	-0.295347		0.315219	2.209542
(0.2445)		(0.5739)	(0.1172)		(0.2407)	(0.3392)	(0.1182)			(0.08659)
13.85401		-0.079894	0.141289		0.019626	0.508905	-0.539848	0.932082	0.600590	5.764151
(0.1560)		(0.5786)	(0.0300)		(0.6494)	(0.1603)	(0.0148)	(0.3492)		(0.00088)

Appendix 3.1.4

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR1) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
9.505728	0.007609		0.058346	-0.254551		0.359057	-0.171798		0.428208	3.594660
(0.0308)	(0.9519)		(0.1884)	(0.0598)		(0.2496)	(0.3657)			(0.01441)
5.652436	-0.012266		0.056725	-0.126382		0.389604	-0.171610	1.265627	0.371614	2.266952
(0.0875)	(0.9252)		(0.1735)	(0.3738)		(0.1866)	(0.3655)	(0.1149)		(0.07268)
4.706219	0.006782		0.065731		0.049442	0.362645	-0.220678		0.319474	2.253372
(0.3705)	(0.9593)		(0.1349)		(0.2080)	(0.2511)	(0.2430)			(0.08162)
5.274798	0.019098		0.066671		0.023225	0.359020	-0.239999	1.339751	0.382675	2.376251
(0.2829)	(0.8825)		(0.1142)		(0.5721)	(0.2349)	(0.1905)	(0.1113)		(0.06209)
7.146508		-0.116385	0.085437	-0.242776		0.505909	-0.161743		0.409196	3.324523
(0.0258)		(0.2329)	(0.0824)	(0.0685)		(0.0699)	(0.3423)			(0.02017)
5.983480		-0.073560	0.078136	-0.171899		0.478888	-0.166546	1.051661	0.429005	2.880091
(0.0503)		(0.4629)	(0.1046)	(0.2169)		(0.0824)	(0.3238)	(0.2025)		(0.03046)
2.980357		-0.073580	0.078348		0.046004	0.410367	-0.183120		0.261809	1.702381
(0.3878)		(0.4367)	(0.0972)		(0.2780)	(0.1335)	(0.2843)			(0.17244)
8.031306		-0.038548	0.104796		0.017072	0.483895	-0.310404	1.383638	0.501128	3.850671
(0.2556)		(0.7424)	(0.0559)		(0.6552)	(0.1142)	(0.0906)	(0.1181)		(0.00835)

Appendix 3.1.5

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR2) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
7.050221	0.096157		0.036087	-0.275415		0.381717	-0.102436		0.373772	2.864939
(0.0514)	(0.4609)		(0.3919)	(0.0477)		(0.2067)	(0.5897)			(0.03630)
5.941538	0.097453		0.037974	-0.214268		0.380316	-0.114335	0.730238	0.358710	2.144202
(0.0775)	(0.4654)		(0.3642)	(0.1437)		(0.2037)	(0.5508)	(0.3617)		(0.08683)
7.189779	0.123762		0.051810		0.022694	0.282873	-0.290774		0.264738	1.728284
(0.1690)	(0.3779)		(0.2474)		(0.5767)	(0.3807)	(0.1404)			(0.16646)
7.837079	0.135984		0.052762		-0.000758	0.278096	-0.313656	1.156739	0.314160	1.755924
(0.1257)	(0.3277)		(0.2296)		(0.9862)	(0.3786)	(0.1089)	(0.1904)		(0.15311)
5.047896		-0.073433	0.067652	-0.305924		0.611093	-0.039544		0.396359	3.151743
(0.1049)		(0.4536)	(0.1706)	(0.0280)		(0.0344)	(0.8189)			(0.02510)
4.627490		-0.051665	0.064322	-0.272939		0.595803	-0.042540	0.513908	0.400314	2.558899
(0.1443)		(0.6224)	(0.1983)	(0.0662)		(0.0418)	(0.8080)	(0.5466)		(0.04783)
3.494643		-0.029607	0.058100		0.018526	0.368479	-0.155540		0.162338	0.930238
(0.2656)		(0.7534)	(0.2127)		(0.6785)	(0.1788)	(0.3677)			(0.47894)
9.866952		-0.021855	0.113878		-0.005200	0.620402	-0.369948	1.197034	0.420213	2.778289
(0.2561)		(0.8752)	(0.0751)		(0.9062)	(0.0869)	(0.0851)	(0.2399)		(0.03510)

Appendix 3.1.6

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR3) using IS/LM model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
9.545956	0.172048		0.046803	-0.296332		0.371672	-0.184540		0.441064	3.787742
(0.0309)	(0.2267)		(0.3230)	(0.0493)		(0.2693)	(0.3777)			(0.01138)
6.685239	0.161321		0.046468	-0.181233		0.369989	-0.192564	1.137480	0.382999	2.379517
(0.0627)	(0.2711)		(0.3060)	(0.2519)		(0.2515)	(0.3578)	(0.1948)		(0.06180)
9.784361	0.202410		0.061738		0.023398	0.268497	-0.394864		0.339738	2.469845
(0.1292)	(0.1861)		(0.2199)		(0.5933)	(0.4584)	(0.0741)			(0.06107)
8.528078	0.192709		0.059158		-0.004468	0.278272	-0.368965	1.521346	0.361303	2.168465
(0.1046)	(0.1981)		(0.2027)		(0.9241)	(0.4029)	(0.0772)	(0.1088)		(0.08383)
5.958787		-0.070413	0.090291	-0.342678		0.729160	-0.077069		0.451194	3.946255
(0.1240)		(0.5368)	(0.1146)	(0.0254)		(0.0257)	(0.6901)			(0.00941)
4.837680		-0.036658	0.079701	-0.274165		0.681990	-0.076795	0.866773	0.432779	2.924765
(0.1884)		(0.7556)	(0.1566)	(0.0898)		(0.0363)	(0.6923)	(0.3610)		(0.02863)
4.351936		-0.040071	0.077897		0.021464	0.476765	-0.219326		0.210922	1.283045
(0.3058)		(0.7157)	(0.1553)		(0.6525)	(0.1346)	(0.2699)			(0.30374)
9.651501		0.002097	0.126724		-0.002332	0.694973	-0.402214	1.452077	0.454293	3.191191
(0.2891)		(0.9887)	(0.0645)		(0.9608)	(0.0732)	(0.0804)	(0.1853)		(0.01988)

APPENDIX 3.2

2SLS Cochrane-Orcutt estimates (Probabilities in brackets) for the level nominal interest rates using the loanable funds model

Appendix 3.2.1

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR1) using loanable funds model

CONSTANT	DEF1GNP	DEF2GNP	P^e	r_{S1}	r_{S2}	r_{S3}	g	CAPGNP	R^2	F-Statistic
1.967036 (0.0341)	-0.071499 (0.1463)		0.863878 (0.0000)	0.839670 (0.0000)			-0.004488 (0.9002)		0.854535	36.71573 (0.00000)
2.109002 (0.0145)	-0.061114 (0.3293)		0.780489 (0.0000)	0.754787 (0.0000)			-0.021671 (0.5418)	0.393661 (0.4643)	0.797278	18.87780 (0.00000)
2.506448 (0.0000)	0.034680 (0.3524)		0.816243 (0.0000)		0.807255 (0.0000)		0.027538 (0.2742)		0.913913	66.35123 (0.00000)
2.171604 (0.0001)	0.032926 (0.4632)		0.786760 (0.0000)		0.774324 (0.0000)		0.012705 (0.6033)	0.286971 (0.4475)	0.886456	37.47426 (0.00000)
1.972884 (0.0002)	0.030475 (0.4385)		0.815289 (0.0000)			0.806459 (0.0000)	0.012372 (0.5809)		0.901594	57.26255 (0.00000)
1.878520 (0.0003)	0.045548 (0.2646)		0.783897 (0.0000)			0.771581 (0.0000)	0.011585 (0.5954)	0.475356 (0.1583)	0.907429	47.05183 (0.00000)
1.873906 (0.0431)		0.011901 (0.8411)	0.821201 (0.0000)	0.823647 (0.0000)			0.003798 (0.9151)		0.823992	29.25969 (0.00000)
1.902113 (0.0401)		0.051822 (0.4084)	0.769669 (0.0000)	0.766548 (0.0000)			0.002388 (0.9456)	0.753630 (0.1311)	0.851749	27.57760 (0.00000)
2.518092 (0.0000)		0.029854 (0.4684)	0.808085 (0.0000)		0.799512 (0.0000)		0.014991 (0.5250)		0.904125	58.93893 (0.00000)
2.501266 (0.0000)		0.043574 (0.3316)	0.780997 (0.0000)		0.771043 (0.0000)		0.011268 (0.6370)	0.322102 (0.3869)	0.905495	45.99107 (0.00000)
2.129254 (0.0000)		0.011148 (0.7765)	0.812213 (0.0000)			0.799136 (0.0000)	0.007507 (0.7302)		0.901753	57.36501 (0.00000)
2.218334 (0.0000)		0.034764 (0.4043)	0.775618 (0.0000)			0.761309 (0.0000)	0.006048 (0.7816)	0.468780 (0.1755)	0.914033	51.03506 (0.00000)

