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ESTIMATING THE EQUILIBRIUM REAL EXCHANGE RATE AND MISALIGNMENT FOR NAMIBIA

by

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SUMMARY

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By

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The exchange rate is one of the most challenging macroeconomic policy issues in any economy. There is a general agreement that policymakers should aim at avoiding real exchange rate misalignment. To avoid real exchange rate misalignment, it is important to identify the equilibrium real exchange rate. To identify the equilibrium real exchange rate it is necessary to understand the drivers of the real exchange rate, and investigate the extent to which the real exchange rate is driven by various determinants.

Despite the fact that the real exchange rate is a very important component of macroeconomic policy, empirical investigation of the real exchange rate in Namibia is very limited. It is against this background that the objective of this study is to estimate the equilibrium real exchange rate and the resulting real exchange rate misalignment for Namibia during period 1970 to 2004. It also investigates the impact of real exchange rate misalignment on economic performance and competitiveness. The equilibrium real exchange rate and resulting real exchange rate misalignments were estimated using theoretical models and the application of time series econometric techniques. The fundamental approach model and the model of real exchange rate and real prices of commodities exports were estimated using the Johansen full information maximum

likelihood technique. According to the estimation based on the fundamental model the real exchange rate is determined by terms of trade, openness of the economy and ratio of investment to GDP. Equilibrium real exchange rate was estimated and the results showed that the real exchange rate was misaligned. Since Namibia is a commodity exporting country the relationship between the real exchange rate and prices of commodities was also investigated. The analysis revealed that there is a long-run co-movement between real exchange rate and prices of commodity exports. Increase in prices of commodities causes the real exchange rate to appreciate. There was some overvaluation and undervaluation.

The VAR methodology was implemented to test the impact of real exchange rate misalignment on economic performance and competitiveness. The analysis revealed that real exchange rate misalignment hampers economic growth and competitiveness. It is important for policymakers to monitor the real exchange rate and ensure that it does not diverge significantly from its equilibrium value. Reduction in real exchange rate misalignment is also important to ensure that the country achieves a high level of export and remains competitive in order to have a sustainable level of growth. As a commodity exporting country, Namibia can have either a flexible nominal exchange rate regime which facilitates slow change of relative inflation rate, or price and wage flexibility to facilitate the maintenance of the nominal exchange rate peg. Alternatively, Namibia is a good candidate for pegging the currency to the prices of export commodities because its export is concentrated on few products. This option implies that Namibia leaves the CMA. However, it is important to note that Namibia is a proponent of regional integration and a move away from the CMA will not be consistent with the plans of SADC to establish a monetary union by 2016.

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BMA	Bilateral Monetary Agreement
CMA	Common Monetary Area
ERER	Equilibrium real exchange rate
FIML	Full Information Maximum Likelihood
GDP	Gross Domestic Product
IMF	International Monetary Fund
LAGRIC	Log of agricultural output
LEXPORT	Log of total export of goods and services
LGOV	Log of government expenditure
LINVGDP	Log of the ratio of investment to GDP
LOPEN	Log of openness of the economy
LRCOMP	Log of real commodity prices
LREER	Log of REER
LRESBAL	Log of resource balance
LRPERCAPI	Log of real GDP per capita
LTOT	Log of terms of trade
LTUNITCOST	Log of total unit labour cost
MISALIGNMENT	Real exchange rate misalignment
OPEN	Openness of the economy
PPP	Purchasing Power Parity
REER	Real Effective Exchange Rate
RER	Real Exchange Rate
TOT	Terms of Trade
VAR	Vector Autoregression
VECM	Vector Error Correction Model

CHAPTER 1. INTRODUCTION

1.1 Introduction

One of the most challenging macroeconomic policy issues is exchange rate management. It is generally agreed that the main objectives of the exchange rate policy should be to correct real exchange rate misalignment. Real exchange rate misalignment is a serious problem in many developing countries. In order to correct real exchange rate misalignment it is important to identify the equilibrium real exchange rate. The identification of the equilibrium real exchange rate is not observable directly and this poses a fundamental difficulty in real exchange rate economics.

A large number of empirical studies estimated the equilibrium real exchange rate using the theory which states that the equilibrium real exchange rate depends on the fundamental variables, and that the actual real exchange rate converges to the equilibrium over time. It is important for monetary policy makers to understand what drives developments in the real exchange rate. That is because the investigation of macroeconomic impact of the real exchange rate depends on the source of the variables that drive them (developments in the real exchange rate). Although it is not easy, it is important to investigate the extent to which developments in the real exchange rate are driven by various fundamentals.

Like other economies, a study of the behaviour of the real exchange rate and its determining factors is very important for Namibia. Empirical studies of the real exchange rate for Namibia are limited. It is in light of this background that the general objective of this study is to develop and estimate the equilibrium real exchange rate and the resulting real exchange rate misalignment for Namibia.

This chapter starts by introducing the real exchange rate theory, an overview of Namibia's exchange rate policy and outlines the research objectives as well as hypotheses to be tested. The chapter also discusses the research methodology and outline of the thesis. This chapter is organised as follows. Section 1.2 introduces the real exchange rate theory. Section 1.3 presents an overview of exchange rate policy in Namibia. Section 1.4 defines the research problem while Section 1.5 discusses the research objectives. The methodology and outline of the thesis are presented in Sections 1.6 and 1.7.

1.2 Introduction to Real Exchange Rate Theory

The exchange rate is important because it affects many variables in the economy. Changes in the country's exchange rate affect the local currency equivalent of prices which domestic producers of given goods and services receive and their incentives to supply those products. The exchange rate affects resource allocation between tradable goods and non-tradable goods. The exchange rate movement may also affect foreign demand, depending on the type of product and the country's position in the world market for that product. In a small open economy, the prices of a country's exports and imports are determined in the world market, and in this context the exchange rate affects the output of goods and services and demand for foreign products, but does not affect the foreign demand for the country's products.

The exchange rate affects the decision to invest and save. Changes in the exchange rate may have direct effects on the distribution of income and wealth. This is especially applicable between urban consumers and rural producers of exports. The exchange rate is the main variable that determines movements in the balance of payments and is regarded as a nominal anchor for the level of prices. This means that changes in exchange rates because of shocks to the balance of payments affect output and stability of prices.

Edwards (1988a) pointed out that the exchange rate is expected to provide signals to economic agents in the economy. Information on the extent to which the real exchange rate diverges from its equilibrium level, serves as a guide to policy makers to ensure that the real exchange rate does not send wrong signals to economic agents. Wrong signals can result in inefficient resource allocation and lead to reduction of the country's welfare. Misalignment of the real exchange rate could rise economic instability and distort investment decisions.

Studies on the real exchange rate have taken and still are taking centre stage in both academic and policy research. That is because almost all structural adjustment programmes target the exchange rate as a key instrument to achieve the necessary reforms. Duesenberry *et al*. (1994) maintained that because of the variety of influences exerted by the exchange rate, disagreements over the choice of the exchange rate target and whether and how government should intervene to attain a certain target is inevitable. Concern often centres on steering the right mix of policies which aim at avoiding real exchange misalignments.

Analysts of the real exchange rate often encounter problems of determining by how much the real exchange rate diverge from its equilibrium value. Measuring the real exchange rate misalignment requires information about the real exchange rate and equilibrium real exchange rate. These are not observable directly like the nominal exchange rates. Real exchange rate misalignment is defined by Edwards (1988a; 1988b) as a sustained departure of the actual real exchange rate from its equilibrium value. To obtain the values of the real exchange rate misalignment, the equilibrium real exchange rate must be estimated, and the real exchange rate must also be computed. The literature does not provide clear cut guidance on the measurement and conceptual definitions and interpretations of the real exchange rate, although the World Bank has prepared manuals on the computation of external and internal real exchange rate.

1.3 Overview of the Exchange Rate Policy in Namibia

1.3.1 Monetary and Exchange Rate Arrangements

Developments in exchange rate and monetary policy in Namibia must be viewed in the context of the country's colonial relationship with South Africa. Namibia was a German colony between 1884 and 1919 and used the German Reichsmark. The League of Nations abolished Germany's colonisation of the then South West Africa after the First World War (which ended in 1919) and placed the country under the mandate of South Africa. This resulted in the inclusion of Namibia into the South African monetary and exchange rate system. South African banking institutions were extended to Namibia with the main purpose of financing commerce and trade. The South African Reserve Bank opened its branch in Windhoek in 1961 (Kalenga, 2001: 3; Ikhide and Fitchat, 2002: 42). The role of the South African Reserve Bank branch in Windhoek was the distribution of notes and coins, administration of exchange controls and acting as banker to commercial banks.

At independence from South Africa in 1990 Namibia faced a choice on whether to remain in the Common Monetary Area (CMA) or whether to have an independent monetary system by leaving the CMA and explore some alternative exchange rate regimes (Namibia was regarded as *de facto* member of the CMA before independence by being a South African colony). Namibia formally joined the CMA on 6 February 1992 (Van Der Merwe, 1996: 14). This membership was formalised by accession to both the multilateral agreement between Namibia, Lesotho, Swaziland and South Africa in 1990 and a separate agreement between each country and South Africa in 1992. The obligations of Namibia are spelled out in the Multilateral Monetary Agreement (MMA) of 1992 and the Bilateral Monetary Agreement (BMA) with South Africa in 1993. As Kalenga (2001: 3) and Dwight (2006: 52) point out, the dominant features of the MMA arrangement are:

- Each CMA member country may issue its own national currency after consulting with South Africa;

- Current or capital account transactions in the CMA may not be restricted, but members (of the CMA) may impose domestic investment requirements.
- The agreement makes provision for governments and financial institutions of Lesotho, Namibia and Swaziland to have access to South African capital and money market;
- Each CMA member country has a Central Bank and foreign exchange responsibility within its territory;
- Since the rand is circulating within the territories of Lesotho, Namibia and Swaziland, South Africa compensates these countries for loss of seigniorage.

The mechanics of Namibia's peg to the rand and access to South Africa's financial markets are provided in the BMA of 1993 (Dwight, 2006: 52):

- The bilateral agreement provides that either of the contracting parties has the right to issues its own currency, and either party may introduce measures for domestic resource mobilisation in the interest of the development of their respective economies.
- A commitment by the Bank of Namibia to exchange the domestic currency for a specified amount of the reserve currency, the rand without restrictions and this is subject to the normal handling charge at a fixed exchange rate;
- A requirement that at least a proportion of its monetary liabilities be backed by reserve currency or foreign assets. The BMA provides for 100 percent foreign exchange backing for the Namibia dollar. Namibia agrees that the South African rand is a legal tender within its territory;
- The Bank of Namibia and the South African Reserve Bank manage their own foreign exchange reserves separately;
- Lack of flexibility in changing the exchange rate and the need to fulfil backing rules.
- Namibia agrees to bring its exchange controls in conformity with those of South Africa. South Africa agrees to consult with Namibia before changing the exchange controls.

- South Africa agrees to compensate Namibia for loss of seigniorage because of rand circulation in Namibia.

From the key features of the MMA and BMA it is clear that that the CMA countries do not share a common currency and they have not committed themselves to exchange rate parities irrevocably. This means that Namibia, Lesotho and Swaziland still have the option to adjust the value of their currencies. Although Lesotho, Namibia and Swaziland are compensated to some extent by South Africa, they do not share in the seigniorage of a common currency.

The CMA is an asymmetric currency and the three smaller countries (Namibia, Lesotho and Swaziland) are dominated by South Africa. Namibia's currency, the Namibia dollar is pegged to the South African rand on a one to one basis (see Tjirongo, 1995: 2). Together with Lesotho and Swaziland, Namibia is constrained by its fixed exchange rate to follow South Africa's monetary policies and there is no joint policy making. The CMA is a hybrid of a currency board and a monetary union. It is regarded as a currency board because the issuing of domestic currency is backed by foreign assets. The domestic currency is fully convertible with the reserve currency. Monetisation of a fiscal deficit is not allowed in the CMA. However, as Ikhide and Fitchat (2002: 58) state, the monetary system in Namibia is governed by a central bank, the Bank of Namibia. The Bank of Namibia has the authority to do normal functions ordinarily done by central banks. This includes the possibility of extending loans to the government of Namibia. It regulates commercial banks and provides lender of last resort services. The CMA differs from the full monetary union in the sense that each country has its own central bank.

Since there is no institution that acts as an orthodox currency board, the central banks of Lesotho, Namibia and Swaziland have some freedom in monetary policy (Dwight, 2006: 53). Dwight notes that the Bank of Namibia maintained a varying and largely negative interest rate with South Africa's policy rate before 2004.

Following the classification of the different types of monetary integration by Cobham and Robson (1994: 287), the CMA would be regarded as an informal exchange rate union. That is because the CMA has no reserve pooling, no single central bank and no single currency.

1.3.2 The CMA and Optimum Currency Areas

Monetary arrangements under the CMA raise an important question on whether it (CMA) is an optimum currency area. An optimum currency area is defined as an area in which it is best to use a single currency. Mundell (1961) initiated the literature of optimum currency area and argued that although transaction costs associated with changing or exchanging money are lower within the currency union, fixing the exchange rate across countries by forming a currency union is costly if countries face asymmetric disturbances and when prices are sticky. These costs could be reduced if there is a high level of factor mobility (such as labour mobility) between countries, flexible wages and prices as well as fiscal transfers. Mundell viewed mobility of factors such as labour as a key factor in deciding whether to join a currency union.

McKinnon (1963) stated that openness of the economy is another important criterion for the choice of currency union. If an economy is more open to external trade, a floating exchange rate would be relatively ineffective because changes in the exchange rate would destabilise the internal price level and have few advantages on real wages and terms of trade. Kenen (1969) states that countries with a wide range of products would be able to maintain a currency union compared to those with few products. This is because countries with low product diversification are subject to larger disturbances. Mundell (1961), McKinnon (1963) and Kenen (1969) represent the core of the theory of optimum currency areas and form the basis for much of the empirical studies in this area.

Other criteria that affect the desirability of currency union or a fixed exchange rate are benefits from lower trade and investment costs, asymmetry of shocks, the ability of authorities to resist monetising fiscal deficits and the desirability of adopting monetary policy of the anchor currency (see Dwight, 2006; Tjirongo, 1995). As Dwight (2006: 54) notes, there is no consensus on the methodology of assessing the costs and benefits identified by the theory of optimum currency areas, and many analyses focus on criteria such as labour mobility and asymmetry of shocks. Some criteria such as the cost of political considerations or the value of tying the hands of the authorities are difficult to measure, and hence different analysts place different weights on different aspects of monetary integration.

A fixed exchange rate regime can alleviate the costs of trade and cross-border investment if the intensity of trade and cross-border investment is higher. Namibia's direction of trade by region in 2003 compared with other members of the CMA is presented in Table 1. Table 1 shows that Lesotho, Namibia and Swaziland trade more with South Africa. Since the intensity of mutual trade in the CMA especially on imports is high, a fixed exchange rate could help to reduce the costs of trade.

Table 1. Direction of trade (in percentage) in 2003

Region	Lesotho	Namibia	South Africa	Swaziland
		Exports		
CMA	19.0	28.6	7.3	68.2
Rest of Africa	0.2	5.5	12.7	11.7
Europe	0.1	49.7	30.6	1.9
America	79.5	5.9	9.7	9.1
Other	0.8	10.3	39.7	9.1
		Imports		
CMA	86.0	81.5	1.3	89.0
Rest of Africa	0.1	1.3	3.0	0.6
Europe	0.1	6.2	43.4	1.2
America	0.2	0.8	9.7	0.3
Other	13.6	10.2	42.6	9.0

Source: Dwight (2006: 55)

According to the theory of optimum currency areas, countries that are subject to similar economic shocks have less need for exchange rate adjustment as an instrument to offset those shocks. Although the intensity of mutual trade in the CMA is high, Table 2 and Table 3 show that Namibia together with Lesotho and Swaziland are exposed to different economic shocks than South Africa. Namibia has lost the ability to adjust the exchange rate due to its peg of the Namibia dollar to the rand. Compared to other CMA members, Namibia's exports are concentrated on two commodities, diamonds and fish. These two commodities account for more than half of Namibia's total commodity exports. Clothing is Lesotho's major exports, accounting for 71.8 percent of the total commodity exports. Swaziland's exports are concentrated on edible concentrates which accounts for 55 percent of the total commodity exports. South Africa is the only country with diversified exports, and no single commodity accounts for more than 12 percent of its total exports.

Table 2. Main commodity exports of the CMA (percentage of total export) in 2003/2004

Lesotho	Namibia	South Africa	Swaziland
Clothing (71.8)	Diamonds (40.8)	Gold (11.8)	Edible concentrates (55.1)
Telecom equipment (8.1)	Fish (18.3)	Iron and steel (9.0)	Cotton seed and lint
Footwear (3.7)	Other minerals (14.6)	Platinum (8.2)	Wood pulp (12.9)
Beverages and tobacco (2.7)	Some manufactured (12.1)	Other metals (7.2)	Sugar (8.5)
Wool (2.3)	Live animals (6.3)	Motor vehicles (6.9)	Plastic products (2.7)

Sources: Data for Lesotho are obtained from the IMF Country Report No. 05/438 and Central Bank of Lesotho's Annual Report. Data for Namibia are obtained from the Namibia's Central Bureau of Statistics. Data for Swaziland were obtained from the IMF's Country Report No. 06/109, and data for South Africa were obtained from Statistics South Africa.

The structure of production in the CMA shows that agriculture is a significant contributor to GDP in Lesotho, Namibia and Swaziland, but it accounts for only 4 percent of the GDP in South Africa. Mining accounts for 15 percent of Namibia's GDP compared to 8 percent of South Africa's GDP. Namibia has the lowest share of manufacturing as percentage of GDP than other CMA members.

Table 3. The structure of production in the CMA: sectors' contribution to GDP in 2004

	Lesotho	Namibia	South Africa	Swaziland
Agriculture, forestry and fishing	16	11	4	13
Mining and quarrying	0	15	8	0
Manufacturing and construction	38	16	24	30
Services	46	58	64	57
Total	100	100	100	100

Sources: Data for Lesotho are obtained from Central Bank of Lesotho' Annual Reports. Data for Namibia are obtained from the Bank of Namibia's Annual Reports, while those of Swaziland are obtained from the IMF Country Report No. 06/109. South African data were sourced from South African Reserve Bank's Quarterly Bulletins.

The CMA agreements could restrict the ability of the Bank of Namibia to pursue expansionary monetary policies in order to boost growth or create money to finance the budget deficit. The CMA arrangements require that the Namibia dollar be 100 percent backed by foreign exchange. This arrangement puts an upper limit on the quantity of money which the Bank of Namibia can circulate. Despite these arrangements Dwight (2006: 56) notes that foreign exchange backing for the Namibia dollar has been about twice the currency in circulation and this implies that the 100 percent backing requirement has not been binding. The Bank of Namibia has been able to use its limited flexibility within the constraint of the fixed exchange rate in order to keep interest rates below those in South Africa for an extended period so as to promote economic growth. According to Dwight (2006: 57) this differential was eliminated in mid-2004 to help safeguard international reserves.

With regard to fiscal policy the authorities' policies have been prudent and the government has relied on the issuance of debt and has not financed the deficit through money creation. Since the CMA arrangements imply that the hands of the authorities are tied, the value of tying the hands of the authorities may be less.

Labour mobility that was cited by Mundell (1961) as an important criterion for currency or monetary union to be successful appears to be more important for Lesotho and Swaziland, but has less impact for Namibia and South Africa. The mobility of labour between countries can help to compensate for lack of exchange rate flexibility. According to De Grauwe (1992: 8), if there are two countries, one with trade surplus and the other one with a trade deficit, labour can move from a country with high unemployment and trade deficit to the one with low unemployment and trade surplus. This can smooth income by preventing employment losses in countries with trade deficit.

Dwight (2006: 57) states that a significant number of workers from Lesotho and Swaziland work in South Africa. Approximately 2 percent of Swaziland's workforce is employed in South African mines and remittances from expatriates accounted for 5 percent of GDP in 2004. Lesotho has about 15 percent of its workforce employed in South Africa and remittances have accounted for 22 percent of GDP in recent years. According to Dwight (2006: 58) labour mobility with regard to Namibia appears lower because the government limits immigration in order to promote Namibianisation. With regard to South Africa, labour mobility to and from CMA has less impact because South Africa accounts for more than 90 percent of the CMA population. Tjirongo (1995: 9) notes that labour mobility between South Africa and its neighbouring countries has been extensive, and more so in mining. Labour movement between Namibia and South Africa has been very small and this could be attributed to the fact that mining itself is the dominant activity in the Namibian economy. It appears that the mobility of labour in the CMA is a significant instrument of adjustment for Lesotho and Swaziland, but not for Namibia.