Appendix 3.2.2

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR2) using loanable funds model

CONSTANT	DEF1GNP	DEF2GNP	P^e	r_{S1}	r_{S2}	r_{S3}	g	CAPGNP	R^2	F-Statistic
2.019403 (0.0185)	0.038091 (0.4918)		0.842389 (0.0000)	0.831849 (0.0000)			-0.036025 (0.3099)		0.824769	29.41714 (0.00000)
2.086442 (0.0116)	0.027376 (0.6758)		0.817316 (0.0000)	0.807667 (0.0000)			-0.041530 (0.2388)	-0.105292 (0.8482)	0.790394	18.10014 (0.00000)
1.818602 (0.0000)	0.124590 (0.0069)		0.815295 (0.0000)		0.815870 (0.0000)		-0.006143 (0.7578)		0.888155	49.63116 (0.00000)
1.819084 (0.0001)	0.118112 (0.0131)		0.828969 (0.0000)		0.830468 (0.0000)		-0.006545 (0.7449)	-0.200829 (0.5566)	0.888625	38.29772 (0.00000)
1.074171 (0.0001)	0.104466 (0.0098)		0.846375 (0.0000)			0.845817 (0.0000)	-0.012409 (0.3596)		0.914703	67.02335 (0.00000)
1.427784 (0.0001)	0.127483 (0.0017)		0.841522 (0.0000)			0.842765 (0.0000)	-0.008041 (0.6079)	-0.016741 (0.9498)	0.924433	58.71954 (0.00000)
2.052863 (0.0145)		0.086805 (0.1370)	0.841261 (0.0000)	0.846802 (0.0000)			-0.043842 (0.1906)		0.843201	33.60989 (0.00000)
2.098299 (0.0108)		0.088211 (0.1734)	0.814259 (0.0000)	0.820936 (0.0000)			-0.048023 (0.1560)	0.048708 (0.9250)	0.822694	22.27181 (0.00000)
2.416451 (0.0000)		0.088472 (0.0427)	0.799712 (0.0000)		0.798312 (0.0000)		-0.027912 (0.2170)		0.878746	45.29475 (0.00000)
2.500150 (0.0000)		0.081049 (0.0868)	0.823415 (0.0000)		0.821823 (0.0000)		-0.025690 (0.2776)	-0.252099 (0.5232)	0.883457	36.38650 (0.00000)
2.029453 (0.0000)		0.070210 (0.0611)	0.812734 (0.0000)			0.808124 (0.0000)	-0.028991 (0.1330)		0.898423	55.27949 (0.00000)
2.233574 (0.0000)		0.072404 (0.0934)	0.820740 (0.0000)			0.814818 (0.0000)	-0.028307 (0.1879)	-0.084141 (0.8122)	0.898839	42.64918 (0.00000)

Appendix 3.2.3

2SLS Cochrane-Orcutt estimates for 'level' long-term nominal interest rate (LR3) using loanable funds model

CONSTANT	DEF1GNP	DEF2GNP	P^e	r_{S1}	r_{S2}	r_{S3}	g	CAPGNP	R^2	F-Statistic
1.658552	0.067897		0.937250	0.923162			-0.033739		0.817390	27.97597
(0.1210)	(0.2922)		(0.0000)	(0.0000)			(0.4445)			(0.00000)
1.884445	0.073610		0.868873	0.854223			-0.041126	0.221521	0.770326	16.09915
(0.0646)	(0.3470)		(0.0000)	(0.0000)			(0.3476)	(0.7392)		(0.00000)
1.987335	0.186922		0.909385		0.911298		0.008699		0.901260	57.04744
(0.0017)	(0.0004)		(0.0000)		(0.0000)		(0.7587)			(0.00000)
1.745310	0.173712		0.877846		0.877364		-0.003010	0.104767	0.859989	29.48299
(0.0025)	(0.0047)		(0.0000)		(0.0000)		(0.9117)	(0.8144)		(0.00000)
1.598356	0.192983		0.921514			0.925239	0.006205		0.926602	78.90211
(0.0023)	(0.0000)		(0.0000)			(0.0000)	(0.7897)			(0.00000)
1.382975	0.190125		0.894963			0.895219	-0.002018	0.286041	0.906361	46.46094
(0.0043)	(0.0004)		(0.0000)			(0.0000)	(0.9280)	(0.4287)		(0.00000)
1.638718		0.124860	0.950448	0.954097			-0.043606		0.849055	35.15586
(0.1226)		(0.0718)	(0.0000)	(0.0000)			(0.2917)			(0.00000)
1.767662		0.137408	0.908081	0.910399			-0.050137	0.301779	0.835396	24.36082
(0.0928)		(0.0788)	(0.0000)	(0.0000)			(0.2343)	(0.6152)		(0.00000)
2.621839		0.127391	0.882748		0.876465		-0.031904		0.861239	38.79137
(0.0002)		(0.0292)	(0.0000)		(0.0000)		(0.3093)			(0.00000)
2.595320		0.124607	0.882527		0.876454		-0.032040	-0.021407	0.858798	29.19381
(0.0003)		(0.0489)	(0.0000)		(0.0000)		(0.3184)	(0.9666)		(0.00000)
2.293108		0.107733	0.891746			0.881321	-0.033896		0.875560	43.97503
(0.0004)		(0.0430)	(0.0000)			(0.0000)	(0.2340)			(0.00000)
2.321080		0.115885	0.882199			0.871293	-0.034763	0.140603	0.877916	34.51708
(0.0005)		(0.0474)	(0.0000)			(0.0000)	(0.2390)	(0.7618)		(0.00000)

APPENDIX 3.3

2SLS Cochrane-Orcutt estimates (Probabilities in brackets) for the level term structure of interest rates using the term structure model

Appendix 3.3.1

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS11) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-1.222407	-0.109050		0.016930	0.100255		-0.005701	0.239416	1.967375
(0.1183)	(0.0443)		(0.5272)	(0.0382)		(0.8734)		(0.130498)
1.359995	-0.111119		0.019186		-0.017278	-0.010726	0.117469	0.831905
(0.1865)	(0.0966)		(0.5241)		(0.2682)	(0.7784)		(0.517646)
-1.070283		-0.012981	-0.012981	0.069833		0.023152	0.110313	0.774945
(0.2084)		(0.9478)	(0.6716)	(0.1488)		(0.5259)		(0.551878)
0.404401		0.014273	-0.007879		-0.005345	0.026764	0.032096	0.207254
(0.6712)		(0.8251)	(0.8069)		(0.6799)	(0.4783)		(0.931973)

Appendix 3.3.2

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS12) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-0.800829	0.002871		0.000846	0.138930		0.028595	0.403183	4.222228
(0.1120)	(0.9467)		(0.9647)	(0.0014)		(0.2151)		(0.009529)
1.656063	-0.005677		0.001154		-0.024943	0.010139	0.119195	0.845784
(0.0213)	(0.9258)		(0.9585)		(0.1383)	(0.6898)		(0.509547)
-1.013997		0.030099	-0.008756	0.139465		0.040785	0.555776	7.819481
(0.0499)		(0.4336)	(0.6475)	(0.0001)		(0.0709)		(0.000313)
2.623302		0.033093	-0.003786		-0.025441	0.049174	0.389873	3.993773
(0.0003)		(0.4566)	(0.8638)		(0.0085)	(0.0625)		(0.012208)