1.3.3 Implications for Monetary and Exchange Rate Policies

The full convertibility requirement implies that 100 percent of the Namibian currency, the Namibia dollar, is fully backed by foreign exchange assets. Budget deficit cannot be accommodated by printing money. As Tjirongo (1995: 3) states, the free flow of capital between Namibia and the rest of the CMA ensures that interest rates in Namibia are determined in the larger money and capital market of South Africa. CMA membership also implies that Namibia loses the nominal exchange rate as a policy instrument. The exchange rate system of the South African rand is applicable in the CMA.

Under these conditions, the equilibrium real exchange rate will not only be influenced by Namibian fundamentals, but South Africa's as well. Pegged currencies are also vulnerable to speculative attacks, and this suggests that the focus on the causes of exchange rate tensions and the extent to which exchange rates are in line with economic fundamentals, are important. It is necessary to examine trends over time in the indicators of a country's external competitiveness and balance of payments to asses whether its real exchange rate is likely to be consistent with a sustainable external account. Devarajan

(1999) showed that real exchange rate misalignment in the CFA Franc Zone, was disproportionally distributed. Countries whose exports are dominated by primary products experienced the largest real exchange rate misalignments. This shows that the costs of real exchange rate misalignments for countries participating in a currency union may be unevenly distributed.

Estimation of the real exchange rate misalignments is necessary for Namibia. Namibia has a higher share of primary exports to overall exports in comparison to other members of the CMA. It is likely that Namibia experienced some real exchange rate misalignments in response to shocks that affected primary products.

1.4 Statement of the Research Problem

The preceding sections provided a basis on which to conceptualise the research problem. It was pointed out firstly that the real exchange rate is important because it affects many variables in the economy. It affects foreign demand for domestic goods depending, on the country's position in the world market. It affects decisions to save and invest and is expected to provide signals to economic agents in the economy. Information on the extent to which the real exchange rate diverges from its equilibrium rate serves as a guide to policy makers to ensure that it does not send wrong signals to economic agents. Wrong signals can result in inefficient allocation of resources and could cause a reduction in the country's welfare.

Secondly, a review of monetary and exchange rate arrangements showed that the CMA is an informal exchange rate union. Namibia's membership of the CMA implies that the country loses the exchange rate as an instrument of adjustment. Although there is a significant amount of trade between Namibia and South Africa, the two countries are subjected to different shocks. The composition of Namibia's trade as well as that of its GDP differs from South Africa's. It is to be expected that Namibia's terms of trade differs from that of South Africa.

Thirdly, labour mobility which was cited as a key criterion for the success of currency union is not important to Namibia. There is very low labour mobility between Namibia and South Africa. Labour mobility is not a significant instrument of adjustment for Namibia.

Fourthly, Namibia's export is dominated by few primary commodities, and it is argued that countries with a high percentage of primary commodities in their total export, experience the largest real exchange rate misalignments. Since Namibia has more primary commodities in its total exports compared to other members of the CMA it is likely that the country experienced real exchange rate misalignment in response to shocks that affect commodity export prices. Since Namibia cannot use the exchange rate as an instrument of adjustment, it is likely that there were some misalignments because under that arrangement real exchange rate cannot be immediately or easily realigned.

Although the real exchange rate is an important variable in the economy, empirical research on the determination of the equilibrium real exchange rate in Namibia is limited. This could be because estimating the equilibrium real exchange rate is a challenging task. It requires the determination of the equilibrium real exchange rate in the first place and then measurement of the degree of deviation of the actual real exchange rate from this equilibrium value. Methods of estimating the equilibrium real exchange rate and the resulting real exchange rate misalignments have been advanced by new time series econometrics such as unit roots, cointegration and vector autoregression. It is against this background that this thesis focuses on the determinants of the real exchange rate and resulting real exchange rate misalignments in Namibia. It also assesses the impact of real exchange rate misalignment on economic performance. The research is divided into the following questions:

- What are the determinants of the equilibrium real exchange rate in Namibia?
- Was the real exchange rate in Namibia misaligned?
- If there were misalignments, what is the impact of those real exchange rate misalignments on economic performance of Namibia?

1. 5 Objective of the Study

The objective of the study is to:

- Estimate the determinants of the real exchange rate and equilibrium real exchange rate for Namibia and policy implications;
- Measure the resulting real exchange rate misalignment;
- Test the impact of real exchange rate misalignment on measures of economic performance (investment, per capita, agricultural sector and export sector).

The study covers the period 1970 to 2004. The analysis of how changes in the fundamental determinants affect the equilibrium real exchange rate can provide some additional guidance to the prevailing exchange rate policy. This could help to draw inferences about the type of exchange rate regime for Namibia.

The study will test the following main hypotheses:

- Pegged currencies are vulnerable to speculative attacks, and countries whose exports are dominated by primary exports experience the largest real exchange rate misalignment.
- The following two sub-hypotheses will also be tested:
    - Namibia’s export is dominated by primary export and is likely to have experienced real exchange rate misalignment in response to external shocks that affected primary products.
    - Real exchange rate misalignment affects economic growth, investment, export and competitiveness of the country’s economy. It also increases capital flight and could undermine the performance of the agricultural sector.

1.6 Methodology

The methodology of this study comprises the following:

- A review of exchange rate and monetary policies in Namibia.
- Extensive review of the literature on the determinants of the real exchange rate and the resulting real exchange rate misalignment. An investigation of the theories and empirical studies regarding the hypothesis and signs of coefficients of the determinants of the real exchange rate.
- The application of time series techniques to estimate the equilibrium real exchange rate and resulting real exchange rate misalignment. The technique applied to estimate the equilibrium real exchange rate is Johansen (1988, 1995) full information maximum likelihood.
- An investigation of the impact of real exchange rate misalignment on economic performance using vector autoregression technique.

1.7 Outline of the Study

The rest of the thesis is organised as follows. Chapter 2 deals with the fundamental literature on the real exchange rate with special emphasis on concepts, definitions, analytical framework, the theoretical model, fundamental determinants and empirical studies.

Chapter 3 deals with real exchange rate and commodity prices. It examines the theory and empirical studies on the relationship between real exchange rate and commodity prices for a commodity exporting country such as Namibia. The model is discussed and empirical studies are reviewed.

Chapter 4 discusses the real exchange rate misalignment. The emphasis is on theory, models and empirical studies of the impact of real exchange rate misalignment on economic performance.

Chapter 5 presents an econometric analysis of real exchange rate in Namibia. It discusses the estimation technique and data to be used in the estimation. It then presents the results for both the three-good model and the Cashin *et al*. model.

Chapter 6 discusses the impact of real exchange rate misalignment on economic performance. It applies the technique for assessing the impact of real exchange rate misalignment on economic performance and presents the results. The conclusion and policy implications are provided in Chapter 7.

CHAPTER 2. FUNDAMENTAL LITERATURE ON REAL EXCHANGE RATE

2.1 Introduction

This chapter discusses the fundamental literature on the real exchange rate. It starts with the conceptual definition of the real exchange rate, the analytical framework and theoretical model. The chapter also reviews the literature on the fundamental factors that influence the real exchange rate as well as the empirical studies on the real exchange rate.

The chapter is organised as follows. Section 2.2 discusses briefly the theoretical foundations of real exchange rate. Section 2.3 provided concepts and definitions. Section 2.4 deals with analytical framework. Section 2.5 presents the theoretical model. Section 2.6 reviews the literature on fundamentals and empirical studies. The conclusion is provided in Section 2.7.

2.2 Theoretical Foundations of Real Exchange Rate

Frequent movements in the real exchange rate had been and still are regarded as temporary divergence of the real exchange rate from its sustainable equilibrium value. The purchasing power parity (PPP) hypothesis remains a prevailing pattern in the discussion of the real exchange rate and other topics of international finance. The PPP hypothesis was pioneered by Cassel (1922) and states that the nominal exchange rate should reflect the purchasing power of one currency against another. According to Cassel (1922: 140-162) the purchasing power exchange rate is measured by the reciprocal of one country's price level, $1/P$ against another, $1/P*$, where $1/P$ and $1/P*$ are domestic and foreign countries' internal purchasing power parity. The purchasing power parity rate is a rate at which the nominal exchange rate e would tend. This is when trade imbalances, speculation, central bank intervention and other barriers to trade do not exist. It is expressed as: *e =(1/P*)/(1/P)=P/P*=n*, where *n* is purchasing power exchange rate. The real exchange rate, *rer* is defined as $(e \cdot P^*)/P$. If absolute PPP holds *rer =1*. The relative version of the PPP which uses price indexes allows *rer* to be some constant scalar *Φ* (see Breuer, 1994: 247). The PPP hypothesis is tested empirically as $\ln e_t = \alpha + \beta \ln(p_t - p_t^*) + \varepsilon_t$, where p_t and p_t^* are domestic and foreign prices and ε_t is the error term. If there is absolute PPP $\alpha = 0$ and $\beta = 1$. Evidence of relative PPP requires that α will not be zero. The PPP equation has been tested empirically, and Officer (1976), Isard (1976) and Frenkel (1978; 1981), were some of the first notable studies. Isard (1976) and Officer (1976) did not find evidence in support of the PPP hypothesis. However, Frenkel (1978, 1981) found evidence in favour of the PPP hypothesis.

Breuer (1994: 263-274) summarised some empirical studies on the PPP hypothesis and showed that many studies did not find evidence in support of the PPP hypothesis. There were few studies that supported the PPP hypothesis before the late 1980s, but after that period most studies rejected the PPP hypothesis. Although the PPP had served as and still regarded as a benchmark for the value of currencies it is not an appropriate representation of the equilibrium real exchange rate especially when fundamental disturbances exist (Allen, 1995: 1). It only relates the exchange rate to the relative foreign and domestic prices. Allen argues that the natural real exchange rate offers an alternative pattern or paradigm for the equilibrium real exchange rate. The natural real exchange rate refers to medium term and inter-cyclical equilibrium real exchange rate. It is the equilibrium real exchange rate that clears the balance of payments when cyclical factors, speculative capital flows and movements in international reserves do not exist (Allen, 1995: 6). This equilibrium real exchange rate changes when there is a movement in the fundamentals.

The natural equilibrium real exchange rate approach identifies the fundamental determinants and models for estimation (of the equilibrium real exchange rate). This approach is mainly empirical and it aims at explaining long-term movement of the real exchange rate. Fundamental disturbances (which will be explained later in this study) occur regularly and move the natural equilibrium real exchange rate to a new long-run value, and does not (the natural equilibrium real exchange rate) reach a steady state.

According to Allen (1995: 9) since the fundamental disturbances are not constant around the mean, the real exchange rate will also not be moving around the mean. If that was the case, then the real exchange rate will also converge to a given mean or trend. The main criticism of the PPP hypothesis is that it does not take into account of movements in the fundamentals. It postulates that the real exchange rate is stationary around a given mean and fluctuations in the nominal exchange rate are solely attributed changes in relative prices.

The natural real exchange rate is also supported by Stein (1994: 137) who argues that the PPP hypothesis is not correct and must be replaced by the natural real exchange rate generated by the fundamentals. Stein provided empirical evidence using USA data that the real exchange rate has not been stationary.

Williamson (1983, 1994) also rejected the PPP postulation that the equilibrium real exchange rate is an immutable number. He argued that the real exchange rate changes over time and this can be caused by factors such as productivity. If a country is growing faster than others the real exchange rate will appreciate. Other fundamentals such as accumulation of foreign liabilities by a country in order to finance its deficit, and changes in the terms of trade also cause the real exchange rate to fluctuate. Williamson proposed a fundamental equilibrium real exchange rate. The fundamental equilibrium real exchange rate is a rate which is in line with macroeconomic balance. This means that internal and external balances are achieved.

The fundamental equilibrium real exchange rate differs from the natural equilibrium real exchange rate in the sense that it is a rate that will guide policy. It is a measure that makes the current account to be consistent with sustainable capital flows. According to Allen (1995: 10) and Williamson (1994: 180) the fundamental equilibrium real exchange rate is normative and this is the main difference with the natural equilibrium real exchange rate. The natural equilibrium real exchange rate takes the fundamentals such as trade and commercial policies as given, and has no judgement as to whether the fundamentals are in line with the welfare of the country. This analysis illustrate that there is a criticism of the PPP hypothesis and the natural real exchange rate which is a function of fundamentals has gained popularity in real exchange rate discussions.

2.3 Concepts and definitions

There is no single definition of the real exchange rate that is accepted generally by economists as well as analysts. Montiel (2003: 312) defines in broad terms the real exchange rate as the relative price of foreign goods in terms of domestic goods. Montiel notes that what constitutes domestic and foreign goods depends on the particular analytical framework and the specific macroeconomic model being used. Economists use different types of models for different purposes and this cause a variety of analytical real exchange rate definitions.

Hinkle and Nsengiyuma (1999: 41) define the real exchange rate in two ways. The first is in external terms where real exchange rate is defined as the nominal exchange rate adjusted for differences in price level between economies and these are measured in a common currency. The second way defines real exchange rate in internal terms as the ratio of local price of tradable to nontradables within a country. The first way of defining real exchange rate derives originally from the purchasing power parity (PPP) theory and it compares the relative value of currencies by measuring the relative prices of foreign and domestic consumption baskets. The second way of real exchange rate definition captures the internal relative price incentive in a particular economy for the production or consumption of tradable as opposed to nontradables goods. In this latter definition, the real exchange rate is an indicator of resource allocation and incentives in the local economy.

Edwards (1988a) also defines the real exchange rate as the ratio of the prices of tradables to nontradables (*RER*= price of tradable goods/price of nontradable goods), where *RER* is real exchange rate. In practical terms it is not easy or straightforward to calculate the ratio of prices of tradables to nontradables, and a more operational definition of the real exchange rate is computed as: $RER = EP_T/P_N$, where E is the nominal exchange rate defined as units of domestic currency per unit of foreign currency, P_T is the world price of tradable goods, P_N is the domestic price of nontradable goods. Empirically, P_T and P_N are proxied by foreign price level such as wholesale price index and the local consumer price index. Using this definition, an increase in RER is described as appreciation and a decrease is described as depreciation.

Equilibrium real exchange rate is defined as the value of the real exchange rate where internal and external equilibrium are attained at the same time. The economy is in internal equilibrium when there is a clearing in the nontradable goods market. External equilibrium is attained when the current account is sustainable. This is a situation in which the country's current account deficit is equal to the value of sustainable capital inflows that it can expect to receive (Edwards, 1988a: 4; Montiel, 2003: 316).

The definition of the equilibrium real exchange rate raises an important question on what it takes for macroeconomic equilibrium to be sustainable. Montiel (2003) suggests that this question can be answered by formalising the dynamic structure of the economy. The exchange is determined at any moment in time by predetermined variables, exogenous policy variables and other exogenous variables (see also Edwards, 1988a). Predetermined variables are endogenous that change slowly over time, for example the capital stock of the economy, technology and the country's international net creditor position. Exogenous policy variables are variables which are under the control of the domestic authorities. These include fiscal, monetary and trade policies. Other exogenous variables are variables that can be regarded as random shocks and bubble variables because they affect the economy through their influence on expectation. These include variables such as weather, terms of trade and world interest rates.

The economy determines the values of endogenous variables such as the real exchange rate and the rate of change of predetermined variables. Montiel (2003) and Edwards (1988a) noted that the actual real exchange rate observed at any time may be influenced by speculative bubble factors, by actual values of predetermined variables and transitory variables of policy and exogenous variables. If the variables on which the actual real exchange rate depends become unsustainable the actual real exchange rate will tend to change over time. Speculative factors are generally short-lived and transitory and in this case, short-run equilibrium real exchange rate can be derived. The equilibrium real exchange rate in the short run is conditioned on the short-run fundamentals.

Montiel (2003: 317) states that the short-run equilibrium real exchange rate will not be sustainable because the policy and exogenous variables that affect it can deviate from their sustainable values. The short-run equilibrium real exchange rate can be expected to change when policy and exogenous variables change. In addition to that, even if the policy and exogenous variables are at their sustainable levels, predetermined variables may not have completed their adjustment to permanent positions. Changes in predetermined variables would result in the short-run real exchange rate to change even if there are no adjustments in the policy and predetermined variables. According to Montiel predetermined variables will stop changing when they reach a steady state. Hence, the long-run equilibrium real exchange rate depends only on the sustainable values of the exogenous and policy variables which affect the real exchange rate directly. Edwards (1998a; 1998b; 1989) calls these variables long-run fundamentals.

Despite the fact that the equilibrium real exchange rate depends on permanent variables, the actual real exchange rate responds to both short and permanent variables. The existence of equilibrium does not mean that the actual real exchange rate is always similar to the equilibrium real exchange rate. The actual real exchange rate often moves away from its equilibrium in the short-run. According to Edwards (1988a: 9) short-run and medium-run deviations which are not very large and result from temporary changes in real variables can be quite common. Other types of deviations can generate a large and persistent difference between the actual and equilibrium real exchange rates. The gap between actual and equilibrium real exchange rates is called real exchange rate misalignment. Real exchange rate misalignment is a continuous movement away of the exchange rate from its long-run equilibrium level (see also Williamson, 1983: 13).

2.4 Analytical Framework

The previous section dealt with concepts and definitions with regard to the real exchange rate. As stated above, the sustainable values of the predetermined, policy and exogenous variables constitute the long-run fundamentals which determine the equilibrium real exchange rate in the long run. The most important step in estimating the long-run equilibrium real exchange rate is identification of these fundamentals. That is because the dynamic behaviour of these fundamental variables determines the path followed by the real exchange rate over time. The use of specific analytical models that can explain the time path followed by the real exchange rate in response to macroeconomic shocks is required to make this identification.

The production structure of the model is the key factor in the definition of the real exchange rate in analytical models. The most widely used modelling frameworks of the real exchange rate are as follows (Montiel, 2003: 312):

2.4.1 One-Good Model

The one-good model framework contains a single good which is assumed to be traded internationally and elsewhere arbitrage is assumed to equalise prices. The one-good model framework is useful for the analysis of phenomena that are purely monetary, such as inflation. As Montiel (2003: 313) states, there can be no real exchange rate in the one-good modelling framework because with only a single good there is no difference to be made between domestic and foreign goods.

2.4.2 Complete Specialisation Model

The complete specialisation model is an alternative framework which assumes that the local economy and the rest of the world are each specialised in the production of a single good. These goods are traded internationally and are imperfect substitutes for each other. According to Montiel (2003: 313) this model is applicable to countries whose trade consists largely of manufactured products, because these goods tend to be imperfect substitutes for goods produced by the rest of the world. Real exchange rate in this context is defined as the number of units of the domestically produced good that have to be given up for each unit of the foreign good. In this framework real exchange rate is the main determinant of the composition of both domestic and foreign absorption between goods produced locally and those that are produced abroad. This means that the real exchange rate determines the aggregate demand for goods produced domestically and is also an important determinant of the country's balance of trade.

In the complete specialisation model, the real exchange rate coincides with the country's terms of trade (Ahler and Hinkle, 1999: 315). Although this is the artefact of the assumption of complete specialisation in production, Montiel (2003: 313) acknowledges that the two concepts are generally different from each other in analytical frameworks which do not make this assumption.

2.4.3 Dependent Economy Model

The dependent economy model has a production structure that contains two goods. One good, nontraded is produced locally and consumed only locally, and the other is produced and consumed locally and abroad. The good which can be bought and sold across international boundaries is called traded or foreign good (see also Montiel, 1999). The real exchange rate in this case is defined as the number of nontraded goods required to purchase one unit of the traded good. It is expressed as:

$$RER = \frac{P_T}{P_N} \qquad (1)$$

where P_T is the domestic currency price of the traded good, and P_N is the domestic currency price of the nontraded good. According to Montiel (2003: 313) this is sometimes called internal real exchange rate. This modelling framework contains only one type of foreign good and does not have terms of trade. This framework is useful when analysing issues where the role of terms of trade is not important. This is mainly in economies whose terms of trade are exogenous, and is primarily used to analyse the effects of macroeconomic policies in small economies (Montiel, 2003: 314).

2.4.4 The Three-Good Model

The three-good (exportable-importable-nontraded) model is required when terms of trade do matter. The exportable and importable goods can be produced and consumed at home. There are two foreign goods in this model and therefore two real exchange rates and separate as well as distinct definition of the terms of trade (Montiel, 2003: 314). If P_X is the domestic currency price of the exportable good and P_Z is the domestic currency price of the importable good, the exportable real exchange rate is $E_X = \frac{P_X}{P_N}$ and the importable real exchange rate is $E_Z = \frac{P_Z}{P_N}$. The terms of trade (TOT) is defined as $TOT = \frac{P_X}{P_Z}$. According to Ahlers and Hinkle (1999) the three-good model is useful when analysing the macroeconomic effects of movements in the terms of trade. It is also useful for analysing the macroeconomic effects of terms of trade changes and also changes in commercial policies that affect the domestic relative prices of exportables and importables.

2.5 Theoretical Model

The growth of the traded goods in relation to nontraded goods is important for the development of developing countries' economies, and analytical framework such as the dependent economy model can be important in indicating the incentives of reallocating local resources. It is an important method to capture the Balassa-Samuelson effects clearly. The dependent economy model has been adopted for the economies which are in transition. These are economies that are opening up to the global economy and are characterised by a large increase in traded goods relative to nontraded goods. Hence in the dependent economy model, the equilibrium real exchange rate is the prices of tradable goods relative to the prices of nontradable goods for which a given sustainable value of other important factors result in the achievement of internal and external equilibrium at the same time.

The main problem of the dependent economy model is that data are not available. The data on tradable and nontradable goods' prices for a developing economy such as Namibia are not readily available. Therefore, for empirical analysis this study uses the three-good model. The three-good model is applied to estimate the equilibrium real exchange rate. The study uses the model developed by Edwards (1988b). This model of real exchange rate determination allows nominal and real factors to play a role in the short run. Only real fundamentals influence the equilibrium real exchange rate in the long run. This model is usually adopted for small developing economies whose production structures are less flexible and whose exports are dominated by undifferentiated primary products. It attempts to capture some of the most salient macroeconomic features of the developing economy in a simple way. These include exchange control, trade barriers, and freely determined parallel exchange rates for financial transactions. This model is also referred to as the fundamental approach to real exchange rate determination.

The study follows Edwards (1988a; 1988b), Montiel (1999; 2003) and Elbadawi (1994) to specify the equilibrium real exchange rate. The relationship between the equilibrium real exchange rate and the factors influencing it or the fundamentals is specified as:

$$\ln eq_t = \beta_0 + \beta_1' PX_t \qquad (2)$$

where eq_t is the equilibrium real exchange rate, β_0 and β_1 are the vector of parameters to be estimated, PX_t is a vector of the components of fundamentals that are permanent. Equation (2) is not easily estimated empirically because the equilibrium real exchange rate cannot be observed. The β_s and PX_t are estimated by using the actual values of the real exchange rate and fundamentals in order to have an empirical model which is in line with Equation (2) as follows:

$$\ln RER_t = \beta_0 + \beta_1^{'} X_t + \varepsilon_t \tag{3}$$

where RER is the observed or actual real exchange rate, X_t is the vector of fundamentals and ε_t is the error term assumed to be stationary and zero mean.

The central most important part of this model is the error correction model (ECM) which captures the dynamics of the real exchange rate. Factors which cause the real exchange rate to move away from the equilibrium in the short run should bring the system back into equilibrium. This is represented in Equation (4):

$$\Delta \ln RER = \gamma(\ln RER_{t-1} - \beta' X_{t-1}) + \sum_{j=1}^{p} \mu_j \Delta \ln RER_{t-j} + \sum_{j=0}^{p} \eta'_j \Delta X_{t-j} + n_t \tag{4}$$

where Δ denotes the first differences of the vector of variables, $(\ln RER_{t-1} - \beta' X_{t-1})$ is the error correction term, and n_t is the error term assumed to be independent and identically distributed with mean zero. Under the assumption that variables are stationary or I(1) Equation (3) is implied by Equation (4) and the value of γ represents a speed of adjustment (see Enders, 2004). The speed depends on the value of γ, and $0 < \gamma < 1$. If the values of γ is closer to 1 the speed of adjustment will be faster, and the long-run equilibrium is stable if $\gamma < 0$.

Equilibrium real exchange rate depends on the fundamental factors, and to estimate the equilibrium real exchange rate those factors must be specified. In his study of real exchange rate for developing countries, Edwards (1988a) identified a number of fundamental variables that determines the real exchange rate. Following Edwards, and Elbadawi (1994) the vector of fundamentals is specified as:

$$X_t = [\ln TOT_t, \ln GOVEX_t, \ln TARIFF_t, \ln PROD_t, \ln CAPITAL_t, \ln INVGDP_t] \quad (5)$$

where *TOT* is the terms of trade, *GOVEX* is government expenditure to GDP, *TARRIF* is import tariff, *PROD* is a measure of productivity or technology, *CAPITAL* is capital inflows and *INVGDP* is ratio of investment to GDP. This Edwards' specification has many explanatory variables and some of them are related to each other and this is one problem when applied to estimate the equilibrium real exchange rate of the Namibia dollar. The estimated equilibrium real exchange rate applied in this study does not include all the variables specified by Edwards and hence it does not coincide completely with his model. The next section explains how these fundamental variables influence the real exchange rate. As discussed in Chapter 1, the real exchange rate of Namibia can also be influenced by the fundamentals of South Africa and one would estimate the model by including some of South Africa's fundamentals. Despite this, it is important to note that not all fundamentals or South African variables are relevant to the determination of the real exchange rate in Namibia. Hence estimating the real exchange rate for Namibia with some South African variables cause difficulties, because theoretically or *a priori*, there is no methodology of determining which of the variables to include or exclude.

2.6 Real Exchange Rate Fundamentals and Empirical Studies

2.6.1 Real Exchange Rate Fundamentals

Edwards (1988a) provides a detailed explanation of the real exchange rate fundamentals. Real exchange rate fundamentals are variables that in addition to the real exchange rate play a role in the determination of the country's internal and external equilibrium. Jointly, these variables determine the country's internal and external position. Fundamentals can be classified into two groups, external fundamentals and domestic fundamentals. The external fundamentals include international terms of trade, international transfers and world real interest rate. Domestic real exchange rate fundamentals consist of variables that can be directly affected by policy decisions and those that cannot be affected by policy decisions. Policy related real exchange rate fundamentals are trade restrictions such as import tariffs, import quotas, taxes on export, exchange and capital controls, other taxes and subsidies, and the composition of government expenditure. Domestic non-policy real exchange rate fundamental such as technological progress is another important determinant. Edwards (1988a: 7-8) considered few general cases in order to explain how the fundamental variables determine the equilibrium real exchange rate. Imposition of an import tariff will increase the domestic price of importable goods and generates intratemporal and intertemporal substitution effects, and income effects. Tariffs decrease the demand for importable goods and therefore the volume of imports. Higher demand for nontradable goods will be induced because of substitutability. The price of nontradable goods will increase in order to maintain equilibrium in that market. This will result in appreciation of the equilibrium real exchange rate. However, since the imposition of tariff results in both substitution and income effect, the real exchange rate can depreciate or appreciate. This depends on whether the income or substitution effect of import tariff dominates. Edwards notes that in most cases the substitution effect of trade restrictions dominates the income effect and thus, increasing restrictions leads to a higher relative rise in the price of nontradable goods and results in real exchange rate appreciation. Reduction of trade restrictions results in real exchange rate depreciation.

Terms of trade is one of the main factors or fundamentals that influence the real exchange rate. If the terms of trade increases it will raise the purchasing power and this results in the increase in the demand for domestic goods. Under the assumption of a small country such as Namibia the prices of traded goods remain unchanged but those of nontraded goods increases. This causes the real exchange rate to appreciate. This is called income effect (see Asfaha and Huda, 2002). On the other hand, an increase in the terms of trade can also cause the real exchange rate to depreciate and this is called substitution effect. Consumers will change from consuming exportable and nontraded goods to consuming importable goods. When import increases the prices of nontraded goods will decrease and results in real exchange rate depreciation. The effect of terms of trade on the real exchange rate cannot be assigned *a priori.* It is ambiguous. Although the net effect of terms of trade on real exchange rate is ambiguous, Edwards (1988b) suggests that in most cases the income effect of terms of trade changes overwhelm the substitution effect.

Capital control can be defined as any restriction or control that causes impediments on free borrowing and lending to and from the rest of the world. Relaxation of capital control may cause the real exchange rate to appreciate or depreciate. According to Edwards (1988a: 8) if liberalisation of capital controls raises the inflows of capital, it leads to the expansion of the monetary base. The expansion of the monetary base results in higher expenditure for all goods including nontradables. Increase in the demand for nontradable goods results in an increase in their prices and in order to maintain internal equilibrium in the current period, the equilibrium real exchange rate appreciates. The net effect of capital control on the equilibrium real exchange rate depends on the net inflow of capital.

International transfer is another fundamental determinant of the equilibrium real exchange rate. According to Edwards (1988a) if a country has to make transfer to the rest of the world, current and future domestic real income and expenditure will fall. This generates a fall in the relative price of nontradable goods and the real exchange rate will depreciate. In cases where countries are receiving transfers from the rest of the world such as those developing countries receiving foreign aid, the equilibrium real exchange rate will appreciate.

Government expenditure is also an important fundamental variable which determines the equilibrium real exchange rate. The effect of change in government expenditure on the equilibrium real exchange rate depends on the composition of the expenditure between tradable and nontradable goods. If a greater share of the increase in government expenditure is on nontradable goods there will be an increase in the demand for nontradable goods in the short run and that raises up the prices of nontradable goods. This results in real exchange rate appreciation. On the other hand, if a large share of the increase in government expenditure is directed towards tradable goods, the relative price of non-tradable goods will fall and the real exchange rate depreciates (Edwards, 1988b, Asfaha & Huda, 2002, and Mongardini, 1998).

The ratio of investment to GDP is another determinant of the real exchange rate. According to Mongardini (1998:14) investment is more intensive to import than to consumption. An increase in the ratio of investment to GDP will increase spending, deteriorate the current account and lead to depreciation of the real exchange rate. However, Mathisen (2003: 7) notes that the expected sign is ambiguous and an increase in the share of investment can cause the real exchange rate to appreciate or depreciate.

Technology and productivity is a domestic variable that is not related to policy and generates productivity and efficiency. This variable captures the Balassa-Samuelson effect hypothesis which states that an increase in the productivity of tradable goods versus nontradable goods of one country relative to foreign countries raises its relative wages. This leads to a rise in the price of nontradable goods and causes the real exchange rate to appreciate (Mathisen, 2003:8; Spatafora & Stavrey, 2003: 5 and Asfaha and Huda 2002).

2.6.2 Empirical Studies

The exchange rate has gained great prominence in economic discussions in developing countries. Edwards (1989) argues that inappropriate exchange rate policies pursued by some countries in the late 1970s contributed to the international debt crisis of the 1980s. Overvalued exchange rates in many African countries resulted in deterioration of the agricultural sector and external current accounts. Inappropriate exchange rate policy also caused disappointing outcomes from Argentina, Chile and Uruguay's economic reform and free market policies during the 1970s.

The issue of whether the real exchange rate is in line with its long-run equilibrium value is very important. Maintaining the real exchange rate out of its equilibrium value can result in significant welfare costs. It can send wrong signals to economic agents and this will in turn result in economic instability.

Edwards (1988b) developed a dynamic model of the real exchange rate behaviour in developing countries. This dynamic model analyses real and monetary variables in the determination of the real exchange rate in the short and long run. In the long run, only real variables or fundamentals influence the equilibrium real exchange rate. The model attempts to capture some of the salient macroeconomic features of the developing economy. These features include the existence of the exchange controls, trade barriers and freely determined parallel exchange rate for financial transaction. A three goods economy, consisting of exportable, importable and nontradable goods is considered. Residents of the country hold domestic and foreign assets and there is a dual exchange rate regime. There is a government that consumes importable goods and nontradable goods. Real exchange rate equilibrium is distinguished from real exchange rate disequilibrium. According to the Edwards' model, the most important fundamental determinants of the equilibrium real exchange rate are terms of trade, government expenditure, import tariffs, and capital flows. Other possible fundamental variables are technological progress and the ratio of investment to GDP. The equilibrium real exchange rate was estimated as follows:

$$\begin{aligned}\ln e_t^* = \beta_0 + \beta_1 \ln(TOT)_t + \beta_2 \ln(GOVEX)_t + \beta_3 \ln(TARIFFS)_t + \beta_4 \ln(TECH)_t \\ \beta_5 \ln(CAPFLOW)_t + \beta_6 \ln(INV)_t + \varepsilon_t\end{aligned} \qquad (6)$$

where e^* is equilibrium real exchange rate, *TOT* is the terms of trade, *GOVEX* is the level and composition of government expenditure, *TARIFFS* is import tariffs, *TECH* is a measure of technological progress, *CAPLOW* is capital inflows, *INV* is the ratio of investment to GDP, and ε is the error term. The impact of terms of trade on the equilibrium real exchange rate is not without ambiguity. Equation (6) was estimated using pooled data for 12 developing countries (Brazil, Colombia, El Salvador, Greece, India, Israel, Malaysia, Philippines, South Africa, Sri Lanka, Thailand and Yugoslavia). The dependent variable, real exchange rate was computed as ($RER=E*WPI^{US}/CPI$) where E is the nominal exchange rate between the domestic country and the US dollar, WPI^{US} is the wholesale price index in the US and it is a proxy for the foreign price of tradable goods, and CPI is the consumer price index and it is considered as proxy for domestic price of nontradable goods. An rise in the real exchange rate (RER) indicates a real depreciation, while a decrease reflects real appreciation.

The results showed that the coefficient of terms of trade was significant and indicate that an increase in the terms of trade will result in equilibrium real exchange rate appreciation. The coefficient of government expenditure was insignificant in all regressions and in most cases it was positive. The coefficient of the proxy for technological progress showed that an improvement in technology causes real exchange rate depreciation and this was not consistent with theoretical expectations of the model. It contradicted the Balassa-Samuelson effect prediction. The estimated coefficient for tariff was in line with the theoretical expectation, indicating that an increase in tariffs results in real exchange rate appreciation. However, this coefficient was not significant. Increase in capital flows cause real exchange rate appreciation.

The results suggest that real exchange movements have responded to both real and monetary variables. An equation for real exchange rate dynamics was postulated in order to carry out the analysis. The dynamic equation captures the most important features of the theoretical analysis in a simple but powerful way. The gap between the real exchange rate equilibrium and actual real exchange rate will tend to disappear slowly if left on their own. Although nominal devaluation is neutral in the long run, it can help to restore real exchange rate to its equilibrium value at a faster rate.

Baffes, Elbadawi & O'Connell (1997) outline an econometric methodology for analysis of both the equilibrium real exchange rate and the degree of real exchange rate misalignment. The methodology was illustrated using annual data from the Ivory Coast and Burkina Faso. The procedure involves three steps (Baffes, *et al*., 1997: 1). In the first step, time series characteristics of the real exchange rate and the fundamentals are examined. This determines the estimation technique to be used in the next step and to uncover the parameters of the long-run relationship between the real exchange rate and its fundamentals. The third step involves using the long-run parameters to calculate equilibrium real exchange rate and the level of real exchange rate misalignment. Johansen cointegration methodology was applied to estimate equilibrium real exchange rate for the Ivory Coast and Burkina Faso. Terms of trade, resource balance, openness of the economy and share of investment to GDP were included as explanatory variables in the estimation for both countries. The results for both countries indicate that an increase in resource balance shift the composition of potential output towards nontraded goods and the real exchange rate depreciates. Real exchange rate appreciates in response to improvement in the terms of trade for both countries, while an increase in openness causes the real exchange rate to depreciate. This suggests that trade liberalising reforms in Burkina Faso and the Ivory Coast caused the real exchange rate to depreciate. For Ivory Coast, an increase in investment causes real exchange rate depreciation.

The coefficient of the error correction term which measures the speed of adjustment of the real exchange rate to its equilibrium level is a crucial parameter in the estimation of the short run dynamic models (Baffes *et al*. 1997: 27). The number of years required to eliminate disequilibrium in the real exchange rate can be derived from these estimates of the coefficient of the error correction term. The estimated adjustment speed for the Ivory Coast was between -0.3 and -0.45 and for Burkina Faso was between -0.5 and -0.61. This suggests that the speed of adjustment of Burkina was higher than that of the Ivory Coast. Baffes *et al*. (1997) used four measures (the fitted real exchange rate, its corresponding 5 year moving average, an equilibrium rate based on the Beveridge-Nelson decomposition of the fundamentals, and one based on counterfactual simulations) to estimate real exchange rate misalignment for these two countries. The computation revealed that there was overvaluation and undervaluation of the real exchange rates for the two countries.

Feyzioglu (1997) investigated the real exchange rate for Finland. The investigation was done by looking at the reduced form implied by the theoretical model in accordance with Edwards (1988; 1994). The equilibrium real exchange rate is defined as the rate that is in line with the attainment of internal and external balances simultaneously. A set of exogenous fundamentals variables which determine the internal and external equilibrium was identified. A reduced form was then constructed linking the real exchange rate to the fundamentals. The Johansen cointegration technique was used to estimate the equilibrium real exchange rate. According to Feyziouglu (1997: 10), the most important fundamental determinants of the equilibrium real exchange rate for Finland are terms of trade, real long term interest rates, difference in productivity, and price differential. The real exchange rate appreciates in the long run if the terms of trade improves or if the interest rate rises and if the productivity differential increases above the trend. The real exchange rate deviates from its equilibrium value for a long period of time, and short-run influence on the fundamentals is minimal.

Mongardini (1998) estimated empirically Egypt's equilibrium real exchange rate using the Edwards model for the period 1987 to 1996 (monthly data). The real exchange rate was regressed on terms of trade, government consumption, technology and debt service ratio. The results showed that an increase in the terms of trade, government expenditure and technology improvement cause real exchange rate appreciation. A rise in capital flows and ratio of debt service cause real exchange rate depreciation. After estimation of the coefficients of the fundamental determinants, the 12 months moving average of the fundamentals was calculated so as to smooth out temporary volatility. These averages are then used to calculate the equilibrium real exchange rate. This method reduces the sample by 12 observations. Egypt's real exchange rate was overvalued for almost the entire estimation period. Egypt experienced a high level of real exchange rate misalignment between 1989 and 1993.

Zhang (2001) estimates the behavioural equilibrium real exchange rate and the resulting misalignment in China for the period 1952 to 1997. The real exchange rate in China is determined by the ratio of investment to GDP, government expenditure, growth in exports and openness of the economy. The Johansen methodology was used to estimate the equilibrium real exchange rate and the resulting misalignment. Misalignment was estimated using a unique cointegrating vector. The results showed that an increase in investment and openness of the economy causes real exchange rate depreciation while increase in government expenditure and export is associated with real exchange rate appreciation. There was evidence of chronic overvaluation in China but economic reforms brought the real exchange rate closer to its equilibrium level. These reforms led to substantial depreciation of the real exchange rate of China after 1981. The results provided indications that China adopted proactive exchange rate policy and the nominal exchange rate is employed to attain real targets.

Buchs (2004) examines the determinants of the real effective exchange rate in Brazil from 1994 to 2003. Based on the standard theoretical model and the Johansen cointegration methodology, Brazil's long-run behaviour of the real exchange rate is determined by relative productivity differentials, real commodity prices, government expenditure on tradable and nontradable goods, trade openness and real interest differentials. Increase in government expenditure on non-tradable goods, interest rate differential, real commodity prices, and productivity differential cause real exchange rate appreciation, while increase in government expenditure on tradable goods and trade openness leads to real exchange rate depreciation. The speed of adjustment between the real exchange rate and its equilibrium values as measured by the error correction term range from -0.14 to -0.23 and this implies that about 14 to 23 percent of disequilibrium is corrected every period. Full adjustment takes place within a maximum of one year and half.

Buchs (2004: 24) uses three alternative measures to compute equilibrium real exchange rate and the resulting real exchange rate misalignment. The first measure calculates the median real equilibrium exchange rate since the 1999 devaluation and uses the permanent value as a benchmark against which to measure potential misalignments, treating the equilibrium real effective exchange rate as constant. The second measure uses normalised cointegrating vectors to calculate the real exchange rate which is line in with the long run equilibrium values of the determining variables. This measure neutralises the temporary fluctuations in the cointegration relationship with the Hodrick-Prescott filter. Hodrick-Prescott filter is a smoothing technique which is now extensively used in the literature. The third measure computes the equilibrium real exchange rate using both the long-term cointegrating vectors and short-run deviations of the error correction model representation, thereby decomposing the real exchange rate into permanent and transitory components. This is done by using the method proposed by Gonzalo and Granger (1995). According to Buchs (2004) the main advantage of the proposed decomposition between I(1) and I(0) components is that the temporary component does not Granger cause permanent component in the long run, which itself is a linear combination of the contemporaneous observed variables. Irrespective of the measure used, the results showed that real exchange rate misalignments were moderate in the 1990s. This includes the period immediately preceding the devaluation of the Brazilian Real. This suggests that supply-side effects and demand side effects put pressure on the real exchange rate path. It also suggests that there was no inherent inevitability from a misalignment point of view in the timing of the devaluation that took place in 1999. Although the real exchange rate was slightly appreciated at the end of 2003, misalignment was relatively small.

Bjornland (2004) estimates the equilibrium real exchange rate in an oil producing country, Venezuela. The relationship between demand shocks, supply shocks and real exchange rate is examined. Four structural shocks were identified by imposing long-run restrictions on a vector autoregression (VAR) model. These structural shocks are nominal demand, real demand, supply and oil price shocks. A positive oil shock causes real exchange rate appreciation, while a supply shock leads to real exchange rate depreciation. Positive real demand shock causes the real exchange rate to appreciate and raises prices slowly. A nominal shock causes the real exchange rate to depreciate temporarily before it appreciates back or converges to its long-run equilibrium. This is closely associated with the overshooting model of Dornbusch. The analysis provides clear evidence that the movement of the real exchange rate in Venezuela is not related to PPP. Therefore, the PPP hypothesis cannot be used to predict any over or undervaluation of the exchange rate (Bjornland, 2004: 7).