Appendix 3.3.3

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS13) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-0.788572	-0.002812		0.004586	0.143774		0.016834	0.352431	3.401476
(0.0650)	(0.9499)		(0.7881)	(0.0021)		(0.3811)		(0.023654)
1.174649	-0.003153		0.001820		-0.022841	0.001311	0.087441	0.598872
(0.0515)	(0.9577)		(0.9250)		(0.1950)	(0.9516)		(0.666859)
-1.082730		0.004728	-0.000367	0.142776		0.025794	0.480130	5.772238
(0.0202)		(0.8975)	(0.9841)	(0.0002)		(0.1974)		(0.001967)
2.156748		0.004225	0.001715		-0.026814	0.029725	0.304875	2.741184
(0.0010)		(0.9236)	(0.9377)		(0.0119)	(0.2229)		(0.051053)

Appendix 3.3.4

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS21) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-0.558540	0.013347		0.005843	0.078944		-0.027093	0.157913	1.172032
(0.4728)	(0.8096)		(0.8335)	(0.1192)		(0.4575)		(0.346970)
2.435607	-0.013503		0.006354		-0.029711	-0.033419	0.221450	1.777740
(0.0132)	(0.8132)		(0.8132)		(0.0340)	(0.3393)		(0.164895)
-0.420086		0.083623	-0.013920	0.075497		-0.030047	0.228711	1.853315
(0.5772)		(0.1558)	(0.6305)	(0.1117)		(0.3666)		(0.150203)
2.305451		0.073807	-0.015477		-0.024705	-0.026148	0.292477	2.583639
(0.0071)		(0.1798)	(0.5672)		(0.0299)	(0.4083)		(0.061626)

Appendix 3.3.5

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS22) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-0.219715	0.120029		-0.008289	0.109500		0.012145	0.491575	6.042872
(0.6185)	(0.0097)		(0.6405)	(0.0108)		(0.5502)		(0.001520)
3.555346	0.111431		-0.012267		-0.037848	0.019970	0.760884	19.88797
(0.0000)	(0.0014)		(0.4130)		(0.0000)	(0.3075)		(0.000000)
-0.141381		0.085083	-0.013545	0.133301		-0.008741	0.357901	3.483708
(0.7266)		(0.0335)	(0.4768)	(0.0077)		(0.6463)		(0.021543)
3.808506		0.076778	-0.013751		-0.046640	-0.012341	0.662460	12.26634
(0.0000)		(0.0387)	(0.4393)		(0.0000)	(0.5198)		(0.000012)

Appendix 3.3.6

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS23) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
-0.144755	0.104236		-0.003764	0.098300		0.002249	0.449972	5.113063
(0.6018)	(0.0115)		(0.7626)	(0.0159)		(0.8677)		(0.003767)
2.789041	0.102743		-0.013704		-0.040387	0.001694	0.786290	22.99530
(0.0000)	(0.0009)		(0.2449)		(0.0000)	(0.9036)		(0.000000)
-0.115487		0.062832	-0.007894	0.121920		-0.010889	0.366478	3.615480
(0.6465)		(0.0268)	(0.5504)	(0.0062)		(0.4104)		(0.018567)
2.801271		0.040979	-0.010700		-0.050317	-0.022023	0.662288	12.25690
(0.0000)		(0.1422)	(0.4282)		(0.0000)	(0.1143)		(0.000012)

Appendix 3.3.7

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS31) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
0.517270	0.056501		0.011809	0.027826		-0.030567	0.127191	0.910784
(0.5812)	(0.4129)		(0.7284)	(0.6505)		(0.4870)		(0.472904)
1.848623	0.039508		0.011438		-0.014980	-0.035054	0.145831	1.067057
(0.1178)	(0.5804)		(0.7336)		(0.3732)	(0.4214)		(0.393540)
0.738341		0.120493	-0.007900	0.026047		-0.042036	0.209402	1.655409
(0.4198)		(0.0884)	(0.8180)	(0.6315)		(0.2962)		(0.191804)
2.003816		0.115417	-0.010465		-0.013395	-0.041936	0.233086	1.899544
(0.0497)		(0.0970)	(0.7567)		(0.3339)	(0.2878)		(0.141875)

Appendix 3.3.8

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS32) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
0.513656	0.175877		-0.006510	0.064215		0.014286	0.524092	6.882794
(0.3789)	(0.0010)		(0.7687)	(0.1470)		(0.5963)		(0.000703)
2.900104	0.162039		-0.007258		-0.023609	0.015642	0.625765	10.45073
(0.0003)	(0.0010)		(0.7241)		(0.0290)	(0.5550)		(0.000041)
0.376545		0.116120	-0.004518	0.105976		-0.020509	0.361306	3.535592
(0.5493)		(0.0370)	(0.8656)	(0.0401)		(0.4676)		(0.020315)
3.841217		0.117702	-0.006953		-0.035584	-0.022057	0.516454	6.675336
(0.0000)		(0.0247)	(0.7792)		(0.0033)	(0.4229)		(0.000847)

Appendix 3.3.9

2SLS Cochrane-Orcutt estimates for 'level' term structure of interest rates (TS33) using term structure model

CONSTANT	DEF1GNP	DEF2GNP	P^e	M1GNP	M2GNP	g	R^2	F-Statistic
0.241337	0.180631		-0.007982	0.067377		0.010640	0.627068	10.50909
(0.6064)	(0.0001)		(0.6578)	(0.0698)		(0.6240)		(0.000039)
2.682359	0.172133		-0.010099		-0.023063	0.016333	0.747847	18.53656
(0.0001)	(0.0000)		(0.5335)		(0.0068)	(0.4401)		(0.000000)
0.101244		0.095588	0.000560	0.112196		-0.022496	0.400118	3.973467
(0.8536)		(0.0513)	(0.9811)	(0.0185)		(0.3655)		(0.012482)
3.209554		0.076522	-0.003065		-0.040385	-0.029235	0.499958	6.248962
(0.0000)		(0.0889)	(0.8873)		(0.0014)	(0.2039)		(0.001253)

APPENDIX 4.1

2SLS estimates (Probabilities in brackets) for the 'differenced' nominal interest rates using the IS/LM model[148]

Appendix 4.1.1

2SLS estimates for the 'differenced' short-term nominal interest rate (ΔSR1) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.124232	-0.211604		0.058208	0.071669		0.367400	-0.087999	1.464692	0.481576
(0.6678)	(0.6284)		(0.3660)	(0.7448)		(0.4100)	(0.8254)	(0.5173)	(0.815111)
0.366704	-0.367325		0.050840		-0.136521	0.507754	0.155768	0.168651	0.628671
(0.3472)	(0.4045)		(0.4779)		(0.2733)	(0.2451)	(0.6858)	(0.9401)	(0.705795)
0.196530		0.173255	0.034922	0.361755		-0.038931	-0.334798	3.177656	0.326355
(0.5639)		(0.7026)	(0.6550)	(0.5696)		(0.9555)	(0.4487)	(0.5095)	(0.915945)
0.534849		-0.162622	0.047793		-0.202521	0.388926	-0.024273	-0.114397	0.692700
(0.3039)		(0.6310)	(0.4495)		(0.3853)	(0.3311)	(0.9335)	(0.9688)	(0.657949)

Appendix 4.1.2

2SLS estimates for the 'differenced' short-term nominal interest rate (ΔSR2) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.167497	-0.040132		0.051520	0.067710		0.117141	-0.025971	-0.190428	0.209261
(0.5347)	(0.9212)		(0.3891)	(0.7409)		(0.7761)	(0.9442)	(0.9275)	(0.970234)
0.258770	-0.128903		0.048279		-0.053657	0.206829	0.108830	-0.919908	0.304542
(0.4451)	(0.7355)		(0.4399)		(0.6176)	(0.5826)	(0.7455)	(0.6389)	(0.928126)
0.210115		-0.005982	0.047021	0.078626		0.094010	-0.032825	-0.313791	0.177720
(0.4643)		(0.9875)	(0.4760)	(0.8828)		(0.8727)	(0.9292)	(0.9380)	(0.980068)
0.454312		-0.161953	0.052833		-0.137781	0.259990	0.096178	-1.669601	0.248925
(0.4227)		(0.6619)	(0.4450)		(0.5875)	(0.5500)	(0.7628)	(0.6028)	(0.954567)

Appendix 4.1.3

2SLS estimates for the 'differenced' short-term nominal interest rate (ΔSR3) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.160647	-0.149216		0.048243	-0.006351		0.240801	0.135747	-1.274837	0.215980
(0.5517)	(0.7135)		(0.4199)	(0.9752)		(0.5602)	(0.7149)	(0.5445)	(0.967842)
0.235715	-0.176299		0.046289		-0.040679	0.258430	0.181058	-1.506791	0.292564
(0.4848)	(0.6434)		(0.4573)		(0.7039)	(0.4917)	(0.5889)	(0.4426)	(0.934324)
0.214507		-0.007164	0.040158	0.033926		0.129681	0.046553	-1.132074	0.220402
(0.4571)		(0.9851)	(0.5438)	(0.9495)		(0.8258)	(0.9001)	(0.7800)	(0.966033)
0.346551		-0.087433	0.043137		-0.074107	0.212708	0.111831	-1.817176	0.251862
(0.5276)		(0.8076)	(0.5199)		(0.7632)	(0.6141)	(0.7179)	(0.5600)	(0.953296)

148 The R^2 's are not shown here because the insignificant F-statistics automatically imply that those models produce bad fits. The low R^2 's are expected in models having 'differenced' variables.