Aron, Elbadawi & Kahn (2000) presented what was probably the first formal model of the real exchange rate in South Africa. The model focused on the period of South Africa's dual exchange rate regime and the estimation was quarterly, covering the period 1970:1 to 1995:1. Cointegration and the single equation error correction models were used to investigate the short-run and long-run determinants of the real exchange rate simultaneously. In this model the real exchange was determined by terms of trade, the price of gold, tariffs, openness of the economy, capital flows, reserves and government expenditure. The estimated parameters are in line with the theoretical expectations. Policies aimed at reducing tariffs and trade restrictions and increase in openness are associated with real exchange rate depreciation. The estimated elasticity for the price of gold revealed the dominance of income over substitution effect which is as expected by the theory of real exchange rate estimation. The terms of trade also showed the dominance of income effect over substitution and this indicated that an increase in the terms of trade causes real exchange rate appreciation. Levels of government expenditure that are unsustainable lead to real exchange rate depreciation and overvaluation. The results also indicate that the declining level of sustainable capital flows causes the real exchange rate to depreciate.

MacDonald and Ricci (2003) estimated the equilibrium real exchange rate for South Africa based on the Johansen cointegration methodology. The long-run behaviour of the real exchange rate for South Africa is determined by real interest differentials, GDP per capita, real commodity prices, trade openness, the fiscal balance and the extent of foreign assets. The real exchange rate was more depreciated in 2002 compared to other years. The speed of adjustment showed that disequilibrium in the real exchange rate is corrected after two years.

2.7 Conclusion

This chapter introduced the fundamental literature on the real exchange rate. It started with the theoretical foundations, concepts and definitions with regard to the real exchange rate. It discussed the analytical and theoretical models. Fundamental determinants of the real exchange rate are also discussed. The PPP hypothesis has been used as a benchmark for exchange rate discussions, but it has weaknesses because it does not take into account of the fundamentals that influence the real exchange rate. The natural equilibrium real exchange rate and the fundamental equilibrium real exchange rate take the fundamentals into account. The analytical model distinguishes between four models, the one good model, complete specialisation model, dependent-economy and three-good model. The three-good model will be applied in this study. Hence the theoretical model is based on the three-good model. The three-good model is selected because it is more appropriate for a small open and developing economy such as Namibia.

The model defines real exchange rate as a function of fundamental variables. When the fundamentals change the real exchange rate will also change. Fundamentals are classified into two groups, external and domestic fundamental. External fundamentals are factors such as terms of trade, international transfers and world real interest rates. Domestic fundamentals consist of variables that can directly be influenced by policy decisions and those that cannot be affected by policy decisions. Fundamentals that are related to the real exchange rate are import tariffs, import quotas, export taxes, exchange and capital control, subsidies and composition of government expenditure. Technological progress is an example of a domestic non-policy related fundamental. The impact of the fundamentals on real exchange rate is also discussed in detail.

CHAPTER 3. REAL EXCHANGE RATE AND COMMODITY EXPORTS' PRICES

3.1 Introduction

Many studies that have been conducted on the behaviour of the real exchange rate in developing countries emphasised the importance of the movements in the terms of trade in explaining variation in the real exchange rate. Despite this, it is naturally assumed that changes in the real commodity prices have the potential to explain a greater part of the changes in the real exchange rates for developing countries. This is due to the fact that most developing countries rely on the export of commodities, and in some cases, on a single commodity for their foreign exchange revenues. Cashin, Liang and McDermott (2000) classify developing countries based on the composition of their exports. The IMF similarly classifies countries based on the composition of exports. Countries whose commodities account for a significant share of total export are classified as commodity exporting countries.

Namibia is a commodity exporting country since its export is dominated by two main commodities. In 2003 and 2004, diamonds accounted for 41 percent of the total export and fish accounted for 20 percent. Other minerals products such as copper, uranium, zinc, gold accounted for 15 percent of total exports. Although Namibia is a commodity exporting country there is no study investigating the relationship between real exchange rate and real commodity prices. This chapter will examine whether prices of commodity exports are key determinants of the real exchange rate of Namibia. The chapter start with a review of the theory and empirical studies on the relationship between the real exchange rate and prices of export commodities. It then discusses the empirical model to be applied for Namibia. It is important to note that the purpose of this chapter is not to develop a model, but review the existing empirical and theoretical models and suggest the appropriate one for Namibia. The chapter is organised as follows. Section 3.2 discusses the literature and empirical studies. Section 3.3 presents the empirical model for Namibia and Section 3.4 concludes.

3.2 Literature and Empirical Studies

One of the topics that have caused a lot of disagreements in international economics is the relationship between the real exchange rate and it fundamental determinants. This demonstrated a number of empirical puzzles such as that of purchasing power parity (PPP). The literature identifies numerous problems in linking the behaviour of the real exchange rate and shocks to it fundamental determinants. For example, Cashin, Cespedes and Sahay (2004: 240) states that:

> *" A variety of structural exchange rate models failed to forecast more accurately than a naive random walk model for both real and nominal exchange rates and their key findings have not been overturned in the succeeding three decades".*

This demonstrates that if the real exchange rate follows a random walk, the shocks to it remain and time series can move without limits. This is not consistent with PPP. PPP which is also referred to as the law of one price states that any good should sell for the same price in different countries when prices are converted in the same currency (Rogoff, 1996). The controversial results of various models of the real exchange rate have shown that the PPP is not a good model for the long-run real exchange rate.

Numerous problems in linking the behaviour of the real exchange rate to shocks in fundamentals were identified. In an effort to deal with these problems, Taylor and Peel (2000) and Taylor (2001) incorporated non-linearities to model the dynamics of the real exchange rate. It has also been noted by Chen and Rogoff (2003) that if real shocks which are volatile can be found, these empirical problems could be potentially solved.

Rogoff (1996) points out some factors that can help to solve the PPP conundrum. Among these factors are real fundamentals such as the Balassa-Samuelson effect, differentials in interest rates and portfolio models. A large number of studies (such as Edwards, 1988a, 1988b; Elbadawi, 1994; Baffes *et al.* 1997; Aron *et al.*, 2000) emphasised importance of the fundamentals such as terms of trade, capital flows, openness, government expenditure in explaining movements in the real exchange rate. These studies emphasised that terms of trade is a key factor in explaining variation of the real exchange rate. However, it is important to note that most developing countries (including some developed countries such as Australia, Canada and New Zealand) export mainly commodities. The exports of these countries are dominated mainly by primary commodities. This implies that movements in the prices of commodities have a potential to explain more variation in the real exchange rate. Although terms of trade has been regarded as key factor in explaining the behaviour of the real exchange rate in developing countries, it is very broad and may not be an appropriate explaining factor. It is important to investigate how changes in commodity prices influence the real exchange rate in commodity exporting countries such as Namibia.

Empirical research on the mechanism through which changes in the real exchange rate is affected by the commodity prices is limited, but there are some notable studies that examine the link between the real exchange rate and commodity prices. Edwards (1985) was probably the first study that investigated whether the prices of commodities have an important effect on the real exchange rate. The investigation was done to test whether the price of coffee has an effect on the real exchange rate of Colombia. A model was developed to analyse the relationship between the price of coffee, creation of money, inflation and real exchange rate. The emphasis was on the link between the real exchange rate and the price of coffee. The model has the following assumptions. The first one is that there are three goods in the economy and these goods are coffee, nontradable and non-coffee tradable. The second is that the economy (Colombia) has a crawling exchange rate regime in which the nominal exchange rate is adjusted within a band according to some indicators. The third assumption is that capital controls are exogenous.

Edwards developed and tested this model for Colombia. The investigation confirmed that the prices of coffee have an important effect on the real exchange rate. A rise in the price of coffee leads to higher disposable income and the demand for tradable and notradable goods will increase. This is the income effect of the increase in the prices of commodities (coffee) and it causes higher relative price of nontradable and appreciation of the real exchange rate. All this depends on the extent to which the price of other non-coffee tradable goods is given by the price in the world market and the exchange rate. Improvement in the price of coffee causes a surplus in the balance of payments and an increase in the level of foreign exchange reserves. According to Edwards, if the reserves are not sterilised completely it will results in the rise in the monetary base. An increase in the monetary base leads to high inflation and appreciation of the real exchange rate.

Chen and Rogoff (2003) studied the relationship between the real exchange rate and commodity prices for Australia, Canada and New Zealand. These three countries' exports are dominated by commodities and it is logical to think that the prices of commodities have a potential to explain variation in their real exchange rates. According to Chen and Rogoff, this could help to solve empirical PPP conundrum. Prices of commodities could be a missing link that has the potential to solve the PPP conundrum. Chen and Rogoff (2001, 2003) estimated the relationship between real exchange rate and the real prices of commodities as:

$$\ln RER_t = \gamma_0 + \gamma_1 \ln REALCOM_t + v_t \qquad (7)$$

where RER_t is the real exchange rate, $REALCOM_t$ is real commodity prices and v_t is the error term. Chen and Rogoff went further to include real commodity prices in standard monetary models to test if the addition of commodity prices variable affect the significance of some variables in the real exchange rate determination. Real commodity prices were included in the monetary standard models as follows:

$$\ln RER_t = \gamma_0 + \gamma_1 \ln REALCOM_t + \gamma_2 \ln REALDIFF_t + \gamma_3 \ln OUTDIFF_t + v_t \qquad (8)$$

where $REALDIFF_t$ is the differentials in real interest rate and $OUTDIFF_t$ is real output differentials

The study found evidence of close relationship between the real exchange rate and prices of commodities. A rise in commodity prices causes real exchange rate appreciation. Although real commodity prices do not solve the entire PPP empirical conundrum, they play an important role in the determination of the real exchange rates of commodity exporting countries.

A recent model of real exchange rate and commodity has been developed by Cashin *et al*. (2002, 2004) to test whether the prices of commodities have an important effect in the determination of the real exchange rate for commodity exporting countries. To discuss the relationship between the real prices of commodities and the real exchange rate, a model of a small open economy that produces two types of goods is developed. These are nontradable and exportable goods. Production of the exportable good is associated with the production of the primary commodity. This primary commodity can either be agricultural or mineral product. The local economy has one sector responsible for producing a primary product and the other one producing a nontradable good. In this model, labour is the only input in these two sectors. There are two assumptions in this model. The first one is that production takes place in a competitive market where firms have access to constant returns to scale. The second assumption is that labour is mobile between sectors and hence wages are equal in all sectors and there is no arbitrage.

The local economy is characterised by consumers that are suppliers of labour inelastically. These consumers consume nontradable and tradable goods. It is important to note that the tradable good is sourced from the rest of the world and it is not produced locally. The primary commodity and the intermediate commodity (produced abroad only) are used jointly by foreign firms to produce a final tradable good. This final tradable good is consumed by foreign consumers. The algebraic details of this model are presented in Cashin *et al*. (2004: 261-264). This model can be referred to as the commodity price and relative productivity model. According to this model, the real exchange rate for a commodity exporting country is determined as follows:

$$RER = f(PROD / PROD^{*}, PROD_{N}^{*} / PROD_{N}, COM) \quad (9)$$

where ***RER*** is the real exchange rate, $PROD / PROD^{*}$ is the differences in productivity between local and foreign tradable sectors, $PROD_{N}^{*} / PROD_{N}$ represents the differences in productivity between foreign and local nontradable sectors and COM is the world prices of commodities. The variables $PROD / PROD^{*}$ and $PROD_{N}^{*} / PROD_{N}$ represent the Balassa Samuelson effect. In his famous article, Balassa (1964) claimed that deviation from the PPP is related to the relative productivity in one country to another. Taking GDP per capita as a proxy for productivity or technology the real exchange rate will appreciate in response to increase in GDP per capita. In other words, if a country is more productive it will experience overvaluation in its real exchange rate. The variable *COM* represents the effect of the real world prices of commodities on the real exchange rate. It is expected that a rise in real commodity prices result in higher wages and this will cause a rise in the prices of nontradable goods and the real exchange rate will appreciate.

Cashin *et al.* developed and applied their model to a number of developing countries and the results revealed evidence of close relationship between the real exchange rate and real prices of commodities as well as productivity for nearly half of the countries. Increase in both real commodity prices and productivity causes the real exchange rate to appreciate. Spatafora and Stavrey (2003) estimated the real exchange rate for a commodity exporting country, Russia using productivity and commodity prices (oil prices) as explanatory variables. The study found evidence that both commodity prices and productivity causes real exchange rate appreciation. These findings were confirmed by Koranchelian (2005) when the Cashin *et al*. model was applied to Algeria. Spatafora and Stavrey (2003) and Koranchelian (2005) found evidence in support of the Cashin et al. model.

Related studies such as Hatzinikolaou and Polasek (2005) investigated the link between the real exchange rate and commodity prices for Australia for the period 1984:1 to 2003:1. The investigation revealed that commodity prices have an important effect on the exchange rate of Australia. A rise in the prices of commodities causes the real exchange rate to appreciate.

Bjørnland and Hungnes (2005) analysed the behaviour of the real exchange rate in Norway, which is a commodity exporting country. Oil accounts for more than 20 percent of Norway's exports and it can be expected to have a potential to explain a greater part of the variation in the country's real exchange rate. The equilibrium real exchange rate for Norway was estimated as a function oil prices. No cointegration was found between the real exchange rate and commodity prices. This prompted Bjørnland and Hungnes to examine further other variables that cause a sustained movement of the real exchange rate from PPP. Some more variables such as domestic interest rate, foreign interest rate, domestic and foreign prices were added as additional explanatory variables. When these variables were added, cointegration was obtained. The results indicate that the exchange rate appreciates when the price of oil is increasing, and depreciates when the price of oil price is decreasing.

In summary, all the reviewed empirical literature found evidence of a close relationship between the real exchange rate and commodity prices as well as productivity or technology. Therefore this study expects to find evidence that the real commodity prices and productivity cause the real exchange rate for Namibia.

3.3 Empirical Model for Namibia

The literature review in the previous section revealed that there are three main models for investigating the relationship between the real exchange rate and prices of commodities. These are Edwards' (1985) model developed and applied to Colombia, Chen and Rogoff (2001, 2003) and the Cashin *et al.* model (2004) that was developed and tested for a number of developing countries. Edwards' (1985) model included the creation of money and inflation in the determination of the real exchange rate. The model assumes that the country has a crawling exchange rate regime. This makes it inappropriate for Namibia, because the country does not have a crawling exchange rate regime. The country's nominal exchange rate is not adjusted within a band of indicators as in crawling exchange rate regime. The nominal exchange rate of the Namibia dollar with respect to other currencies is determined by the South African Reserve Bank.

The Chen and Roggoff model is a monetary standard that include real commodity prices interest rate and productivity differentials. Since Namibia has pegged its dollar to the South African rand, a model that includes some short-run macroeconomic policy fundamentals such as monetary is not appropriate for Namibia. Pegging requires that monetary and fiscal policies are consistent with the chosen nominal exchange rate to maintain an equilibrium which is sustainable.

The Cashin *et al.* model has interesting features for a developing economy such as Namibia. It assumes a small open economy producing nontradable and exportable goods which are primary commodities. The final tradable good is consumed by consumers abroad. This model fits Namibia because the country is a small open economy producing primary products (such as uranium, copper, diamonds, fish) which are consumed abroad. Looking at the features of the three models, this study considers the Cashin *et al*. model as the suitable model to investigate the relationship between commodity prices and the real exchange rate for Namibia. The relationship between the real exchange rate and the prices of commodities for Namibia is estimated as:

$$LREER_t = \beta_0 + \beta_1 LRCOMP_t + \beta_2 LPERCAPI_t + \varepsilon_t \qquad (10)$$

where $LREER_t$ is the log of the real effective exchange rate, $LRCOMP_t$ is the log real commodity prices, $LPERCAPI_t$ is log of real GDP per capita which is a proxy for productivity or technology and ε_t is the error term. All variables are expected to be positively related to the real exchange rate. Hence, β_1>0 and β_2>0.

3.4 Conclusion

This chapter discussed the relationship between real exchange rate and the prices of commodity exports. Despite the fact that the most developing countries rely on the export commodities, most studies used the fundamental approach to real exchange rate determination. They identified terms of trade as a key factor in explaining movements in the real exchange rate. However, terms of trade is very broad, and commodity prices could be a better explanatory variable for the changes in real exchange rates of commodity exporting countries. Three main models were identified to investigate the relationship between the real exchange rate and commodity prices. These models of real exchange rate and commodity prices suggests that since developing countries rely more on the export of primary commodities, commodity prices have a potential to explain a significant component of the variation in their real exchange rate. All reviewed empirical studies revealed that there is a close link between the real exchange rate and prices of commodities. The empirical model to be estimated later in this study is also expected to provide evidence that commodity prices have a significant effect on the real exchange rate for Namibia.

CHAPTER 4. REAL EXCHANGE RATE MISALIGNMENT

4.1 Introduction

This chapter highlights the literature on the real exchange rate misalignment. It surveys the empirical literature on the impact of real exchange rate on economic performance, and the models or methodologies for testing the effect of real exchange rate misalignment on economic performance.

The rest of the chapter is organised as follows. Section 4.2 provides theory and literature. Section 4.3 reviews the literature, models and methodologies for assessing the impact of real exchange rate misalignment on economic performance. Section 4.4 discusses the measures to correct real exchange misalignments, and Section 4.5 presents the conclusion.

4.2 Theory and Literature

The real exchange rate responds to real and monetary variables, although the equilibrium real exchange rate is a function of real variables only. Since the equilibrium real exchange rate exists, it does not necessarily mean that the actual real exchange rate is always equal to this equilibrium value. Zhang (2001: 83) defines real exchange rate misalignment as the difference between the actual and equilibrium real exchange rate. The observed real exchange rate depends on the values of the fundamentals as well as aggregate macroeconomic pressures generated by an excess supply of money or a fiscal deficit, at any given moment.

Real exchange rate misalignments occur in both fixed and floating exchange rate regimes. Asfaha & Huda (2002:1) pointed out that in fixed and flexible exchange rate regimes, real exchange rate misalignment reflect poor policy fundamentals which prevents the exchange rate from responding to changes in the fundamentals. In floating exchange rate regimes variables such as speculative attacks that move the exchange rate a lot relative to economic fundamentals are the primary cause of real exchange rate misalignments. According to Asfaha & Huda (2002: 1) a large real exchange rate misalignment can be attributed to poor policy fundamentals.

Real exchange rate misalignment has become a central issue in the analysis of macroeconomic policies in developing countries. As Kamnisky *et al*. (1997: 10) state, sustained or continuous overvaluation of the currency is seen as an early warning of a currency crisis. The real exchange rate misalignment has a detrimental effect on the performance of the economy. A real exchange rate misalignment can result in welfare and efficiency costs. According to Pfeffermann (1985: 17-18) and Edwards (1989:12) real exchange rate misalignment especially overvaluation hurts exports and can wipe out the agricultural sector. It can also cause capital flight which may be optimal from a private perspective but a substantial cost in terms of social welfare.

A real exchange rate misalignment, especially overvaluation undermines exports. It is well recognised that a dynamic export sector is important in the course of development. According Pfeffermann (1985: 18), real exchange rate misalignment such as overvaluation reduces other countries' incentive to import from the country with an overvalued real exchange rate, and this strikes at the core of the process of development. In addition to its contribution to total production, exports are important in most countries because the availability of foreign exchange is one of the main determinants of the overall level of economic activity. Even in countries where export accounts for a small percentage of the GDP, a shortfall in foreign exchange reserves can reduce economic growth. Misalignment undermines incentives to produce for exports and for import substitutes. This results from the fact that exports lose competitiveness, and imports become relatively cheaper because of misalignment (mainly overvaluation). This can happen if import restrictions have not been imposed. According to Pfeffermann (1985) if import restrictions are imposed, imports may not become relatively cheaper. Exports are discriminated against because of inefficiencies and the high costs associated with import restrictions, and attempt to offset anti-export bias through subsidies may be unsuccessful because the budget deficit may be widened.

Since the real exchange rate affects the price of tradable goods, it is of immediate importance to farmers who will be influenced in deciding what part of their efforts is to be devoted to growing crops and what part will be destined for the market and what is to be retained for their own consumption. The effect of real exchange rate misalignment especially overvaluation on agriculture was given a special mention by Pfeffermann (1985: 18) because in the early stages of development and in many developing countries the agricultural sector is the key employer. The poorest people live in the rural areas and they are dependent on agriculture and a real exchange rate which is not realistic harms them. A realistic real exchange rate is conducive to rural prosperity and can have a positive effect on growth and the distribution of income.

According to Pfeffermann, where the internal terms of trade are biased against agriculture, causing migration to the urban areas, the need for imported foodstuffs rises and more pressure will be put on the balance of payments. If there are no adequate incentives on agriculture the impact on development can be negative, because there is a close relationship between agriculture and the overall economic development. This can happen even if agriculture accounts for a smaller share of the economy. Pfeffermann extends this argument to other resource-based activities, that misalignment undermines incentives in forestry, mining and agro-industries. If imports are made relatively cheaper, misalignment not only discriminates against the development of domestic technologies, it also encourages relatively capital intensive methods of production through cheaper imports of capital goods. This discourages employment creation.

Real exchange rate misalignment can also cause capital flight, which may be optimal from private perspective but a substantial cost in terms of social welfare. Although most analyses are more concerned about the impact of overvaluation, undervaluation of the currency can also affect the economy negatively through higher inflation and through discouraging consumption and investment. Kahn (1992: 13) argues that although undervaluation results in a build up of reserves that can be used to repay previous debt or as a buffer against future adverse shocks, current account surpluses come at the expense of domestic absorption of resources. Consumption and investment are lower than they would have been. It is not a good development policy to run current account surpluses in order to finance private capital export. Development policy should focus on stimulating investment in the domestic economy instead of investing abroad. Kahn (1992) argues further that an undervalued real exchange rate has an impact on income distribution, in the sense that it redistributes income from labour to capital, but the extent of this would depend on how powerful trade unions are.

Through its impact on the competitiveness of the tradable sector versus the rest of the world and subsequent effect on investment, real exchange rate misalignment affects growth. A country is competitive if it is able to produce products at lower prices in comparison with other countries that are in the international market. Producing products at lower cost than competing countries plays a role in the determination of the external position of the country. The impact of real exchange rate misalignment on the competitiveness of the country can be a sustained problem and therefore it is crucial for those in policy making positions to regularly assess and adjust substantial real misalignments. This would help to avoid potential economic problems.

Misalignment of the real exchange rate can be a serious problem for economists in addition to the damage it causes to the economy (Devarajan, 1999: 359). If the real exchange rate is overvalued everyone turns to economists for a quantitative estimate of the degree of misalignment. This may suggest a multi-year research project to answer questions such as the magnitude of currency devaluation. Data and other information without the aid of a model or a consistency check to develop quick estimates of the real exchange rate misalignment have to be used. Devarajan (1999) illustrates this situation by stating that in the CFA Franc zone, prior to the 1994 devaluation, most observers agreed that the real exchange rate was overvalued but they disagreed on the extent of overvaluation. Data were scarce and robust estimates and formal models were hard to come by. This problem was made worse by the particular nature of the CFA franc zone in the sense that it was fully convertible and there was no parallel market in foreign exchange which was often used as a guide for estimating real exchange rate misalignment.

Members (Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo-Brazzaville, Ivory Coast, Gabon, Mali, Niger, Senegal, and Togo) of the CFA Franc zone share the same currency across two monetary unions. The degree of misalignment could be different across the countries of the CFA Franc zone. According to Devarajan (1999: 370) the CFA has different representative countries. Some countries are high income and have a high component of primary products in their exports, while some are low income or the component of primary products in exports is low. Countries with a larger component or percentage of primary exports in total exports can experience high real exchange rate misalignments because of shocks that affect primary products. These countries are expected to have high overvalued real exchange rates compared to those with low share of primary products in total exports.

4.3 Impact of Real Exchange Misalignment on Economic Performance

A number of empirical studies investigate the effect of the real exchange rate misalignment on economic performance. Cottani, Cavallo & Khan (1990) was probably the first study to investigate the impact or effect of real exchange rate misalignment on economic performance. Cottani *et al.* (1990) examine the view that real exchange rate behaviour and economic performance are correlated, using empirical evidence from a cross-section of less developed countries. The impact of real exchange rate misalignment on economic performance was examined by regressing per capita growth on real exchange rate misalignment, and investment on real exchange rate misalignment as well as agriculture on real exchange rate misalignment. Export growth was also regressed on real exchange rate misalignment. The results showed a strong negative relationship between real exchange rate misalignment and these measures of economic performance.

However, Cottani *et al*. (1990) acknowledges that the results do not imply that real exchange rate behaviour is the main determinant of economic performance.

Dollar (1992) investigates the relationship between distortion in real exchange rate and GDP growth for the period 1976 to 1985. The investigation was done by running regression and correlation between real exchange rate distortion and economic growth for a cross-section of 95 developing countries (43 in Africa, 16 in Asia, 24 in Latin America, 12 in Europe/Middle East) and 22 developed countries. The investigation revealed that outward-oriented policies and exchange rate levels that encouraged export growth in East Asian countries generated a boost in their growth rates. Real exchange rate distortion has a negative impact on economic growth, and maintenance of stable real exchange rate can improve growth in many poor countries.

Ghura and Grennes (1993) examine the impact of real exchange rate instability and real exchange rate misalignment on economic performance for 33 countries in Sub-Saharan Africa for the period 1972 to 1987. The measures of economic performance were GDP per capita, export to GDP, import to GDP, investment to GDP and savings to GDP. The pooled time series and cross-section data confirmed that there is a negative relationship between real exchange rate misalignment and economic performance. Higher levels of real exchange rate misalignment are associated with higher levels of macroeconomic instability. Lowering real exchange rate misalignment and real exchange rate instability will improve economic performance.

Easterly, Loayza and Montiel (1997) estimated the growth equation for 81 Latin American countries for the period 1960 to 1993. The dependent variable was growth in real GDP per capita, and amongst others, real exchange rate misalignment proxied by black market premium was an explanatory variable. The estimation revealed that real exchange rate misalignment has a negative impact on real GDP per capita.

In studying the effects of real exchange rate misalignment on growth for Egypt, Jordan, Morocco, and Tunisia, Domac and Shabsigh (1999) constructed three alternative measures of real exchange rate misalignment. These are (PPP) measure, black market rate measure and a model based measure which captures policy-induced misalignment.

The first measure of real exchange rate misalignment is based on the PPP theory. The real exchange rate misalignment is computed as the deviations of the actual real exchange rate from some base year in which the real exchange rate is believed to have been in equilibrium (Domac and Shabsigh, 1999: 12). The average of the three highest values of the real exchange rate is used as a proxy for the equilibrium real exchange rate. According to Domac and Shabsigh, selecting the three highest values of the real exchange rate as a reference, one chooses the years of devaluation which may not necessarily be equilibrium years. The highest values are chosen because generally devaluation occurs during balance of payment crises and when the external sector is out of equilibrium. It is assumed that the real exchange rate is closer to its equilibrium value when devaluation takes place.

Misalignment calculated using the PPP is defined as (Domac and Shabsigh, 1999: 13):

$$RERMIS_{it} = \left(\frac{(\sum_j \max RER_{ij})/3}{RER_{it}} - 1 \right) \tag{11}$$

where $RERMIS$ is real exchange rate misalignment, $[(\sum_j \max RER_{ij})/3]$ $(j = 1,2,3)$ is the average of the three highest values of the real exchange rate for the i^{th} country. The PPP measure has a major drawback. It fails to capture changes in the sustainable equilibrium real exchange rate produced by changes in economic fundamentals such as terms of trade and commercial policies.

The black market exchange rate premium measure utilises the premium of the nominal black market exchange rate (B) over the official rate (E) as a proxy for real exchange rate misalignment. It is calculated as:

$$RERMIS_{it} = \left(\frac{B_{it}}{E_{it}} - 1 \right) \qquad (12)$$

This black market exchange rate premium measures misalignment in the real exchange rate, distortion in the foreign exchange market exchange control and rationing of import in the economy.

The third measure of real exchange rate misalignment is based on the formal model of equilibrium real exchange rate determination which was developed by Edwards (1988b). The model-based measure has an advantage over the first two measures. It captures the effects of changes in the fundamentals and domestic macroeconomic, trade and exchange rate policies on the equilibrium real exchange rate. Empirically it can be obtained by using the link between actual real exchange rate and equilibrium real exchange rate (Domac and Shabsigh, 1999: 13). It is computed as:

$$\log_e RER_{it} \equiv \log_e (ERER_{it}) - \left[\log_e (ERER_{it}) - \log_e (RER_{it}) \right] \qquad (13)$$

where the term in square brackets on the right hand side of the identity indicates the gap between the actual real exchange rate (RER) and equilibrium real exchange rate (ERER), which is real exchange rate misalignment. Regression analysis are employed to determine the empirical relationship $log_e(RER_{it})$ and $log_e(ERER_{it})$-[$log_e(ERER_{it})$-$log_e(RER_{it})$].

After constructing the three measures of real exchange rate misalignment, Domac and Shabsigh (1999) investigate the impact of real exchange rate misalignment on economic performance in conjunction with other variables. The following equation was estimated to investigate the impact of real exchange rate misalignment on economic performance:

$$PCGR_{it} = \beta_0 + \beta_1 RERV_{it} + \beta_2 RERMIS_{it} + \beta_3 SIY_{it} + \beta_4 TOTG_{it} + \beta_5 POPG_{it} + v_{it}, \quad (14)$$

where *PCGR* is growth in real GDP per capita, *RERV* is real exchange rate variability, *RERMIS* is real exchange rate misalignment, *SIY* is investment to GDP ratio, *TOTG* is terms of trade growth and *POPG* is population growth. The results showed that the real exchange rate misalignment has a negative impact on economic growth.

Bleaney and Greenaway (2001) used data from a sample of 14 Sub-Saharan African countries that are highly relying on the export of primary commodities for the period 1980 to 1995. The data were used to analyse the effects of real exchange rate volatility and real exchange rate misalignment on investment and GDP growth. The investigation revealed that real exchange rate volatility and misalignment have a negative effect on both investment and GDP growth.

Asfaha and Huda (2002) estimated the degree of real exchange rate misalignment and its effect on international trade competitiveness for the economy of South Africa using quarterly data for the period 1985 to 2000. The estimation was based on Edwards' intertemporal general equilibrium model of a small open economy. The error correction approach was used to estimate equilibrium real exchange rate and the resulting misalignment, and the impulse response and variance decomposition of the vector auto regression (VAR) have been established to test the impact of misalignment on trade competitiveness. International trade competitiveness was proxied by unit labour cost and export. The estimation showed that real exchange rate misalignment affects negatively South Africa's competitiveness accounting for 20 percent of the variation in competitiveness.

The growth effects of real exchange rate misalignment and their volatility were evaluated by Aguire and Calderón (2005). The evaluation was done for 60 countries for the period 1965 to 2003 using both time series and panel cointegration methods. After estimating real exchange rate misalignment indices, the impact on growth using dynamic panel data techniques, controlling for other traditional growth determinants, was evaluated. The evaluation found that developing countries have a higher degree of real exchange rate misalignment than the developed countries. There is a negative relationship between real exchange rate misalignment and economic growth. Real exchange rate misalignment was separated into overvaluation and undervaluation. The impact of overvaluation on economic growth is more negative compared to that of undervaluation. Reducing overvaluation and undervaluation would improve economic growth.

In summary, all the above empirical studies regardless of the method used, pointed out clearly that real exchange rate misalignment has a negative impact on growth of both developing and developed countries.

4.4 Correction of Real Exchange Rate Misalignments

The last section discussed the negative impact of real exchange rate misalignment on economic welfare and efficiency. This section discusses what should be done to correct real exchange rate misalignments. Correction of real exchange rate misalignment is discussed in detail by Edwards (1988a: 23-39).

In the case of macroeconomic induced real exchange rate misalignment the important step is to eliminate the source of macroeconomic disequilibrium, which is the inconsistency between macroeconomic policy and the nominal exchange rate. This policy can be supplemented with other measures or the authorities can simply wait for the economy to adjust on its own so that the real exchange rate returns to its own equilibrium value. As Edwards (1988) notes, this policy, which is referred to as disinflation with automatic adjustment, can be severe and has limitations under predetermined nominal exchange rate. The real exchange rate will differ from its equilibrium value even after policymakers have controlled the inconsistent macroeconomic forces which generate the macroeconomic induced misalignment.

If the real exchange rate is overvalued the country will loose its competitiveness in the international market. Under fixed exchange rate in this case a fast return to equilibrium requires a decline in the nominal domestic prices of nontradables. A fast reduction in these nominal prices is not likely under many situations. Hence an automatic adjustment could take a long time and prolong real exchange rate misalignments. According to Edwards (1988a), if nominal domestic prices and wages are not flexible an automatic adjustment can generate additional unemployment and reduce domestic output. A cut in aggregate expenditure which results from the corrective macroeconomic measures will generate an excess supply for all goods and assets. This low demand for tradables will be reflected in a low current account deficit and reduction in net foreign indebtedness. Disinflation generates an excess supply of nontradables, and this will require a drop in relative prices to restore equilibrium. If nominal prices are sticky or inflexible, this relative price realignment will not happen and this will result in high unemployment.

Devaluation can also be used to correct real exchange rate misalignment. This concentrates on affecting the nominal price of nontradables to restore equilibrium real exchange rate by adjusting the domestic price of tradables. Since the real exchange rate is defined as the exchange rate multiplied by the ratio of prices of tradables to prices of nontradables (P_T/P_N), devaluation aims at generating a higher real exchange rate through an increase in the price of tradables (EP_T). Devaluation can help to sidestep the adjustment costs associated with automatic adjustment policies by affecting the real exchange rate directly and avoid the necessary reduction in the prices of tradables. It is important to note that monetary arrangements in the CMA make it impossible for Namibia to use devaluation for realigning the real exchange rate.

There are other policies that can have the effect similar to that of devaluation, but it is not easy to replicate all results of devaluation. These are import tariffs and export subsidies, and income policies (see also Edwards, 1989: 12-18). The combination of import tariffs and export subsidies replicates some effects of devaluation. Import tariffs increase the price of importables, while export subsidies increase the domestic price exportables. If import tariffs and subsidies are of the same rate the relative price between importables and exportables will remain unchanged, but their relative price with respect to nontradables will increase. As stated by Edwards (1989: 15), this is the same results as is achieved under devaluation. The difference between devaluation and import tariffs and export subsidies is that devaluation affects the visible and invisible trade as well as the domestic currency price of tradable goods, services and tradable assets. Import tariffs and export subsidies affect only the domestic price of tradable goods and services. The other difference is that devaluation affects domestic interest rates if it generates expectations of further devaluations. Even if the capital account is closed partially some fraction of the expected devaluation will be passed onto the domestic interest rates in this situation. Tariffs and subsidies do not have any effect on interest rates. Devaluation does not have direct effects on the fiscal budget, while tariffs and subsidies have a general effect on fiscal imbalances. The problem with imposition of tariffs and subsidies is that they will encourage various interest groups to claim exemptions for their particular industry. According to Edwards (1989: 15) this is political and can be avoided by using devaluation.

Income policies can also be used to realign the real exchange rate. These policies attempt to control wage and price increases through some form of direct intervention. This policy can succeed if the domestic goods prices fall relative to those of foreign goods. According to Edwards (1989) income policies that are not accompanied by restraint on demand will fail to bring down inflation. Correcting real exchange rate misalignment through income policies is inefficient and very risky.

4.5 Conclusion

The purpose of this chapter was to review the literature and models for assessing the impact of real exchange rate misalignment on economic performance. The chapter also discussed measures to correct real exchange rate misalignment. Real exchange rate misalignment, which is a sustained departure of the real exchange rate from its equilibrium value, has now become a central issue in the economies of developing countries. It has a detrimental effect on the economy and can result in welfare and efficiency costs. It can cause reduction in export and can wipe out the agricultural sector. It can also cause capital flight. Countries that have exports dominated by primary commodities experience the highest real exchange rate misalignment compared to those with few primary commodities in their exports. The literature has come up with different methodologies and models that can be used to investigate the impact of real exchange rate misalignment on economic performance. A number of studies test the impact of real exchange rate misalignment on economic performance and competitiveness. Regardless of which measure is used, real exchange rate misalignment has a negative impact on economic performance. Real exchange rate misalignment can be corrected through price and wage flexibility, devaluation and income policies.

CHAPTER 5. ECONOMETRIC ANALYSIS OF REAL EXCHANGE RATE IN NAMIBIA

5.1 Introduction

This chapter presents the results from the three-good model (fundamental approach) and the Cashin *et al.* model of real exchange rate and commodity prices. The real exchange rate equation is estimated and the equilibrium real exchange rate then derived. The resulting real exchange rate misalignment is computed as the difference between the equilibrium and actual real exchange rate. Section 5.2 deals with estimation techniques. Section 5.3 discusses the data. Section 5.4 presents the results of the three-good model. Section 5.5 presents the results of the Cashin *et al*. model and Section 5.6 concludes.

5.2 Estimation Technique

There are different econometric techniques in time series estimation and these are the traditional Ordinary Least Squares (OLS), Engle and Granger two step and Engle-Yoo third step. The OLS does not take stationarity of the variables into account and if the variables in the estimation are non-stationary there results will be spurious. The Engle-Granger two step and Engle-Yoo third step procedure take stationarity and cointegration into account, but assume that there is only one cointegrating vector. That is a main weakness of these two techniques (The Engle-Granger two step and Engle-Yoo third step) and they are not sufficient in multivariate system. Johansen's full information maximum likelihood and vector autoregression (VAR) do not assume that there is one cointegrating vector. They are necessary and appropriate for time series analysis in multivariate systems.

This study employs the Johansen (1988, 1995) full information maximum likelihood (FIML) estimator in order to investigate if there is a long-run cointegrating relationship between the real exchange rate and the explanatory variables. The Johansen methodology was used by MacDonald and Ricci (2003) to estimate the equilibrium real exchange rate for South Africa. This econometrics methodology corrects for autocorrelation and endogeneity parametrically using a vector error correction mechanism (VECM) specification. This methodology will be employed for both the three-good model approach and the Cashin *et al.* (2004) model which models real exchange rate as a function of real commodity prices. The Johansen procedure is described as follows. Defining a vector x_t of *n* potentially endogenous variables, it is possible to specify the data generating process and model x_t as an unrestricted vector autoregression (VAR) involving up to *k*-lags of x_t is specified as:

$$x_t = \mu + A_1 x_{t-1} + ... + A_k x_{t-k} + \varepsilon_t \qquad u_t \sim IN(0, \sum), \tag{15}$$

where x_t is (*n x 1*) and each of the A_i is an (*n x n*) matrix of parameters. Sims (1980) advocates this type of VAR modelling as a way of estimating dynamic relationships among jointly endogenous variables without imposing strong *a priori* restrictions (see also Harris, 1995). This is a system in reduced form and each variable in x_t is regressed on the lagged values of itself and all the other variables in the system. Equation (15) can be re-specified into a vector error correction model (VECM) as:

$$\Delta x_t = \mu + \Gamma_1 \Delta x_{t-1} + ... + \Gamma_{k-1} \Delta x_{t-k+1} + \Pi x_{t-k} + \varepsilon_t \tag{16}$$

where $\Gamma_i = -(I - A_1 - ..... - A_i)$, $(i = 1, ..., k-1)$ and $\Pi = -(I - A_i - ...... - A_k)$, *I* is a unit matrix, and $A_i\,(i = 1,.....p)$ are coefficient vectors, *p* is the number of lags included in the system, ε is the vector of residuals which represents the unexplained changes in the variables or influence of exogenous shocks. Δ represents variables in difference form which are I(0) and stationary and μ is a constant term. Harris (1995: 77) states that this type of expressing the system has information on both the short and long-run adjustment to changes in x_t through estimates of Γ_i and Π respectively. In the analysis of VAR, Π is a vector which represents a matrix of long-run coefficients and it is of paramount interest. The long-run coefficients are defined as a multiple of two (*n x r*) vectors, α and β', and hence $\Pi = \alpha\beta'$, where α is a vector of the loading matrices and denotes the speed of adjustment from disequilibrium, while β' is a matrix of long-run coefficients so that the term $\beta' x_{t-1}$ in Equation (16) represents up to (*n-1*) cointegration relationship in the cointegration model. It is responsible for making sure that the x_t converge to their long-run steady-state values. If there is cointegration it is the same as stating that the rank *(r)* of the Π matrix. If it has a full rank, the rank *r* = *n* and it is said that there are *n* cointegrating relationships and that all variable are *I*(0).