Appendix 4.1.4

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR1) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.135598 (0.5815)	-0.241310 (0.5164)		0.056648 (0.3014)	0.102832 (0.5830)		0.433619 (0.2552)	0.112575 (0.7397)	-0.289408 (0.8797)	0.550835 (0.764273)
0.103020 (0.7498)	-0.303642 (0.4094)		0.056349 (0.3484)		0.012086 (0.9064)	0.516518 (0.1599)	0.198658 (0.5377)	-0.782374 (0.6770)	0.444724 (0.841149)
0.203612 (0.4460)		0.063440 (0.8580)	0.040343 (0.5105)	0.260013 (0.6012)		0.151385 (0.7815)	-0.089873 (0.7937)	0.639076 (0.8647)	0.502080 (0.800000)
0.130525 (0.7985)		-0.024224 (0.9425)	0.044009 (0.4832)		0.028188 (0.9024)	0.323658 (0.4143)	0.019333 (0.9467)	-0.540587 (0.8524)	0.370222 (0.889968)

Appendix 4.1.5

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR2) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.164757 (0.5242)	-0.285105 (0.4659)		0.049234 (0.3906)	-0.015409 (0.9374)		0.471385 (0.2393)	0.271367 (0.4481)	-1.466009 (0.4677)	0.394207 (0.875087)
0.299270 (0.3746)	-0.330653 (0.3860)		0.045779 (0.4603)		-0.072667 (0.4967)	0.499331 (0.1883)	0.348305 (0.3005)	-1.857752 (0.3433)	0.529018 (0.780484)
0.201018 (0.4493)		0.098760 (0.7795)	0.032453 (0.5939)	0.192408 (0.6969)		0.103690 (0.8485)	-0.005929 (0.9862)	0.026480 (0.9943)	0.425353 (0.854106)
0.329061 (0.5247)		-0.054652 (0.8717)	0.038382 (0.5435)		-0.079202 (0.7329)	0.309060 (0.4390)	0.140525 (0.6307)	-1.529762 (0.6026)	0.460167 (0.830038)

Appendix 4.1.6

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR3) using IS/LM model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
0.141902 (0.6170)	-0.315375 (0.4630)		0.064649 (0.3065)	0.024347 (0.9100)		0.498198 (0.2571)	0.230102 (0.5572)	-1.053321 (0.6337)	0.410499 (0.864402)
0.222210 (0.5492)	-0.367401 (0.3838)		0.062201 (0.3658)		-0.045250 (0.7010)	0.545235 (0.1937)	0.311482 (0.4006)	-1.486188 (0.4910)	0.449255 (0.837998)
0.176573 (0.5488)		0.128491 (0.7432)	0.045308 (0.5037)	0.277737 (0.6133)		0.065139 (0.9139)	-0.091846 (0.8089)	0.779065 (0.8509)	0.434495 (0.847878)
0.197015 (0.7281)		-0.013039 (0.9720)	0.050963 (0.4638)		-0.024013 (0.9249)	0.291285 (0.5061)	0.060309 (0.8507)	-0.850600 (0.7917)	0.403931 (0.868409)

APPENDIX 4.2

2SLS estimates (Probabilities in brackets) for the 'differenced' nominal interest rates using the loanable funds model[149]

Appendix 4.2.1

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR1) using loanable funds model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	Δr_{S1}	Δr_{S2}	Δr_{S3}	Δg	ΔCAPGNP	F-Statistic
0.007936	-0.133607		0.623863	0.582168			-0.047185	-1.301854	0.568023
(0.9784)	(0.6442)		(0.6004)	(0.6327)			(0.1941)	(0.6254)	(0.723619)
-0.019725	-0.149333		0.724940		0.689028		-0.019665	-0.479827	1.109967
(0.9237)	(0.4718)		(0.3364)		(0.3727)		(0.6155)	(0.6974)	(0.381285)
-0.019944	-0.109750		0.799020			0.771441	-0.015436	0.111656	1.793839
(0.9010)	(0.5304)		(0.2146)			(0.2462)	(0.6422)	(0.9139)	(0.152243)
0.045454		-0.016830	0.664851	0.639489			-0.043921	-1.261321	0.576606
(0.8873)		(0.9355)	(0.5123)	(0.5338)			(0.2765)	(0.6189)	(0.717352)
-0.005063		-0.020423	0.871519		0.858047		-0.007726	-0.285325	1.404392
(0.9808)		(0.8775)	(0.1881)		(0.2041)		(0.8391)	(0.8472)	(0.259767)
-0.008238		-0.021794	0.896643			0.883850	-0.006252	0.309408	2.214922
(0.9607)		(0.8362)	(0.0953)			(0.1069)	(0.8375)	(0.8127)	(0.087506)

Appendix 4.2.2

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR2) using loanable funds model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	Δr_{S1}	Δr_{S2}	Δr_{S3}	Δg	ΔCAPGNP	F-Statistic
0.044662	-0.139070		0.569566	0.527136			-0.059256	-1.698591	0.916319
(0.8628)	(0.5861)		(0.5878)	(0.6238)			(0.0693)	(0.4714)	(0.487239)
0.021406	-0.154303		0.649419		0.611551		-0.034880	-0.957517	1.929864
(0.9021)	(0.3805)		(0.3090)		(0.3498)		(0.2964)	(0.3622)	(0.126505)
0.021868	-0.119793		0.710413			0.679640	-0.031352	-0.437608	3.714598
(0.8600)	(0.3779)		(0.1558)			(0.1883)	(0.2285)	(0.5848)	(0.012442)
-0.025129		0.045485	1.002835	1.001016			-0.056452	-1.716479	0.790625
(0.9401)		(0.8341)	(0.3461)	(0.3532)			(0.1831)	(0.5174)	(0.567256)
-0.074911		0.050466	1.183555		1.195689		-0.007770	-0.191366	2.441433
(0.7037)		(0.6847)	(0.0614)		(0.0641)		(0.8274)	(0.8902)	(0.064831)
-0.076783		0.049481	1.205984			1.218656	-0.006420	0.628429	4.389119
(0.6015)		(0.5935)	(0.0137)			(0.0147)	(0.8103)	(0.5843)	(0.005952)

Appendix 4.2.3

2SLS estimates for the 'differenced' long-term nominal interest rate (ΔLR3) using loanable funds model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	Δr_{S1}	Δr_{S2}	Δr_{S3}	Δg	ΔCAPGNP	F-Statistic
0.019914	-0.185986		0.565327	0.507026			-0.065629	-1.436677	0.855563
(0.9489)	(0.5453)		(0.6544)	(0.6947)			(0.0927)	(0.6117)	(0.524701)
-0.011727	-0.195495		0.702592		0.652170		-0.039373	-0.707050	1.496849
(0.9589)	(0.3955)		(0.3986)		(0.4446)		(0.3662)	(0.6049)	(0.227952)
-0.012451	-0.157539		0.776450			0.734151	-0.035192	-0.143223	2.343043
(0.9448)	(0.4231)		(0.2803)			(0.3232)	(0.3483)	(0.9016)	(0.072356)
-0.072326		0.055072	1.128379	1.122648			-0.061087	-1.449262	0.629637
(0.8624)		(0.8389)	(0.3943)	(0.4029)			(0.2457)	(0.6604)	(0.678973)
-0.136188		0.057751	1.370204		1.381399		-0.004302	0.261892	1.440094
(0.6325)		(0.7476)	(0.1287)		(0.1336)		(0.9334)	(0.8960)	(0.247678)
-0.139832		0.056076	1.403416			1.415471	-0.002334	1.214217	2.044640
(0.5589)		(0.7095)	(0.0688)			(0.0723)	(0.9572)	(0.5162)	(0.109866)

[149] The R^2 's are not shown here because the insignificant F-statistics automatically imply that those models produce bad fits. The low R^2 's are expected in models having 'differenced' variables.

APPENDIX 4.3

2SLS estimates (Probabilities in brackets) for the 'differenced' term structure of interest rates using the term structure model[150]

Appendix 4.3.1

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS11) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.032251	-0.057317		0.005819	0.023048		-0.034344	0.254728
(0.9030)	(0.8376)		(0.9258)	(0.9019)		(0.4001)	(0.904020)
-0.247742	0.040666		0.003833		0.132886	-0.013381	0.656048
(0.4517)	(0.8876)		(0.9529)		(0.2275)	(0.7430)	(0.628158)
-0.012888		0.082660	-0.009439	0.092044		-0.036940	0.264340
(0.9635)		(0.6386)	(0.8665)	(0.7055)		(0.3955)	(0.897931)
-0.418548		0.184542	-0.011726		0.235931	-0.022476	0.823997
(0.2651)		(0.3671)	(0.8311)		(0.1423)	(0.5934)	(0.522803)

Appendix 4.3.2

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS12) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.026574	-0.049286		0.011059	0.128512		0.009367	0.370056
(0.8641)	(0.7641)		(0.7632)	(0.2478)		(0.6941)	(0.827668)
-0.212105	-0.042705		0.014137		0.094444	0.012523	0.625335
(0.2593)	(0.7936)		(0.7011)		(0.1336)	(0.5892)	(0.648806)
-0.004025		0.001807	0.004704	0.133231		0.009315	0.367610
(0.9800)		(0.9856)	(0.8829)	(0.3401)		(0.7046)	(0.829271)
-0.235039		0.046411	0.003636		0.122748	0.010251	0.688063
(0.2680)		(0.6861)	(0.9068)		(0.1752)	(0.6662)	(0.607297)

Appendix 4.3.3

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS13) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.008247	-0.001542		0.010443	0.146595		0.008507	0.718496
(0.9476)	(0.9907)		(0.7251)	(0.1076)		(0.6588)	(0.587321)
-0.157110	-0.027384		0.014828		0.067789	0.005081	0.445664
(0.3227)	(0.8430)		(0.6350)		(0.2010)	(0.7955)	(0.774471)
-0.002489		-0.045794	0.014618	0.110836		0.009868	0.751835
(0.9852)		(0.5846)	(0.5852)	(0.3426)		(0.6314)	(0.566591)
-0.112706		-0.032361	0.014246		0.051773	0.006045	0.478600
(0.5344)		(0.7437)	(0.5958)		(0.5011)	(0.7678)	(0.751095)

Appendix 4.3.4

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS21) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	Δ P^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.034985	-0.118950		0.005105	-0.094458		-0.056266	0.656297
(0.8827)	(0.6358)		(0.9274)	(0.5742)		(0.1302)	(0.627992)
-0.057951	-0.039141		0.000624		0.031970	-0.040751	0.514675
(0.8460)	(0.8813)		(0.9916)		(0.7467)	(0.2784)	(0.725569)
-0.027746		0.166485	-0.023025	0.037786		-0.059147	0.727714
(0.9132)		(0.2997)	(0.6506)	(0.8636)		(0.1384)	(0.581774)
-0.297125		0.238013	-0.024611		0.160022	-0.047434	0.753295
(0.3990)		(0.2209)	(0.6356)		(0.2861)	(0.2378)	(0.565680)

[150] The R^2 's are not shown here because the insignificant F-statistics automatically imply that those models produce bad fits. The low R^2 's are expected in models having 'differenced' variables.

Appendix 4.3.5

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS22) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.029308	-0.110919		0.010345	0.011005		-0.012556	0.296722
(0.8221)	(0.4236)		(0.7371)	(0.9049)		(0.5309)	(0.877293)
-0.022314	-0.122511		0.010928		-0.006472	-0.014847	0.324832
(0.8902)	(0.3921)		(0.7333)		(0.9039)	(0.4634)	(0.858626)
-0.018883		0.085632	-0.008882	0.078974		-0.012892	0.414532
(0.8754)		(0.2603)	(0.7116)	(0.4502)		(0.4867)	(0.796440)
-0.113616		0.099882	-0.009249		0.046839	-0.014707	0.392968
(0.4953)		(0.2770)	(0.7070)		(0.5071)	(0.4364)	(0.811598)

Appendix 4.3.6

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS23) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.010980	-0.063175		0.009730	0.029089		-0.013416	0.525699
(0.9005)	(0.4978)		(0.6396)	(0.6398)		(0.3231)	(0.717796)
0.032681	-0.107190		0.011619		-0.033127	-0.022289	0.846623
(0.7788)	(0.2996)		(0.6149)		(0.3936)	(0.1326)	(0.509060)
-0.017347		0.038030	0.001032	0.056579		-0.012339	0.582865
(0.8222)		(0.4321)	(0.9465)	(0.3993)		(0.3018)	(0.678004)
0.008717		0.021110	0.001360		-0.024136	-0.018914	0.842049
(0.9339)		(0.7141)	(0.9305)		(0.5894)	(0.1216)	(0.512246)

Appendix 4.3.7

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS31) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.055570	-0.150783		0.020508	-0.069036		-0.061032	0.566641
(0.8403)	(0.6057)		(0.7530)	(0.7233)		(0.1567)	(0.689134)
-0.119697	-0.067303		0.016573		0.053490	-0.044393	0.506145
(0.7266)	(0.8229)		(0.8068)		(0.6377)	(0.3024)	(0.731594)
-0.044726		0.158211	-0.009734	0.056364		-0.062821	0.591747
(0.8804)		(0.3966)	(0.8695)	(0.8262)		(0.1759)	(0.671889)
-0.354179		0.238229	-0.011519		0.181967	-0.050536	0.665566
(0.3862)		(0.2888)	(0.8481)		(0.2954)	(0.2771)	(0.622073)

Appendix 4.3.8

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS32) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.049893	-0.142752		0.025748	0.036427		-0.017321	0.291068
(0.7725)	(0.4364)		(0.5291)	(0.7652)		(0.5138)	(0.880980)
-0.084060	-0.150673		0.026877		0.015048	-0.018489	0.290561
(0.6928)	(0.4227)		(0.5248)		(0.8309)	(0.4868)	(0.881310)
-0.035863		0.077359	0.004409	0.097552		-0.016567	0.316102
(0.8315)		(0.4638)	(0.8955)	(0.5044)		(0.5226)	(0.864368)
-0.170669		0.100099	0.003843		0.068783	-0.017809	0.317231
(0.4609)		(0.4297)	(0.9103)		(0.4830)	(0.4964)	(0.863613)

Appendix 4.3.9

2SLS estimates for the 'differenced' term structure of interest rates (ΔTS33) using term structure model

CONSTANT	ΔΔDEF1GNP	ΔDEF2GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg	F-Statistic
-0.031565	-0.095008		0.025132	0.054511		-0.018181	0.452515
(0.8219)	(0.5230)		(0.4504)	(0.5832)		(0.4004)	(0.769612)
-0.029064	-0.135352		0.027568		-0.011607	-0.025931	0.491749
(0.8712)	(0.3935)		(0.4401)		(0.8451)	(0.2515)	(0.741782)
-0.034326		0.029757	0.014323	0.075157		-0.016014	0.427637
(0.8032)		(0.7290)	(0.6025)	(0.5288)		(0.4501)	(0.787188)
-0.048337		0.021327	0.014453		-0.002192	-0.022016	0.415793
(0.7967)		(0.8354)	(0.6041)		(0.9780)	(0.3052)	(0.795550)

APPENDIX 5.1

Multicollinearity tests in regressions using level variables

Appendix 5.1.1

Correlation coefficients among variables in the IS/LM model using level variables

	DEF1GNP	DEF2GNP	DEF3GNP	P^e	M1GNP	M2GNP	GOVGNP	t	CAPGNP
DEF1GNP				0.574503	0.34666	-0.39205	0.61407	0.495314	-0.48058
DEF2GNP				0.64698	0.279631	-0.25451	0.510778	0.330308	-0.51689
DEF3GNP				0.4280096	0.42064198	-0.4548128	0.54185349	0.5143779	-0.427295
P^e					0.285458	-0.25551	0.120776	0.45108	-0.38515
M1GNP							0.192086	0.801162	-0.52622
M2GNP							-0.35785	-0.80835	0.512616
GOVGNP								0.157224	-0.25597
t									-0.53145
CAPGNP									