If it is assumed that x_t is a vector of nonstationary variables *I*(1), then all terms in Equation (16) which involves Δx_{t-i} are *I*(0), and Πx_{t-k} must also be stationary for ε_t ~ *I*(0) to be white noise. Harris (1995: 79) distinguishes between three instances when this requirement that $\Pi x_{t-k} \sim \mathrm{I}(0)$ is met. The first one is when all variables in x_t are stationary, and this not of paramount importance because it implies that there is no problem of spurious regression and the appropriate modelling is to estimate the standard VAR in levels as in Equation (15). In the second instance, there is no cointegration at all and this implies that there are no linear combinations of the x_t that are *I*(0) and therefore Π is an (n x n) matrix of zeros. The appropriate modelling strategy in this case is a VAR in first differences which involves no long-run elements. The third instance is when there exists up to (*n-1*) cointegration relationships, $\beta' x_{t-k} \sim \mathrm{I}(0)$. In this instance $r \leq (n-1)$ cointegration vectors exists in β together with *(n – r)* nonstationary vectors. The r columns of β form *r* linearly independent combinations of the variables in x_t and each of which is stationary, and the *n –r* columns of β form *I*(1) common trends. Only the cointegrating vectors in β enters Equation (16) otherwise Πx_{t-k} would not be I(0). The implication is that the last *(n – r)* columns of α are insignificantly small. According to Harris, the problem faced is of determining how many $r \leq (n-1)$ cointegrating vectors exist in β and amounts to equivalently testing which columns of α are zero. Testing for cointegration amounts to finding the number of *r* linearly independent columns in Π.

MacDonald and Ricci (2003: 11) mention that a key advantage of the Johansen methodology is that the estimated coefficient, the β vector can be used to prove a measure of the equilibrium real exchange rate, and the expression of the gap between the actual real exchange rate and its equilibrium level.

5.3 Data

This study covers the period 1970 to 2004. Annual data will be used to estimate the equilibrium real exchange rate. The sample of 1970 to 2004 was chosen using annual data. It would have been interesting to use quarterly data for the post-independence period 1990 to 2004, but statistics (quarterly) for some variables such as investment, terms of trade, export and import (to compute openness and resource balance variables), GDP, government expenditure are not available. Using annual data for the period 1990 to 2004 is not adequate for econometric time series analysis. Given the above, the sample of 1970 to 2004 using annual data was considered to be appropriate. The data for the period 1980 to 2004 is obtained from the Central Bureau of Statistics of Namibia and the Bank of Namibia. Data for the period 1970 to 1979 are sourced from Cornwell *et al.* (1991). A detailed description of the data is presented in the Appendix.

Before testing for cointegration it is important to mention that in the original definition of cointegration Engle and Granger, cointegration refers to variables that are integrated of the same order. This does not necessarily mean that all integrated variables are cointegrated. It is possible to find for example a set of I(d) variables that is not cointegrated. If variables are integrated of different orders, they cannot be cointegrated. However, it is possible to have cointegration with variables of different orders. Pagan and Wickens (1989: 1002) illustrate this point clearly that it is possible to find cointegration among variables of different orders (when there are more than two variables):

> *"If the dependent variable in an equation is I(1) then there must be at least one I(1) variable among the explanatory variables. If all explanatory variables are I(0) then the equation will be mis-specified and this will be reflected in the disturbance term which will be I(1) and not I(0) as required. The disturbance will also be I(1) if the dependent variable is I(0) and there is only one I(1) regressor. To achieve an I(0), there must be at least two I(1) regressors. The reason for this is a matter of integration or growth accounting, i.e. the left and right hand sides of the equation must be of the same order of integration or trend. To explain a*

> *series which is growing, at least one of the explanatory variables must also be growing otherwise the growth will be unexplained and will show up in the disturbance term. The remaining variables are simply explaining deviations about the growth path. If the dependent variable is stationary, there must be either zero or at least two trending explanatory variables, one is required to remove the growth of the other and leave their combined stationary".*

Enders (2004: 323) agrees with Pagan and Wickens (1989) that it is possible to find cointegration among groups of variables that are integrated of different orders. This happens when there are more than two variables. This is also supported by Harris (1995: 21).

5.4 The Three-good model

5.4.1 South Africa's Exchange Rate Policy and its Implication for Namibia's Real Exchange Rate

It is important to highlight some monetary and exchange rate policies of South Africa before the estimation of Namibia's real exchange rate. During the 1970s the exchange rate regime changed frequently. The rand was pegged from the USA dollar to the British pound in the period 1971 to 1983. The rand was again pegged to USA dollar during the same period. This was a time when South Africa started implementing a flexible exchange rate (Tjirongo, 1997). The rand was then pegged to a basket of currencies. The De Kock Commission study examined the exchange rate and monetary policy and recommended a move from a government control system to a market-oriented system. There was a dual exchange rate system which consisted of a commercial rand used for current account transactions and securities, and financial rand for equity to protect the current account from capital outflows which resulted from political instability. A managed float system was introduced for the commercial rand in and the financial rand started to float freely. The authorities took steps towards financial liberalisation and the exchange rate was now determined by the market.

South Africa experienced massive capital outflows between 1985 and 1994 (Kahn *et al*, 1998). This can possibly be attributed to political instability because of unrest in the townships and low levels of exports and foreign exchange reserves. There was doubt about South Africa's ability to service its short-term debt. However, Kahn states that after the transformation of South Africa to a democracy in 1994, the country received capital inflows of more than R30 billion during the period July 1994 to December 1995. Although it was good for the economy, it resulted in monetary management difficulties. These inflows of capital to South Africa were reversed and the country experienced capital outflows in 1996 because of sentiments against emerging markets. This resulted in the depreciation of the rand. Although the change in sentiments was not related to any economic fundamental in Namibia the country had no instrument to protect itself from the shocks. These developments in South Africa are important to Namibia even though they are solely related to events in South Africa.

The financial rand was abolished in 1995 (Kahn, 1998). Non-residents started to impact directly on the current account. South African interest rates were no longer protected from world interest rates by the financial rand.

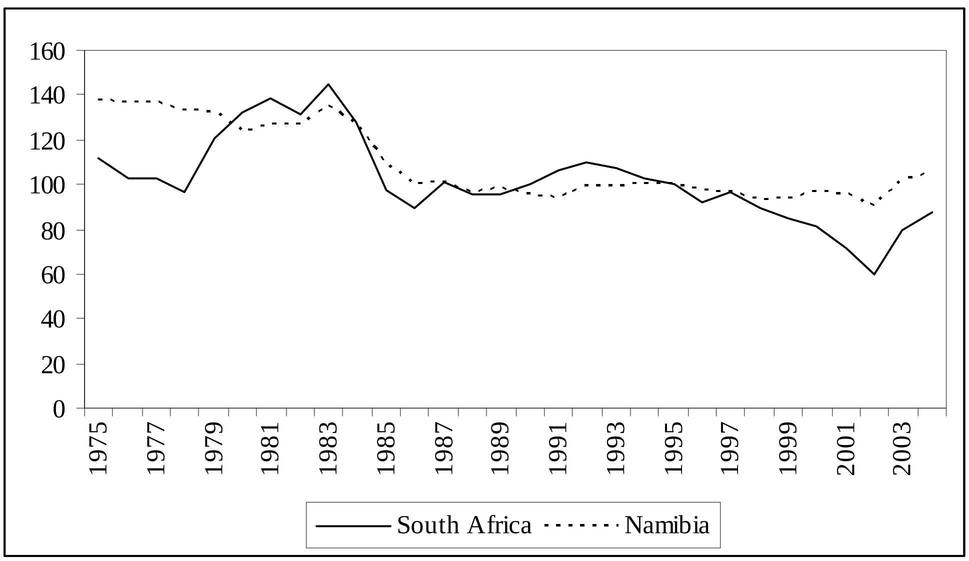
Various quarterly Bulletins of the South Africa Reserve Bank indicate that the inflation rate which averaged 15 percent in the 1980s declined to a single digit in the late 1990s. This implies that South Africa has achieved financial stability. The inflation rate of Namibia also declined since the country imports a high percentage of its products from South Africa.

There has been an expansion of the money supply in South Africa since 1994 because of the extension of credit to the private sector and individuals. The extension of credit continued to grow at a high level because of consumer confidence in the economy. Individuals who did not qualify for credit previously were now given loans. This resulted in high consumer price index. The South African Reserve Bank's stance on interest rate is determined mainly by consumer credit and this is important for Namibia.

Since the Namibia dollar is pegged to the rand, the exchange rate with other currencies is determined by South Africa, and hence it is important to understand the exchange rate policies of South Africa.

Kahn (1992) argued that during the 1980s the price of gold was the main determinant of the real exchange rate of South Africa. The rand depreciated when the price of gold decreased, and appreciated when the price of gold increased. Kahn states that the South Africa Reserve Bank intervened to prevent more appreciation of the rand when the price of gold increase. These developments since 1970 have shown that South Africa is vulnerable to speculative attack and this implies that Namibia will experience the same with respect to other currencies. In light of these discussions, Figure 1 presents the real exchange rates of South Africa and Namibia.

Figure 1. Real exchange rates of Namibia and South Africa (1995=100)



Source: Data are obtained from the International Financial Statistics, Bank of Namibia and South African Reserve Bank.

Figure 1 shows that although the real exchange rates of Namibia and South Africa are moving together, the two indexes showed divergence from each other especially during the periods 1970 to 1979, 1990 to 1994, and 1995 to 2004. The two indexes converged from the late eighties to late nineties. South Africa accounts for about 60 percent of the weight in Namibia's total trade and this implies that the two rates should move together.

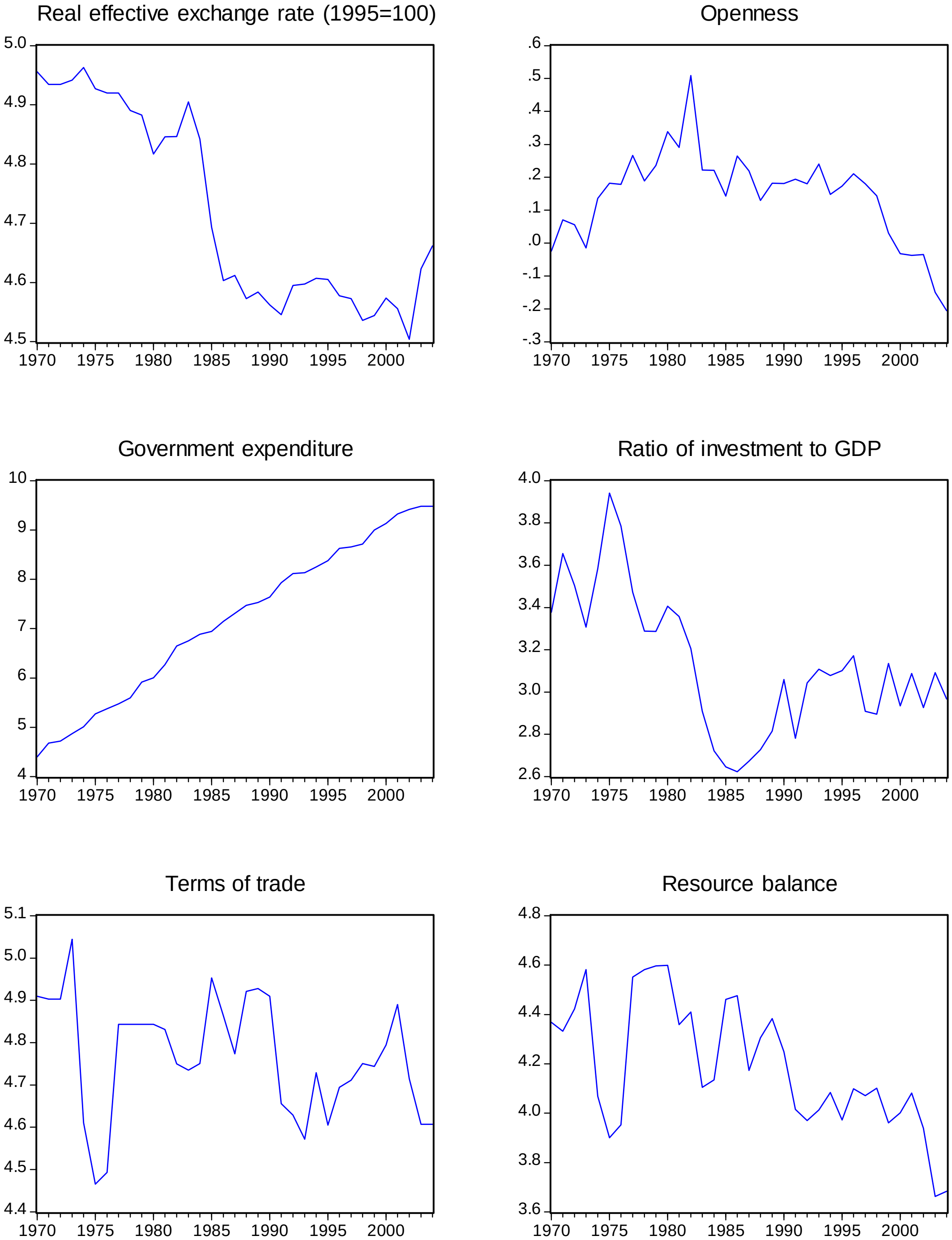
However, the divergence between the real exchange rates of the two countries is expected. This is attributed to the difference in consumer price indexes of the two countries which are used to compute the real exchange rates. The divergence is attributed to the difference in the weights applied to the computation of the consumer price indexes in the two countries. For example, food accounts for 29.63 percent in Namibia's and 22 percent in South Africa's consumer price indexes (South African Reserve Bank, 2005 and Bank of Namibia, 2005).

As mentioned in Chapter 2, the developments in South Africa's fundamentals also have an impact on the real exchange rate of Namibia and it would be interesting to include some of them in the estimation. However, not all South African fundamentals are relevant to Namibia. Determining which of the South Africa's fundamentals to include or exclude falls outside the scope of this study, but can be a subject of future research.

5.4.2 Developments in Namibia's Key Fundamental Determinants of the Real Exchange Rate

Following the theoretical model of Section 2.3 and review of empirical studies in Section 2.4, this section examines the evidence on the evolution of the following fundamentals expected to have an influence on the real exchange rate of Namibia between 1970 and 2004. These include ratio of investment to GDP, terms of trade, resource balance and government expenditure and openness of the economy. These fundamentals are plotted in Figure 2.

Figure 2. Real effective exchange rate and its fundamental determinants (in logs)



Terms of trade

The terms of trade is included in the determination of the real exchange rate to capture foreign price shocks. Namibia's terms of trade has been volatile between 1970 and 2004.

The terms of trade measures the behaviour of export prices relative to import prices. It is important because it looks at both the prices of exports and imports. This is of paramount importance because increase in exports would mean little if the prices of imports increase simultaneously by a higher rate.

Terms of trade deteriorated during the early 1990s and this could be attributed to the decline in the price of diamonds. Diamond production in Namibia increased by 56 percent in 1991 because with the offshore operations, higher grades of diamonds were obtained (Bank of Namibia, 1992). The sea mining operations became more significant in the early 1990s. In 1992 the Central Selling Organisation imposed a 25 percent cut on all production because of an over stock of diamonds and the slump in diamond prices (Bank of Namibia, 1992). The declining trend in uranium between 1988 and the late 1990s might also have contributed to the deterioration of the terms of trade. According to Bank of Namibia (1992) the production of uranium reached its lowest level in 1992 since 1985. The Rossing Uranium mine was operating at 43 percent of its capacity. The main reason for the decline in the production of uranium was the continuing slump in world prices of uranium. In addition, large sales from the former Soviet Union resulted in a glut in minerals in the world market and drove the prices of most minerals to low levels.

The shocks to the prices of commodities for primary product exporting countries such as Namibia have a significant impact on the terms of trade. A greater proportion of Namibia's exports are minerals (such as diamond, uranium, copper and other base metals) and fisheries products. These products cannot reduce the impact of commodity price fluctuations on the terms of trade. Countries that have a wide range of exportable (such as South Africa) have the capacity to absorb deterioration in the terms of trade resulting from a fall in commodity prices than countries (such as Namibia) with few exportables.

Trade Policy (Openness of the Economy)

Openness of the economy (computed as the sum of export and import over GDP) which is a proxy for trade policy or trade and exchange rate restrictions influence the real exchange rate. It refers to the country's trade policy stance which is reflected in import tariffs and quotas. It not only measures trade and exchange restrictions but also the intensity of exchange control. As discussed previously, the coefficient of tariff can be positive or negative depending on whether the substitution or income effect of tariffs and other trade restrictions dominates. The exchange rate can appreciate or depreciate. However, the bulk of the empirical evidence suggested that the substitution effect dominates the income effect and increase in openness is expected to cause real exchange rate depreciation. Although openness of the economy is not a good indicator of trade policy, Figure 2 shows that openness increased in 1981 and 1982. It declined in 1985 and remained almost constant until the late 1990s. This may suggest that structural changes in the economy took place from the late 1990s to 2004.

Ratio of Investment to GDP

The ratio of investment to GDP can appreciate or depreciate the real exchange rate. This depends on whether investment is more consumption intensive than import. If import responds more to investment it will rise spending, deteriorate the current account and results in real exchange rate depreciation. Figure 2 shows that since 1970s the ratio of investment decreased from 40 percent to below 30 percent in 1980. It declined sharply between 1980 and 1989. The decline in investment ratio could be attributed to uncertainties about the political settlement in the country. As a result, the mining sector which is a significant contributor to the GDP and export experienced a long period of inactivity in terms of investment in new technology and exploration (Bank of Namibia, 1991: 6).

The ratio increased slightly between 1990 and 2004. The Bank of Namibia (2001) attributed this increase to the fact that after independence prospecting for new minerals was revived. The long term prospects of the mining industry looked brighter because of an increase in investment in new technology and exploration.

Government Expenditure

Government expenditure increase significantly between 1970 and 2004. The increase in government expenditure between 1970 and 1989 can be explained by the fact that because of the growing demands for Namibia's independence, South Africa responded by establishing a transitional government for the then South West Africa based on 13 ethnic homelands in 1978 (Tjirongo, 1997). There was an expansion of military and security forces with the formation of the South West Africa Territorial Force, and this was in response to the escalation of military activity by the People's Liberation Army of Namibia (PLAN) in Namibia and Angola (see Esterhuysen, 1991: 58-64). It should be noted however, that not all government expenditure were devoted to the expansion of military and expansion of security forces, some were devoted to imports.

Government expenditure continued to increase after independence (1990), although fiscal policy has been prudent in order to maintain macroeconomic stability for sustainable development. The Bank of Namibia (2001) states that current expenditure dominates government spending. Expenditure on human resources accounts for about 52 percent of current expenditure. There has been significant spending on the development of human capital and the education sector received on average about 25 percent of total government expenditure.

Resource Balance

Resource balance is a proxy for capital control and flows (computed as [(import-export)/GDP]. This refers to a net increase in foreign borrowing, transfers and aid. Capital flows can be caused by the removal of capital control, increase in government borrowing in order to cover its deficit, and reduction in real interest rates in the world capital markets. Although it has been fluctuating since 1970 to 2004, it followed a downward trend. This suggests that there has been a decrease in the flow of capital to Namibia. It is not easy to explain what caused fluctuations of capital, although the period 1980 to 1989 was characterised by political uncertainty about the future of Namibia. The fluctuations of the post 1990 period can be attributed decrease in grants to the country because Namibia falls under middle income status and no longer qualify for some grants. The Bank of Namibia's various annual reports state that more than 80 percent of government debt is domestic and the share of foreign in total debt is less than 16 percent. The country did not borrow much from abroad.

5.4.3 Univariate Characteristics of the Variables and VAR Order

In order to estimate the empirical model the variables were tested for unit root (stationarity test). The results of unit roots tests are presented in the Appendix. Based on the Akaike Information Criteria (AIC), Final Prediction Error (FPE) and Swartz Information Criterion (SIC) the lag order was suggested to be 1. Diagnostic statistics were performed on the VAR for stability, serial correlation, normality, autocorrelation and heteroscedasticity. The diagnostic statistics show that the VAR is stable because all roots have modulus of less than one and lie within the unit circle. Diagnostic statistics are presented in Table 13 in the Appendix. The results show that there is no heteroscedasticity and no serial correlation. The error term is white noise and normally distributed.

5.4.4 Testing for Reduced Rank

Cointegration between the variables was tested using the Johansen FIML. The trace and maximum eigenvalues are presented in Table 4.