Appendix 5.1.2

Correlation coefficients among variables in the loanable funds model using level variables

	DEF1GNP	DEF2GNP	DEF3GNP	P^e	r_{S1}	r_{S2}	r_{S3}	g	CAPGNP
DEF1GNP				0.574503	-0.525000	-0.558360	-0.561070	-0.262135	-0.480581
DEF2GNP				0.646980	-0.629369	-0.631850	-0.627052	-0.000669	-0.516891
DEF3GNP				0.428001	-0.409416	-0.428039	-0.43632	-0.353936	-0.427295
P^e					-0.958405	-0.950977	-0.950620	-0.045771	-0.385145
r_{S1}								-0.025549	0.485398
r_{S2}								-0.042249	0.500062
r_{S3}								-0.040201	0.491555
g									-0.017638
CAPGNP									

Appendix 5.1.3

Correlation coefficients among variables in the term structure model using level variables

	DEF1GNP	DEF2GNP	DEF3GNP	P^e	M1GNP	M2GNP	g
DEF1GNP				0.574503	0.346662	-0.39205	-0.26213
DEF2GNP				0.64698	0.279631	-0.25451	-0.00067
DEF3GNP				0.4280096	0.420642	-0.454813	-0.353936
P^e					0.285458	-0.25551	-0.04577
M1GNP							0.092208
M2GNP							-0.04456
g							

APPENDIX 5.2

Multicollinearity tests in regressions using stationary variables

Appendix 5.2.1

Correlation coefficients among variables in the IS/LM model using stationary variables

	ΔΔDEF1GNP	ΔDEF2GNP	ΔDEF3GNP	ΔP^e	ΔM1GNP	ΔM2GNP	ΔGOVGNP	Δt	ΔCAPGNP
ΔΔDEF1GNP				0.4710261	-0.048862	-0.071504	0.268310	0.3371924	0.207195
ΔDEF2GNP				0.5271794	-0.442552	-0.497223	0.244147	-0.054258	-0.203113
ΔDEF3GNP				0.2011614	0.03608945	-0.1555605	-0.0516665	0.01206298	-0.036769
ΔP^e					-0.243476	-0.303393	0.015172	0.286249	0.03142
ΔM1GNP							0.194764	0.11925	-0.046467
ΔM2GNP							-0.036622	0.136878	0.023418
ΔGOVGNP								-0.104489	-0.011936
Δt									0.360124
ΔCAPGNP									

Appendix 5.2.2

Correlation coefficients among variables in the loanable funds model using stationary variables

	ΔΔDEF1GNP	ΔDEF2GNP	ΔDEF3GNP	ΔP^e	Δr_{S1}	Δr_{S2}	Δr_{S3}	Δg	ΔCAPGNP
ΔΔDEF1GNP				0.4710261	-0.466831	-0.503337	-0.508413	-0.035215	0.207195
ΔDEF2GNP				0.5271794	-0.536168	-0.531976	-0.525840	0.2573255	-0.203113
ΔDEF3GNP				0.2011614	-0.2193246	-0.1559053	-0.1732919	-0.2753169	-0.036769
ΔP^e					-0.982952	-0.985582	-0.986414	0.091034	0.03142
Δr_{S1}								-0.096018	0.00131
Δr_{S2}								-0.127837	-0.017149
Δr_{S3}								-0.124592	-0.029145
Δg									-0.086408
ΔCAPGNP									

Appendix 5.2.3

Correlation coefficients among variables in the term structure model using stationary variables

	ΔΔDEF1GNP	ΔDEF2GNP	ΔDEF3GNP	ΔP^e	ΔM1GNP	ΔM2GNP	Δg
ΔΔDEF1GNP				0.4710261	-0.048862	-0.071504	-0.035215
ΔDEF2GNP				0.5271794	-0.442552	-0.497223	0.2573255
ΔDEF3GNP				0.2011614	0.0360896	-0.155561	-0.275317
ΔP^e					-0.243476	-0.303393	0.091034
ΔM1GNP							-0.357067
ΔM2GNP							-0.321879
g							

APPENDIX 6

Heteroscedasticity tests using level variables

Appendix 6.1.1

White's test statistic and its probability value *in* the *IS/LM model (using short rates as dependent variable)*

Regression Equation	White's statistic	Probability
$SR1 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	26.87540	0.470533
$SR1 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	11.27499	0.938777
$SR1 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.63647	0.330733
$SR1 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	19.55019	0.486364
$SR1 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.82703	0.321981
$SR1 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	19.71965	0.475585
$SR1 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	23.61216	0.651732
$SR1 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	17.06012	0.649066
$SR1 = \alpha_0 + \alpha_1 DEF3GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	7.324790	0.835425
$SR2 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	25.95301	0.521209
$SR2 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	16.22583	0.702519
$SR2 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.59444	0.332681
$SR2 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	18.55425	0.550947
$SR2 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.45119	0.339368
$SR2 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	15.36835	0.754957
$SR2 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	27.23705	0.451063
$SR2 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	18.75557	0.537762
$SR2 = \alpha_0 + \alpha_1 DEF3GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	9.287440	0.678203
$SR3 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	25.08137	0.569902
$SR3 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	15.76849	0.730879
$SR3 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.80999	0.322759
$SR3 = \alpha_0 + \alpha_1 DEF1GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	18.80247	0.534697
$SR3 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	29.48347	0.337855
$SR3 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	18.03296	0.585237
$SR3 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	27.37192	0.443873
$SR3 = \alpha_0 + \alpha_1 DEF2GNP + \alpha_2 P^e + \alpha_3 M2GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t$	19.31177	0.501652
$SR3 = \alpha_0 + \alpha_1 DEF3GNP + \alpha_2 P^e + \alpha_3 M1GNP + \alpha_4 g + \alpha_5 GOVGNP + \alpha_6 t + \alpha_7 CAPGNP$	9.763426	0.636706

Appendix 6.1.2

White's test statistic and its probability value *in* the *IS/LM model (using long rates as dependent variable)*

Regression Equation	White's statistic	Probability
LR1= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	27.22766	0.451565
LR1= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	17.87070	0.595926
LR1= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.27584	0.347652
LR1= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	17.73174	0.605075
LR1= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	28.75155	0.373049
LR1= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	16.56403	0.681074
LR1= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.58349	0.333189
LR1= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	13.41545	0.858856
LR1= $\alpha_0 + \alpha_1$ DEF3GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	13.63258	0.324783
LR2= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	27.99168	0.411402
LR2= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	16.10379	0.710165
LR2= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	28.77954	0.371670
LR2= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	17.72751	0.605353
LR2= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	27.97514	0.412256
LR2= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	17.26171	0.635920
LR2= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.95356	0.316245
LR2= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	14.55692	0.801175
LR2= $\alpha_0 + \alpha_1$ DEF3GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	12.51474	0.405274
LR3= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.64891	0.330158
LR3= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	15.68740	0.735818
LR3= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	27.05097	0.461047
LR3= $\alpha_0 + \alpha_1$ DEF1GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	17.02646	0.651255
LR3= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.34282	0.344475
LR3= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t	16.09213	0.710893
LR3= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	29.35844	0.343736
LR3= $\alpha_0 + \alpha_1$ DEF2GNP+ α_2 $P^e + \alpha_3$ M2GNP + α_4 g + α_5 GOVGNP + α_6 t	14.99992	0.776412
LR3= $\alpha_0 + \alpha_1$ DEF3GNP+ α_2 $P^e + \alpha_3$ M1GNP + α_4 g + α_5 GOVGNP + α_6 t + α_7 CAPGNP	13.17157	0.356695