Table 4. Cointegration test results

Null hypothesis	Alternative hypothesis		0.05 Critical value	Probability value [b]
		Trace statistic		
r=0	r=1	113.7714[a]	95.754	0.002
r=1	r=2	75.248 [a]	69.819	0.017
r=2	r=3	45.629	47.856	0.079
r=3	r=4	23.573	29.797	0.219
r=4	r=5	9.400	15.495	0.329
r=5	r=6	1.112	3.841	0.292
		Maximum Eigenvalue statistic		
r=0	r>0	38.525	40.078	0.074
r≤1	r>1	29.618	33.877	0.148
r≤2	r>2	22.056	27.584	0.218
r≤3	r>3	14.173	21.132	0.351
r≤4	r>4	8.288	14.265	0.350
r≤5	r>5	1.112	3.841	0.292

[a] Denotes rejection of the null hypothesis at the 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

The trace statistics shows that there are two cointegrating vectors, while the maximum eigenvalue indicates that there is no cointegration. This study uses at least one statistic to assume a verdict of cointegration. The trace statistic confirm the appropriateness of proceeding with the vector error correction methodology (VECM). Since there are two cointegrating vectors the VECM is visualised as follows:

$$\begin{bmatrix} \Delta LREER_t \\ \Delta LTOT_t \\ \Delta LINVGDP_t \\ \Delta LGOV_t \\ \Delta LOPEN_t \\ \Delta LRESBAL_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \gamma_{35} & \gamma_{36} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \gamma_{45} & \gamma_{46} \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & \gamma_{55} & \gamma_{56} \\ \gamma_{61} & \gamma_{62} & \gamma_{63} & \gamma_{64} & \gamma_{65} & \gamma_{66} \end{bmatrix} \begin{bmatrix} \Delta LREER_{t-1} \\ \Delta LTOT_{t-1} \\ \Delta LINVGDP_{t-1} \\ \Delta LGOV_{t-1} \\ \Delta LOPEN_{t-1} \\ \Delta LRESBAL_{t-1} \end{bmatrix} +$$
$$\begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \\ \alpha_{61} & \alpha_{62} \\ \alpha_{71} & \alpha_{72} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} & \beta_{51} & \beta_{61} & \beta_{71} \\ \beta_{12} & \beta_{22} & \beta_{32} & \beta_{42} & \beta_{52} & \beta_{62} & \beta_{72} \end{bmatrix} \begin{bmatrix} LREER_{t-1} \\ LTOT_{t-1} \\ LINVGDP_{t-1} \\ LGOV_{t-1} \\ LOPEN_{t-1} \\ LRESBAL_{t-1} \\ CONSTANT \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (17)$$

5.4.5 Long-run Restrictions

The long-run restrictions were done in line with the three-good model in the theoretical framework. The structural approach to time series modelling uses economic theory to model the relationship among the variables of interest. However, economic theory is not always rich enough to provide a dynamic specification that identifies all of these relationships. In addition to that, estimation and inference are made difficult by the fact that the endogenous variables may appear on both the left and right sides of the equations. Economic theory provides guidance on the variables to be included in the estimation, but some variables do not necessarily need to be included in the estimation. Testing for the long-run parameter will help to identify which variables should be included in the estimation and which ones should not be included in the estimation. Five long-run restrictions were imposed on the two cointegrating vectors as shown in Equation (18):

$$\begin{bmatrix} \Delta LREER_t \\ \Delta LTOT_t \\ \Delta LINVGDP_t \\ \Delta LGOV_t \\ \Delta LOPEN_t \\ \Delta LRESBAL_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \\ \mu_5 \\ \mu_6 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \gamma_{15} & \gamma_{16} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \gamma_{25} & \gamma_{26} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \gamma_{35} & \gamma_{36} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \gamma_{45} & \gamma_{46} \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & \gamma_{55} & \gamma_{56} \\ \gamma_{61} & \gamma_{62} & \gamma_{63} & \gamma_{64} & \gamma_{65} & \gamma_{66} \end{bmatrix} \begin{bmatrix} \Delta LREER_{t-1} \\ \Delta LTOT_{t-1} \\ \Delta LINVGDP_{t-1} \\ \Delta LGOV_{t-1} \\ \Delta LOPEN_{t-1} \\ \Delta LRESBAL_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11} & \alpha_{12} \\ \alpha_{21} & \alpha_{22} \\ \alpha_{31} & \alpha_{32} \\ \alpha_{41} & \alpha_{42} \\ \alpha_{51} & \alpha_{52} \\ \alpha_{61} & \alpha_{62} \\ \alpha_{71} & \alpha_{72} \end{bmatrix} \begin{bmatrix} 1 & 0 & \beta_{31} & \beta_{41} & \beta_{51} & \beta_{61} & \beta_{71} \\ 0 & 1 & \beta_{32} & \beta_{42} & \beta_{52} & \beta_{62} & \beta_{72} \end{bmatrix} \begin{bmatrix} LREER_{t-1} \\ LTOT_{t-1} \\ LINVGDP_{t-1} \\ LGOV_{t-1} \\ LOPEN_{t-1} \\ LRESBAL_{t-1} \\ CONSTANT \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \quad (18)$$

Since there are more than one cointegration vector, it is not sensible to just take the unrestricted estimates of the vectors in β directly as a meaningful long-run parameter estimate. It is important to impose and test restrictions on the elements of β in an attempt to obtain the structural relationship between the variables.

In the first cointegrating vector, long-run zero restriction was imposed on terms of trade because it is a dependent variable in the second cointegrating vector. Zero restriction was imposed on the real effective exchange rate because it is a dependent variable in the first cointegrating vector. The long-run restrictions show that in the first cointegration relation (real exchange rate equation, LREER) terms of trade (LTOT) does not play an important role in the determination of the real effective exchange rate for Namibia. In other words we can have a real exchange rate equation without a terms of trade variable. In the second cointegration relation (the terms of trade equation, LTOT) the real exchange rate variable does not play an important role in the determination of terms of trade, implying that we can have a terms of trade equation without a real exchange rate variable. The long-run cointegration equation for real effective exchange rate for Namibia can be written as:

$$\underset{}{LREER} = \underset{(6.028)}{0.641LINVGDP} + \underset{(1.738)}{0.047LGOV} + \underset{(4.896)}{0.735LRESBAL} + \underset{(1.995)}{0.414LOPEN} - 0.782 \quad (19)$$

The t-statistics are in parentheses. The results in Equation (19) can be summarised as follows:

- A one percent increase in ratio of investment to GDP is associated with an appreciation of the real exchange rate by 0.64 percent. This is similar to the results obtained by Mathisen (2003) for Malawi.
- A one percent increase in government expenditure causes the real exchange rate to appreciate by 0.047 percent. This is comparable to the results obtained by Elbadawi (1994) for Chile and India, and by Edwards (1988) for developing countries.
- A one percent increase in resource balance (a proxy for capital control) causes the real exchange rate to appreciate by 0.735 percent. This coefficient can also be favourably compared to those obtained by Elbadawi (1994) for Chile, Ghana and India.
- A one percent increase in openness is associated with an appreciation of the real effective exchange rate by 0.414 percent. This is consistent with the results obtained by Asfaha and Huda (2002) for South Africa, and Zhang (2001) for China.

The results of the second cointegrating vector (terms of trade equation) are presented in Equation (20):

$$\begin{aligned} LTOT = & -2.787 LINVGDP - 0.773 LGOV - 4.502 LRESBAL - 4.153 LOPEN \\ & (-4.854) \qquad\qquad (-5.289) \qquad\quad (-5.556) \qquad\qquad (-3.711) \\ & +38.605 \end{aligned} \tag{20}$$

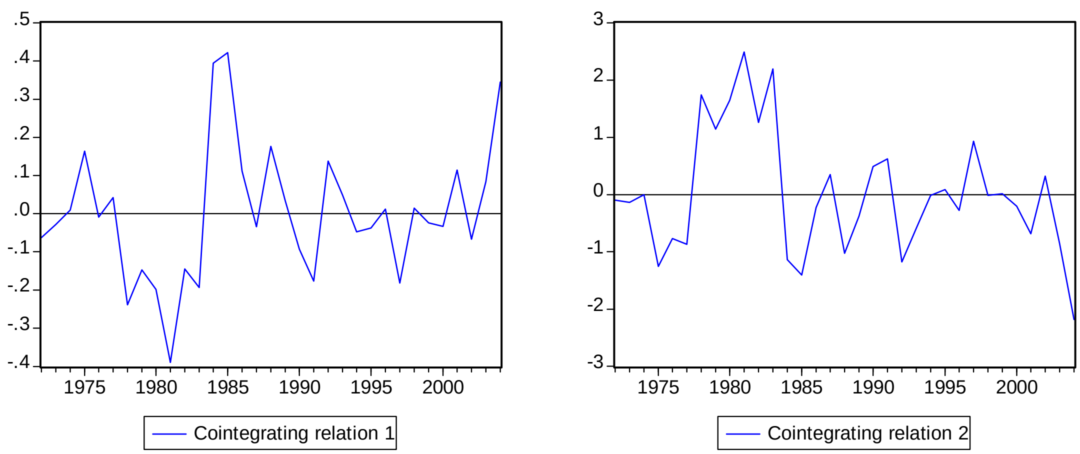
The results of Equation (20) can be summarised as:

- An increase in investment to GDP causes terms of trade to decrease. A one percent increase in investment to GDP causes terms of trade to decrease by 2.787 percent.

- A one percent increase in government expenditure causes terms of trade to decrease by 0.773 percent.
- An increase in resource balance by 10 percent is associated with a decrease in the terms of trade by 4.502 percent.
- An increase in openness causes the terms of trade to decrease.

All t-statistics are statistically significant, and the results are consistent with *a priori* expectations and literature. However, the second cointegrating vector is not important. The most important is the results of the first cointegrating vector (the real exchange rate equation). That is because the focus of this study is on the real exchange rate. Cointegration relations are plotted in Figure 3. They appear to be stationary.

Figure 3. Cointegration relations



5.4.6 Exogeneity Test and Speed of Adjustment

The loading matrix α_s determine into which equation the cointegrating vectors enter and with what magnitudes. It measures the speed of adjustment and the degree to which the variable in the equation respond from the long-run equilibrium relationship. The elements of matrix α_s relate to the issue of weak exogeneity. In a cointegrated system if a variable does not respond to the discrepancy from the long-run equilibrium, it is weakly exogenous. This implies that there are rigidities, which limit the adjustment process. If the variable is not weakly exogenous, it means that it plays some role in bringing the normalised variable in the long run equation to equilibrium. Exogeneity test results are presented in Table 5.

Table 5. Exogeneity

	Cointegration equation 1	Cointegration equation 2.
ΔLREER	-0.477	-0.059
	(-5.687)	(-3.955)
ΔLTOT	0.000	0.000
ΔLINVGDP	0.000	0.000
ΔLGOV	0.000	0.063
		(3.502)
ΔLRESBAL	0.000	-0.061
		(-5.015)
ΔLOPEN	0.000	0.000

LR test for binding restriction (rank=2): χ^2 (8) 8.496,

probability 0.131

The Likelihood Ratio for binding restrictions of LR=5.835 (0.666). The number in parenthesis is the probability of committing a type I error. This test refers to both long run and the above loading matrix restrictions. Since the Likelihood Ratio does not reject the restrictions, it means that the equations are well-specified. The VECM results were diagnosed for serial correlation, normality, lag exclusion test and heteroscedasticity. The diagnostic statistics are presented in Table 6. The VECM results passed all diagnostic statistics.

Table 6. Diagnostic statistics of the VECM

	H_0	Test	Statistic	Probability	Decision
Serial correlation	No serial correlation	LM test-χ^2 (lag 1)	39.286	0.325	No serial correlation
Normality	Error terms are normally distributed	JB-Joint	20.466	0.058	Error terms are normally distributed
		Kurtosis – Joint	23.843	0.011	
		Skewness - Joint	23.926	0.708	
Heteroscedasticity	No heteroscedasticity	χ^2	317.544	0.758	No heteroscedasticity

As shown in Table 5, exogeneity test shows that in the real effective exchange rate equation (Cointegration equation 1) terms of trade, ratio of investment to GDP, government expenditure, resource balance and openness are weakly exogenous and do not play any role in bringing the real effective exchange rate to equilibrium. Disequilibrium in the real exchange is corrected only through adjustment in itself. The second cointegrating vector shows that the real exchange rate and resource balance do play a role in bringing the terms of trade to equilibrium. Government expenditure moves the terms of trade away from equilibrium. Openness, ratio of investment to GDP and terms of trade are weakly exogenous in the terms of trade equation.

As Mathisen (2003: 16) stated, if there is a gap between the real exchange rate and its equilibrium value, the real exchange rate will converge to its equilibrium value. The adjustment requires that the real exchange rate move towards a new equilibrium level or return from its temporary deviation to the original equilibrium.

A significant error term between zero and negative two implies that the long run equilibrium is stable. Since the ECM term is -0.477, the cointegrating relationship is stable. It shows that 47.7 percent of the gap between real exchange rate and its equilibrium value is eliminated in the short run. From this estimated coefficient, the number of years required to eliminate a given real exchange rate misalignment can be derived. The time required to remove or dissipate *x* percent of a shock (disequilibrium) is determined as: $(1-\beta)^t = (1-x)$, where *t* is the required number of periods and β is the coefficient of the error correction term. This implies that the adjustment takes 1.07 years for 50 percent of the deviations to be eliminated. This adjustment speed is faster than the 2.1 years obtained by MacDonald and Ricci (2003) for South Africa, although the data were quarterly. It is lower than the speed of adjustment obtained by Baffes *et al*. (1999) for Burkina Faso, but higher than the one for Ivory Coast. The adjustment estimated for Burkina Faso was -0.94 and for Ivory Coast was -0.39. The adjustment period of 1.07 years is also lower than that obtained by Mathisen (2003) for Malawi. The adjustment period for Malawi is 11 months although the data for Malawi was quarterly.

5.4.7 Impulse Responses

Impulse responses, introduced by Sims (1980), show the response of the real exchange rate to shocks in fundamental determinants. The impulse responses are important in the analysis of an estimated structural VAR. They show the dynamic response of a variable to a shock in one of the structural equations. They indicate the response of present and future values of each of the variables to a one-unit increase in the present value of one of the shocks of VAR (see Stock and Watson, 2001). The impulse responses are plotted for the first cointegration relation (real exchange rate equation) and second cointegration relation (terms of trade equation). They are plotted in Figures 4 and 5. They are orthogonalised using Cholesky or lower triangular decomposition. The variables are ordered as follows: real exchange rate first because it is a variable interest or focus of the study, followed by terms of trade, ratio of investment to GDP, government expenditure, resource balance, and openness.

Figure 4. Impulse response of the real exchange rate: response to Cholesky one standard innovations

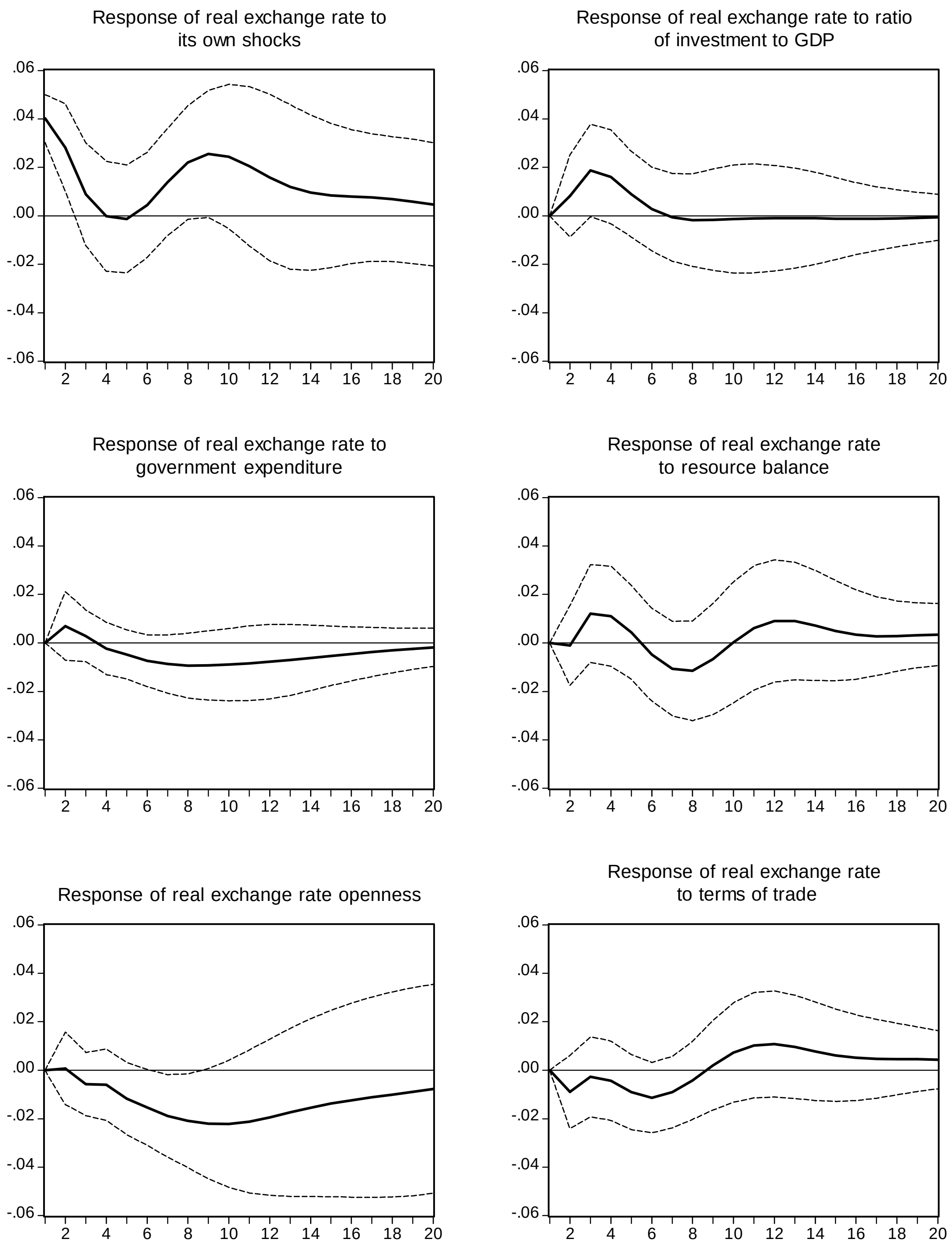


Figure 5. Impulse response of the terms of trade: response to Cholesky one standard innovations

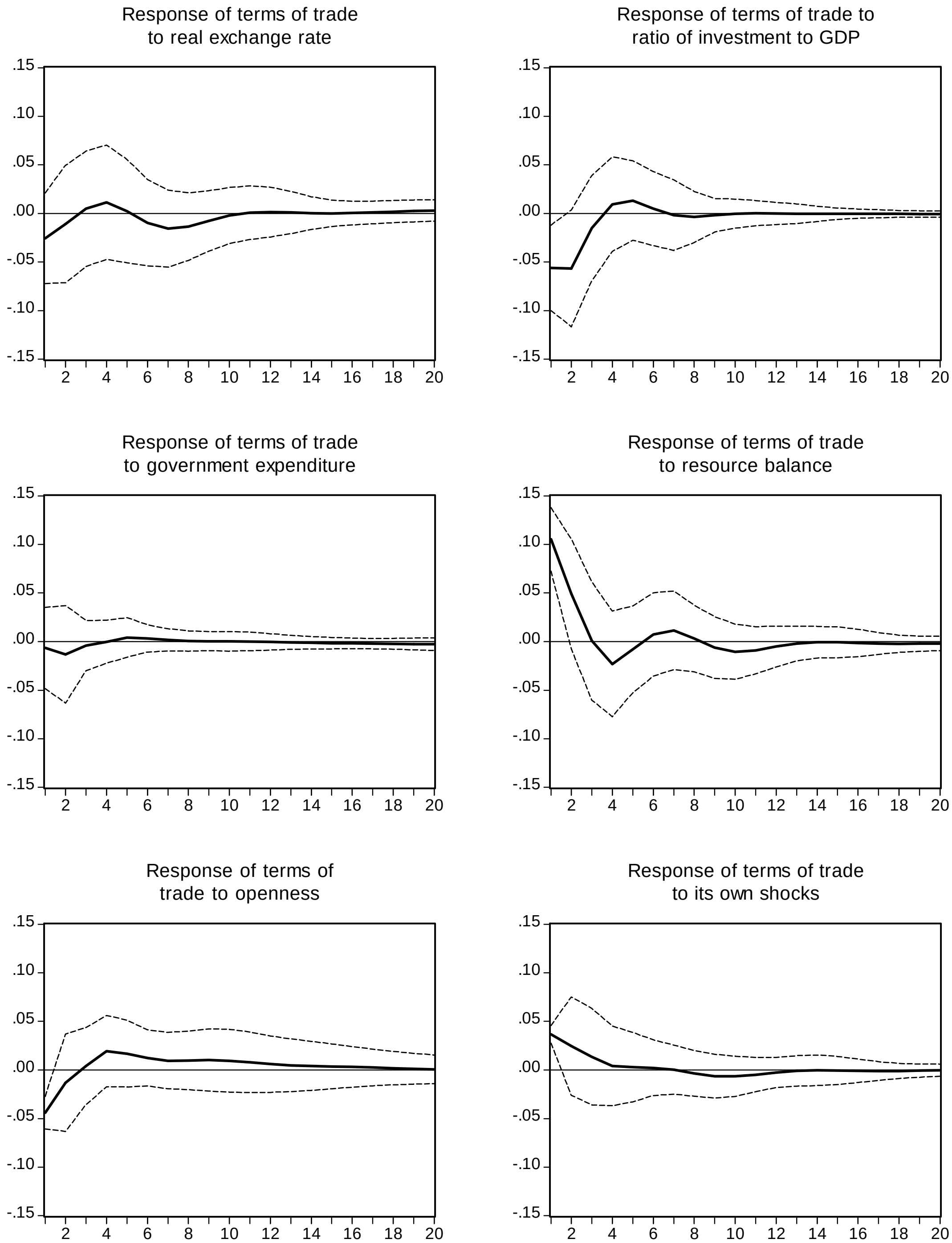


Figure 4 shows that the real exchange rate responds positively to its own shocks and return to equilibrium in period 20. It also responds positively to shocks from the ratio of investment to GDP and return to equilibrium from period 7.