Appendix 6.2

White's test statistic and its probability value in the loanable funds model

Regression Equation	White's statistic	Probability
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	10.05039	0.758490
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	20.39871	0.433250
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	11.80627	0.621857
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	26.75267	0.142367
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	14.86161	0.387680
LR1= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	28.05066	0.108206
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	12.13087	0.595793
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	14.18764	0.820856
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	9.554986	0.793942
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	21.76692	0.353291
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	12.59190	0.558879
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	25.05539	0.199320
LR1= $\beta_0 + \beta_1$ DEF3GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	13.24108	0.210503
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	10.87640	0.695717
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	20.63261	0.419033
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	8.414713	0.866622
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	18.35931	0.563751
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	13.79095	0.465399
LR2= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	23.06389	0.285668
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	14.68688	0.399888
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	18.83814	0.532368
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	9.096184	0.824840
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	20.08584	0.452572
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	10.66200	0.712360
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	15.86607	0.724898
LR2= $\beta_0 + \beta_1$ DEF3GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	4.166400	0.939528
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	13.68429	0.473487
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	17.34345	0.630573
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	7.935931	0.892637
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	10.55637	0.956926
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	9.579434	0.792240
LR3= $\beta_0 + \beta_1$ DEF1GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	11.65653	0.927391
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	14.90120	0.384942
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	17.57804	0.615183
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	11.70477	0.629998
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	17.18749	0.640768
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	13.09639	0.518948
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	19.03258	0.519709
LR3= $\beta_0 + \beta_1$ DEF3GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	8.852151	0.546190

Appendix 6.3

White's test statistic and its probability value in the term structure model

Regression Equation	White's statistic	Probability
TS11= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.69884	0.472380
TS11= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	10.11727	0.753560
TS11= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.75119	0.468407
TS11= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	8.507494	0.861249
TS11= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	23.26292	0.056124
TS12= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.81838	0.463328
TS12= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	12.85926	0.537634
TS12= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	8.971583	0.832867
TS12= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	14.30160	0.427492
TS12= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.88818	0.458074
TS13= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	16.02156	0.312059
TS13= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	13.71108	0.471450
TS13= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.70264	0.472092
TS13= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	16.33428	0.293389
TS13= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	12.45707	0.569647
TS21= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	12.24111	0.586946
TS21= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	7.606641	0.908797
TS21= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	12.26562	0.584981
TS21= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	7.749748	0.901952
TS21= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	12.71024	0.549456
TS22= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	14.13996	0.439337
TS22= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	7.583118	0.909895
TS22= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	16.12770	0.305638
TS22= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	17.04028	0.254038
TS22= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	11.47440	0.648432
TS23= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	7.703641	0.904187
TS23= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	14.13905	0.439404
TS23= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	7.478428	0.914694
TS23= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	18.63859	0.179224
TS23= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	2.640570	0.999558
TS31= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	18.69467	0.176947
TS31= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	18.06395	0.203884
TS31= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	16.39774	0.289693
TS31= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	19.11870	0.160463
TS31= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	16.59396	0.278462
TS32= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	13.26353	0.505886
TS32= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	18.88634	0.169338
TS32= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	15.48029	0.346130
TS32= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	13.05173	0.522455
TS32= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	18.78189	0.173452
TS33= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	16.85868	0.263787
TS33= $\delta_0+\delta_1$ DEF1GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	13.77329	0.466734
TS33= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	11.91485	0.613141
TS33= $\delta_0+\delta_1$ DEF2GNP+ δ_2 P^e + δ_3 M2GNP + δ_4 g	13.45174	0.491302
TS33= $\delta_0+\delta_1$ DEF3GNP+ δ_2 P^e + δ_3 M1GNP + δ_4 g	15.73207	0.330009

APPENDIX 7

Engle-Granger cointegration tests in regressions using level variables

[Significance at the 5% level (*) and the 1% level (**) are based on asymptotic critical values [151]]

[The ADF test statistic carrying no stars (*), implies that the ADF statistic is insignificant even at the 5% level]

Appendix 7.1

Cointegration tests on residuals of the IS/LM model

Regression Equation	ADF Test Statistic
$SR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-4.386735*
$SR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-4.072730*
$SR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-2.487321
$SR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.153854
$SR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-4.557819*
$SR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-4.432786**
$SR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-3.063086
$SR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.291381
$SR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-4.517261*
$SR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-4.474739**
$SR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-3.028501
$SR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.339122
$LR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-4.322353*
$LR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-4.087303*
$LR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-2.972574
$LR1 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.543176
$LR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-4.116499
$LR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-4.078408*
$LR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-2.896129
$LR2 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.609116
$LR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-3.810807
$LR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M1GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.760968
$LR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t + \alpha_7\ CAPGNP$	-2.727521
$LR3 = \alpha_0 + \alpha_1\ DEF2GNP + \alpha_2\ P^e + \alpha_3\ M2GNP + \alpha_4\ g + \alpha_5\ GOVGNP + \alpha_6\ t$	-3.282314

[151] Harris, 1995: 158

Appendix 7.2

Cointegration tests on residuals of the loanable funds model

Regression Equation	ADF Test Statistic
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	-2.210999
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	-2.418514
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	-3.412695
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	-3.568525
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	-3.254285
LR1= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	-3.465321
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	-1.787638
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	-1.914306
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	-2.681838
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	-2.598378
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	-2.377681
LR2= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	-2.278426
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g	-1.912215
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s1} + β_4 g + β_5 CAPGNP	-1.872001
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g	-2.886542
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s2} + β_4 g + β_5 CAPGNP	-2.896621
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g	-2.658053
LR3= $\beta_0 + \beta_1$ DEF2GNP+ β_2 $P^e + \beta_3$ r_{s3} + β_4 g + β_5 CAPGNP	-2.601692

Appendix 7.3

Cointegration tests on residuals of the term structure model

Regression Equation	ADF Test Statistic
TS11= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-2.255201
TS11= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-2.382379
TS12= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-3.621021
TS12= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-3.162832
TS13= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-3.578240
TS13= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-2.894775
TS21= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-1.717711
TS21= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-2.318963
TS22= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-2.892569
TS22= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-3.380573
TS23= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-2.674932
TS23= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-2.715520
TS31= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-1.977442
TS31= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-2.258186
TS32= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-2.978510
TS32= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-3.593377
TS33= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M1GNP + δ_4 g	-2.783746
TS33= $\delta_0 + \delta_1$ DEF2GNP+ δ_2 $P^e + \delta_3$ M2GNP + δ_4 g	-3.241106

APPENDIX 8

Correlation coefficients between endogenous and instrument variables

Endogenous variable	Instrument variable	Correlation
DEF1GNP	GOVGNP(-1)	0.628245
DEF2GNP	CAPGNP(-1)	0.454871
DEF3GNP	GOVGNP(-1)	0.507798
P^e	INFL(-1)	0.829870
CAPGNP	M1GNP(-1)	0.614427
ΔΔDEF1GNP	Δt(-1)	0.592679
ΔDEF2GNP	ΔTS12(-2)	0.540370
ΔDEF3GNP	ΔM1(-2)	0.465675
ΔP^e	ΔINFL(-1)	0.711505
ΔCAPGNP	ΔRM	0.408752

APPENDIX 9

Correlation coefficients between bond market rates and commercial bank deposit rates in South Africa

Yield	Proxy variable	Correlation
Government stock: 0 – 3 years (TSE code: RB2000J)	Retail deposits - banks fixed deposits - 1-year (TSE code: RB2007J)	0.695684
Government stock: 3 –5 years (TSE code: RB2001J)	Retail deposits - banks fixed deposits - 3-years (TSE code: RB2008J)	0.626202

(Source: TSE, South African Reserve Bank)

APPENDIX 10.1

2SLS Cochrane-Orcutt estimates (Probabilities in brackets) using DEF3GNP as explanatory variable in 'level' models

Appendix 10.1.1

IS/LM model using 'level' variables

Dependent variable	CONSTANT	DEF3GNP	P^e	M1GNP	GOVGNP	t	CAPGNP	R^2	F-Statistic
SR1	6.131389 (0.2106)	0.047343 (0.7037)	0.040449 (0.3643)	-0.37536 (0.0057)	0.630303 (0.0238)	-0.00385 (0.9819)	1.052739 (0.2305)	0.606564	4.882077 (0.00356)
SR2	10.41395 (0.0358)	0.096832 (0.4639)	0.041448 (0.3821)	-0.33474 (0.0218)	0.362444 (0.2068)	-0.16898 (0.3608)	0.984515 (0.2997)	0.582269	4.413976 (0.00587)
SR3	11.19323 (0.0266)	0.038368 (0.7733)	0.042123 (0.3810)	-0.33701 (0.0229)	0.350213 (0.2284)	-0.17014 (0.3644)	0.501359 (0.5989)	0.564315	4.101585 (0.00831)
LR1	6.772771 (0.0935)	0.062878 (0.5899)	0.026316 (0.5303)	-0.19038 (0.1390)	0.435825 (0.0972)	-0.08858 (0.5910)	1.178209 (0.1732)	0.412912	2.22719 (0.08524)
LR2	5.599329 (0.2004)	0.114172 (0.3655)	0.019762 (0.6595)	-0.29122 (0.0378)	0.552639 (0.0519)	0.011337 (0.9485)	0.502050 (0.5784)	0.420343	2.296334 (0.07766)
LR3	5.631274 (0.2379)	0.125260 (0.3646)	0.033945 (0.4911)	-0.28904 (0.0573)	0.644346 (0.0397)	-0.02605 (0.8921)	0.731470 (0.4611)	0.430527	2.394032 (0.06814)

Appendix 10.1.2

Loanable funds model using 'level' variables

Dependent variable	CONSTANT	DEF3GNP	P^e	r_{S3}	g	CAPGNP	R^2	F-Statistic
LR1	2.183058 (0.0020)	0.080040 (0.1469)	0.732117 (0.0000)	0.726803 (0.0000)	0.006528 (0.7828)	0.533703 (0.1673)	0.865940	25.83729 (0.00000)
LR2	2.192390 (0.0008)	0.129180 (0.0205)	0.808494 (0.0000)	0.801428 (0.0000)	-0.00226 (0.9185)	-0.26696 (0.4713)	0.880070	29.35282 (0.00000)
LR3	2.177849 (0.0117)	0.144609 (0.0564)	0.857708 (0.0000)	0.841490 (0.0000)	-0.00624 (0.8406)	-0.08698 (0.8648)	0.814109	17.51794 (0.00000)

Appendix 10.1.3

Term structure model using 'level' variables

Dependent variable	CONSTANT	DEF3GNP	P^e	M1GNP	g	R^2	F-Statistic
TS11	-2.041759 (0.0304)	-0.133314 (0.0746)	-0.023103 (0.3907)	0.152786 (0.0094)	-0.008478 (0.8460)	0.344093	2.754181 (0.055059)
TS12	-1.140419 (0.0467)	-0.000633 (0.9911)	-0.006774 (0.7270)	0.165945 (0.0010)	0.034661 (0.1825)	0.493134	5.107759 (0.004923)
TS13	-1.102578 (0.0273)	0.032725 (0.5314)	-0.006246 (0.7183)	0.159671 (0.0015)	0.027191 (0.2143)	0.464639	4.556471 (0.008319)
TS21	-0.826912 (0.3473)	0.039935 (0.6333)	-0.008411 (0.7762)	0.103213 (0.1099)	-0.025163 (0.5474)	0.214803	1.436224 (0.256970)
TS22	-0.642790 (0.2782)	0.097209 (0.1261)	0.003498 (0.8676)	0.144109 (0.0074)	0.017560 (0.5177)	0.499757	5.244894 (0.004336)
TS23	-0.600602 (0.1360)	0.109284 (0.0228)	0.002340 (0.8737)	0.138127 (0.0029)	0.014418 (0.4240)	0.564460	6.803996 (0.001123)
TS31	0.091683 (0.9303)	0.062751 (0.5498)	0.001691 (0.9630)	0.070242 (0.3816)	-0.033003 (0.5065)	0.141014	0.861856 (0.502828)
TS32	0.029699 (0.9693)	0.115051 (0.1560)	0.012510 (0.6469)	0.117850 (0.0655)	0.009004 (0.8027)	0.398599	3.479619 (0.024888)
TS33	-0.208659 (0.7402)	0.145304 (0.0366)	0.008681 (0.6996)	0.113687 (0.0383)	0.009953 (0.7330)	0.504375	5.342686 (0.003964)

APPENDIX 10.2

2SLS estimates (Probabilities in brackets) using ΔDEF3GNP as explanatory variable in 'differenced' models[152]

Appendix 10.2.1

IS/LM model using 'differenced' variables

Dependent variable	CONSTANT	ΔDEF3GNP	ΔP^e	ΔM1GNP	ΔGOVGNP	Δt	ΔCAPGNP	F-Statistic
ΔSR1	0.140352 (0.7040)	-0.03692 (0.9346)	0.045645 (0.5014)	0.118204 (0.6505)	0.229424 (0.5098)	-0.22444 (0.4419)	1.825261 (0.3925)	0.389609 (0.87654)
ΔSR2	0.319205 (0.4826)	-0.30693 (0.5793)	0.056067 (0.5002)	0.172257 (0.5904)	-0.01335 (0.9749)	-0.08707 (0.8062)	0.123222 (0.9620)	0.124940 (0.99181)
ΔSR3	0.350377 (0.4088)	-0.28595 (0.5789)	0.049613 (0.5212)	0.147610 (0.6199)	0.007865 (0.9841)	-0.01244 (0.9699)	-0.66439 (0.7830)	0.166698 (0.98267)
ΔLR1	0.271786 (0.5731)	-0.41329 (0.4838)	0.049009 (0.5788)	0.260265 (0.4462)	0.203676 (0.6523)	-0.09521 (0.8009)	0.591426 (0.8301)	0.294973 (0.93183)
ΔLR2	0.284008 (0.4565)	-0.17337 (0.7081)	0.044815 (0.5201)	0.142512 (0.5952)	0.176808 (0.6199)	0.019093 (0.9488)	-0.46427 (0.8307)	0.254900 (0.95114)
ΔLR3	0.226295 (0.5512)	-0.05931 (0.8977)	0.056948 (0.4146)	0.168485 (0.5298)	0.207305 (0.5608)	-0.03299 (0.9115)	-0.07818 (0.9712)	0.318369 (0.91932)

Appendix 10.2.2

Loanable funds model using 'differenced' variables

Dependent variable	CONSTANT	ΔDEF3GNP	ΔP^e	Δr_{S3}	Δg	ΔCAPGNP	F-Statistic
ΔLR1	-0.166331 (0.6990)	0.092334 (0.8873)	1.312934 (0.2756)	1.324929 (0.2957)	0.016050 (0.8890)	0.742627 (0.6634)	1.560909 (0.216466)
ΔLR2	0.092203 (0.8467)	-0.200249 (0.7821)	0.498135 (0.7056)	0.471402 (0.7343)	-0.053575 (0.6753)	0.027640 (0.9883)	1.105339 (0.388639)
ΔLR3	0.213312 (0.8415)	-0.488835 (0.7629)	-0.059430 (0.9839)	-0.121030 (0.9689)	-0.111221 (0.6974)	0.294093 (0.9445)	0.252276 (0.933694)

Appendix 10.2.3

Term structure model using 'differenced' variables

Dependent variable	CONSTANT	ΔDEF3GNP	ΔP^e	ΔM1GNP	Δg	F-Statistic
ΔTS11	-0.047500 (0.9439)	-0.860162 (0.5504)	0.000836 (0.9940)	-0.174849 (0.7571)	-0.139822 (0.4779)	0.149828 (0.961003)
ΔTS12	0.006448 (0.9721)	-0.026454 (0.9461)	0.002910 (0.9237)	0.161122 (0.3022)	0.009968 (0.8522)	0.421880 (0.791048)
ΔTS13	0.026017 (0.8662)	-0.051670 (0.8749)	0.006929 (0.7856)	0.180193 (0.1727)	0.005854 (0.8961)	0.773182 (0.554846)
ΔTS21	-0.109123 (0.8387)	-0.608121 (0.5948)	-0.000901 (0.9919)	-0.286895 (0.5245)	-0.132037 (0.4002)	0.225642 (0.920993)
ΔTS22	-0.055174 (0.7783)	0.225587 (0.5892)	0.001172 (0.9710)	0.049076 (0.7648)	0.017754 (0.7550)	0.122914 (0.972662)
ΔTS23	-0.035605 (0.7711)	0.200370 (0.4442)	0.005192 (0.7970)	0.068146 (0.5079)	0.013640 (0.7014)	0.398706 (0.807307)
ΔTS31	-0.122912 (0.8005)	-0.428628 (0.6789)	0.011042 (0.8905)	-0.215184 (0.5981)	-0.113513 (0.4248)	0.246899 (0.908304)
ΔTS32	-0.068964 (0.8208)	0.405080 (0.5331)	0.013116 (0.7939)	0.120787 (0.6362)	0.036278 (0.6819)	0.197515 (0.936894)
ΔTS33	-0.049395 (0.8379)	0.379863 (0.4622)	0.017135 (0.6676)	0.139857 (0.4913)	0.032164 (0.6471)	0.359652 (0.834430)

[152] The R^2 's are not shown here because the insignificant F-statistics automatically imply that those models produce bad fits. The low R^2 's are expected in models having 'differenced' variables.