A shock on government expenditure causes the real exchange rate to respond positively during the first four periods. It then starts to respond negatively from period 5. It returns to equilibrium in period 20. The real exchange rate responds positively to shocks on resources balance, but start responding negatively between periods 5 and 9. It then starts to respond positively again from period 10 and return to equilibrium.

A shock to openness causes the real exchange rate to respond negatively. Although it does not reach equilibrium, it shows that there is a move towards equilibrium. The real exchange rate responds negatively to shocks in the terms of trade between periods 1 and 8. It then responds positively between periods 9 and 20, and return to equilibrium. All shocks do not have a permanent effect on the real exchange rate. The real exchange rate returns to or has a tendency of moving towards equilibrium.

Figure 5 shows that the terms of trade responds negatively in the first 2 periods and positively between periods 3 and 5 to shocks on both real exchange rate and ratio of investment to GDP. It then responds negatively between periods 6 and 10. It returns to equilibrium from period 11 onwards.

The terms of trade responds negatively to shocks on government expenditure during the first four periods. The shocks on government expenditure do not have a permanent effect on the terms of trade. The terms of trade returns to equilibrium from the period 5. The response of the terms of trade to shocks in resource balance is positive during the first three periods, negative from periods 3 to 4, positive in period 6 to 7 and negative in periods 8 to 11. The shocks to resource balance also do not have a permanent effect on the terms of trade, because the terms of trade returns to equilibrium from period 14.

Terms of trade responds negatively to shocks on openness during the first 3 periods and become positive from period 4. It however, responds positively to its own shocks. All shocks do not have a permanent impact because the terms of trade always return to equilibrium.

5.4.8 Variance Decomposition

Variance decomposition is another important way of testing the relative importance of each shock to fundamental determinants in accounting for variation in the real exchange rate. Figure 6 shows that during the first period, real exchange rate is only accounted for by itself. Real exchange rate accounted for about 30 percent of the variation in itself between periods 5 and 20. The terms of trade account for about 50 percent of the variations in the real exchange rate. The ratio of investment to GDP accounts for just under 30 percent of the between periods 4 and 8, and under 10 percent of the variation of the real exchange rate. Government expenditure, resource balance, and openness account (each) for just under 10 percent of the variation of the real exchange rate.

In the second equilibrium relationship (terms of trade), Figure 7 shows that the terms of trade accounts for more than 80 percent of the variation of itself. Real exchange rate accounts for just over 10 percent of the variation of the terms of trade. Government expenditure, ratio of investment to GDP, resource balance and openness account for about 1 to 5 percent.

Figure 6. Variance decomposition of the real effective exchange rate

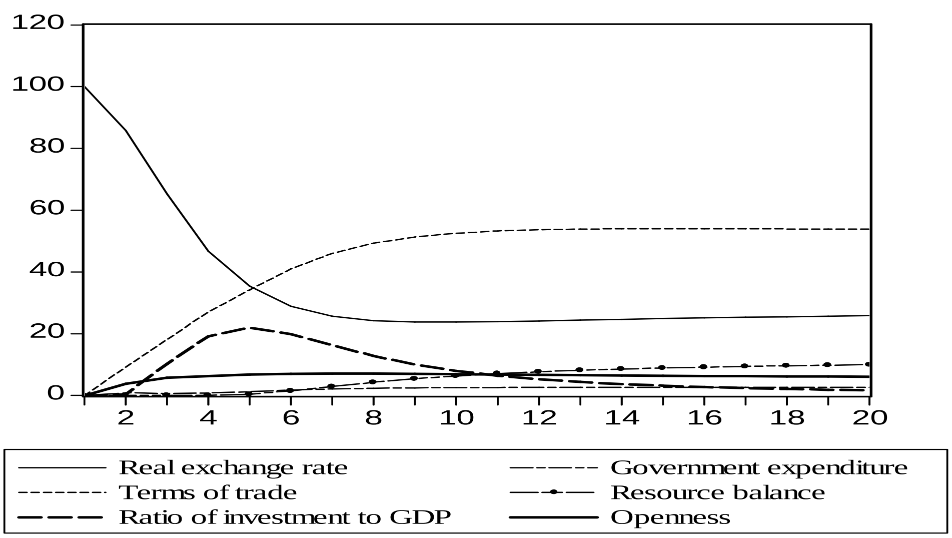
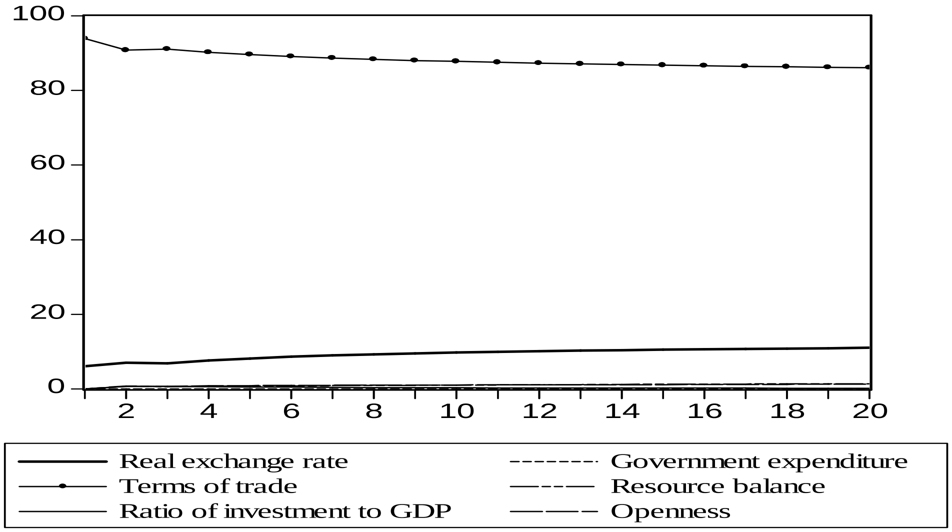


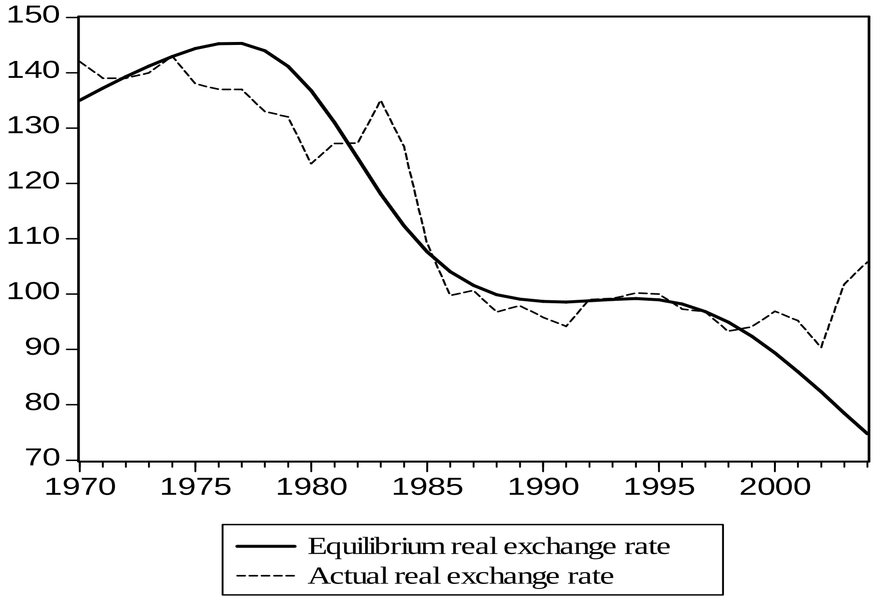
Figure 7. Variance decomposition of the terms of trade



5.4.9 Equilibrium Real Exchange Rate

The long-run relationship above allows an estimate of the equilibrium real exchange rate to be calculated. As defined earlier, this is the level of the real exchange rate that is consistent with the long-run equilibrium value of the fundamental variables. The equilibrium real exchange rate was obtained by imposing the coefficients of the long-run equation on the permanent values of the fundamentals. Hodrick-Prescott filter with a smoothing factor of 100 was used to smooth the variables and derive their permanent values. This smoothing factor is what Hodrick and Prescott suggested for annual data. Figure 8 shows the actual and equilibrium real exchange rate.

Figure 8. Actual and equilibrium real effective exchange rate



When the actual real effective exchange rate is above the equilibrium, it is overvalued, and when it is below the equilibrium, it undervalued. The real exchange rate was overvalued during the periods 1970-1972, 1982-1985, 1992-1995 and 1999-2004. The highest overvaluation was during the period 2002, 2004, and 1985. The real exchange rate was undervalued during the periods 1973-1981, 1986-1991 and 1996 to 1998. The highest undervaluation happened in 1980. Misalignment of the real exchange rate is presented in Figure 9.

Figure 9. Misalignment of the real effective exchange rate

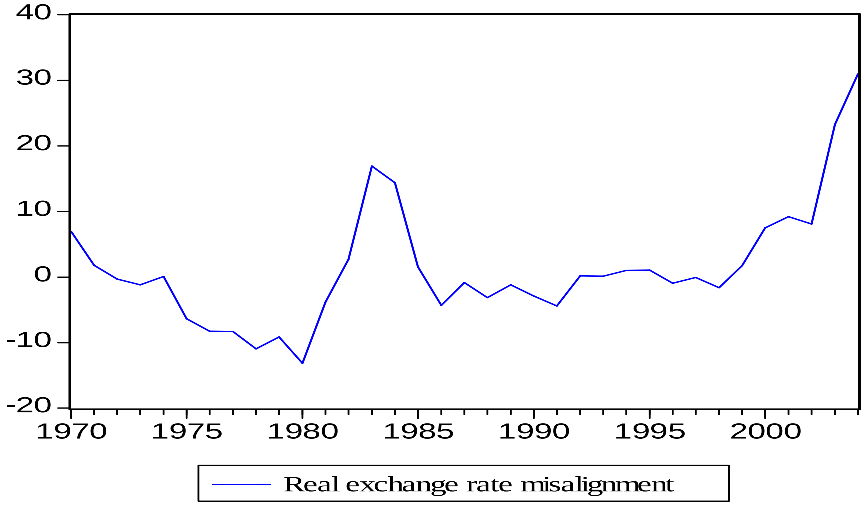


Figure 9 shows that the highest misalignment occurred in 1980 and 2002 to 2004. Real exchange rate misalignment was low between 1987 and 1999. The period 1970 to 1989 is associated with political instability and challenges for independence. The period 2001 to 2002 is associated with the weakening of the Namibia dollar. The Namibia dollar strengthened during 2003 to 2004.

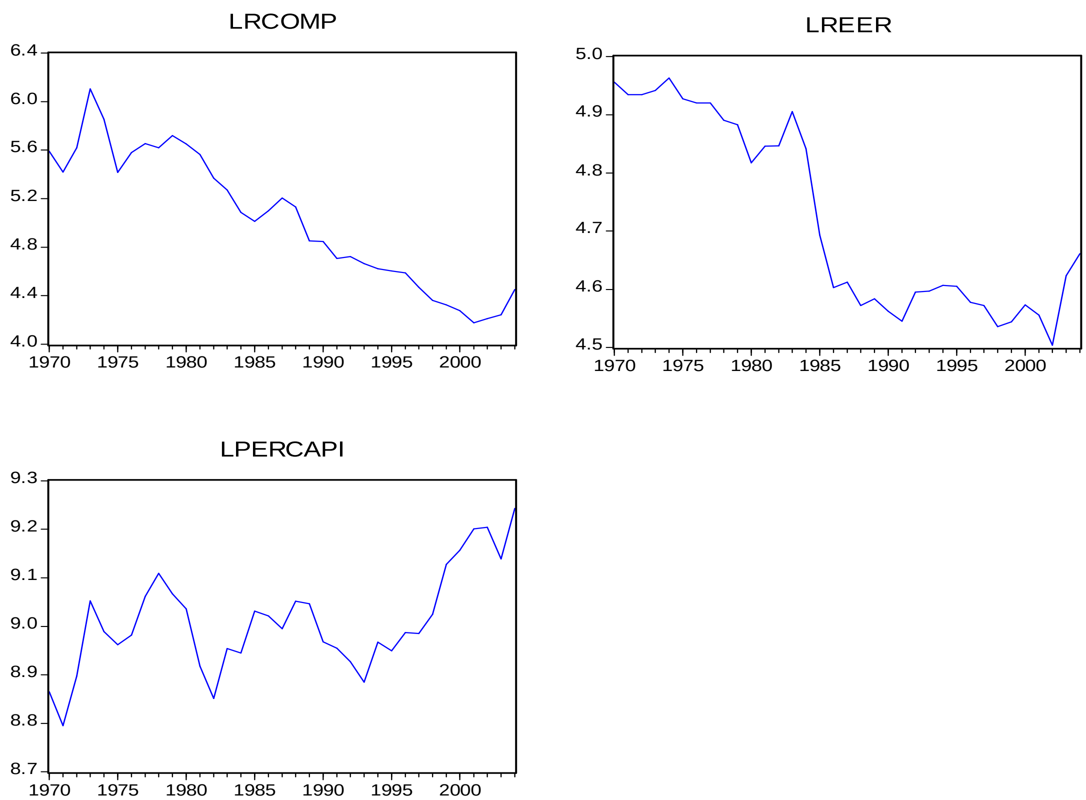
Since Namibia's real exchange rate is likely to be influenced by some South Africa's fundamentals, it is necessary to compare these results with those obtained for South Africa. A recent study on the equilibrium real exchange rate was conducted by MacDonald and Ricci (2004) and showed that like Namibia, the real exchange rate of South Africa was also undervalued during the period 1970 to 1972 and 1980 to 1985. However, it was undervalued during 1994 to 2002 while that of Namibia overvalued during the same period. While Namibia experienced low real exchange rate misalignment for the period 1994 to 1999, this was not the case for South Africa. These differences between the two countries are not unexpected because some of the fundamentals used in this study were not included in the estimation by MacDonald and Ricci. Similarly, this study does not include some of the fundamentals used by MacDonald and Ricci in the model estimated for South Africa. It has also been shown in Figure 1 in Chapter 5 that there is divergence observed between the real exchange rates of Namibia and South Africa.

5.5 Real Exchange Rate and Commodity Prices

5.5.1 Developments in Commodity prices and Productivity

Figure 10 plots the real effective exchange rate, real commodity prices and real GDP per capita. It can be seen that real commodity prices have been on a decreasing trend for the entire estimation period. The real effective exchange rate has also been on a decreasing (depreciating) trend. This suggests that real effective exchange rate and real commodity prices are moving together. Productivity as proxied by GDP per capita, fluctuated between 1970 and 1993 and then increased during the period between 1994 and 2004.

Figure 10. Real effective exchange rate, real commodity prices and real GDP per capita (productivity proxy)



5.5.2 Univariate Characteristics of the Variables and VAR Diagnostic Statistics

In order to estimate the empirical model the variables were tested for unit root (stationarity test). The results of unit root tests are presented in Table 14 in the Appendix. Diagnostic statistics were performed on the VAR for stability, serial correlation, normality, autocorrelation and heteroscedasticity. The diagnostic statistics show that the VAR is stable because all roots have modulus of less than one and lie within the unit circle. The VAR diagnostic test results show that there is no serial correlation, and heteroscedasticity. The errors are normally distributed.

5.5.3 Testing for Reduced Rank

Cointegration between the variables was tested using the Johansen FIML. The trace and maximum eigenvalues are presented in Table 7 below.

Table 7. Johansen cointegration results

Null hypothesis	Alternative hypothesis		0.05 Critical value	Probability value [b]
		Trace statistic		
r=0	r=1	59.218 [a]	35.193	0.000
r=1	r=2	18.134	20.262	0.096
r=2	r=3	8.196	9.165	0.076
		Maximum Eigenvalue statistic		
r=0	r>0	41.084 [a]	22.300	0.000
r≤1	r>1	9.938	15.892	0.340
r≤2	r>2	8.196	9.165	0.076

[a] Denotes rejection of the null hypothesis at the 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

The trace and the maximum eigenvalue statistics show that there is one cointegrating vector. These statistics confirm the appropriateness of proceeding with the vector error correction methodology (VECM). Since there is one cointegrating vector the VECM is visualised as follows:

$$\begin{bmatrix} \Delta LREER_t \\ \Delta LRCOMP_t \\ \Delta LPERCAPI_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{bmatrix} \begin{bmatrix} \Delta LREER_{t-1} \\ \Delta LRCOMP_{t-1} \\ \Delta LPERCAPI_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \\ \alpha_{41} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} \end{bmatrix} \begin{bmatrix} LREER_{t-1} \\ LRCOMP_{t-1} \\ LPERCAPI_{t-1} \\ C \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{bmatrix} \tag{21}$$

5.5.4 Long-run Restrictions

The long-run restrictions are imposed in line with Cashin *et al*. theoretical framework. The long-run zero restrictions were imposed on real commodity prices (LRCOMP) and GDP per capita (LPERCAPI). Both restrictions were rejected and this means that real commodity prices and GDP per capita are important variables in the determination of real exchange rate of Namibia. These variables must be in the long-run equation of the determination of the real exchange rate. The long-run equation is represented as:

$$\pi X_{t-1} = \alpha\beta' X_{t-1} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \\ \alpha_{41} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{21} & \beta_{31} & \beta_{41} \end{bmatrix} \begin{bmatrix} LREER_{t-1} \\ LRCOMP_{t-1} \\ LPERCAPI_{t-1} \\ C \end{bmatrix} \tag{22}$$

The long-run cointegration equation for the real effective exchange rate of Namibia can be written as (t-statistics in parentheses):

$$\underset{}{LREER} = \underset{(-3.613)}{-4.592} + \underset{(23.218)}{0.330}LRCOMP + \underset{(6.058)}{0.849}LPERCAPI \tag{23}$$

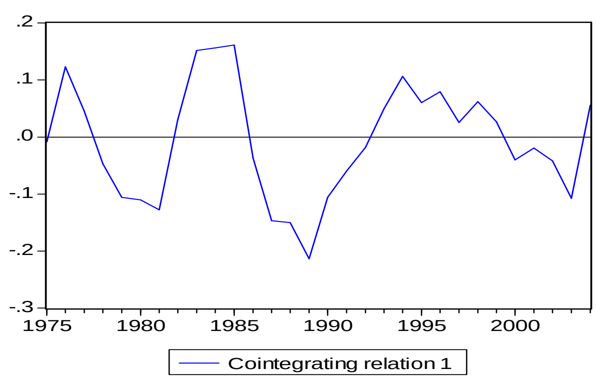
The results can be interpreted as follows:

- An increase in commodity prices by one percent causes an increase in real exchange rate or real exchange rate appreciation by 0.33 percent.
- An increase in GDP per capita, which is a proxy for technology by one percent causes real exchange rate to appreciate by 0.84 percent.

These results are consistent with Cashin *et al.* (2002, 2004) theoretical model predictions and empirical findings. The results are also in line with those obtained by Koranchelian (2005) for Algeria. Since Namibia is a commodity exporting country, fluctuations in real commodity prices have an impact on real exchange rate. The real exchange rate is also dependent on productivity and this is consistent with the Balassa-Samuelson hypothesis.

The cointegrated linear combination or cointegration relation is plotted in Figure 11 below. It appears stationary.

Figure 11. Cointegration relations



5.5.5 Exogeneity Test and Speed of Adjustment

The loading matrix measures the speed of adjustment and the degree to which the variables in the equation respond from the long-run equilibrium relationship. The elements of matrix α_s relate to the issue of weak exogeneity. In a cointegrated system, if a variable does not respond to discrepancy from the long-run equilibrium it is weakly exogenous. If the variable is weakly exogenous, it means that it does not play any role in bringing the normalised variable in the long-run equation to equilibrium. Table 8 presents the results of the exogeneity test.

Table 8. Exogeneity test

Variable	**LREER equation**
ΔLREER	-0.332
	(-1.700)
ΔLRCOMP	0.000
ΔLPERCAPI	0.775
	(5.850)

LR test for binding restriction (rank = 1): $\chi^2(1)$ 2.343
probability 0.126

The results of the exogeneity test show that real GDP per capita variable is not weakly exogenous but moves the real effective exchange rate or the system away from equilibrium. It does not bring the real effective exchange rate into equilibrium. Real commodity price is weakly exogenous. It does not play any role in the bringing the real effective exchange rate into equilibrium. Disequilibrium in the real exchange rate is corrected only through adjustment in the real exchange rate itself.

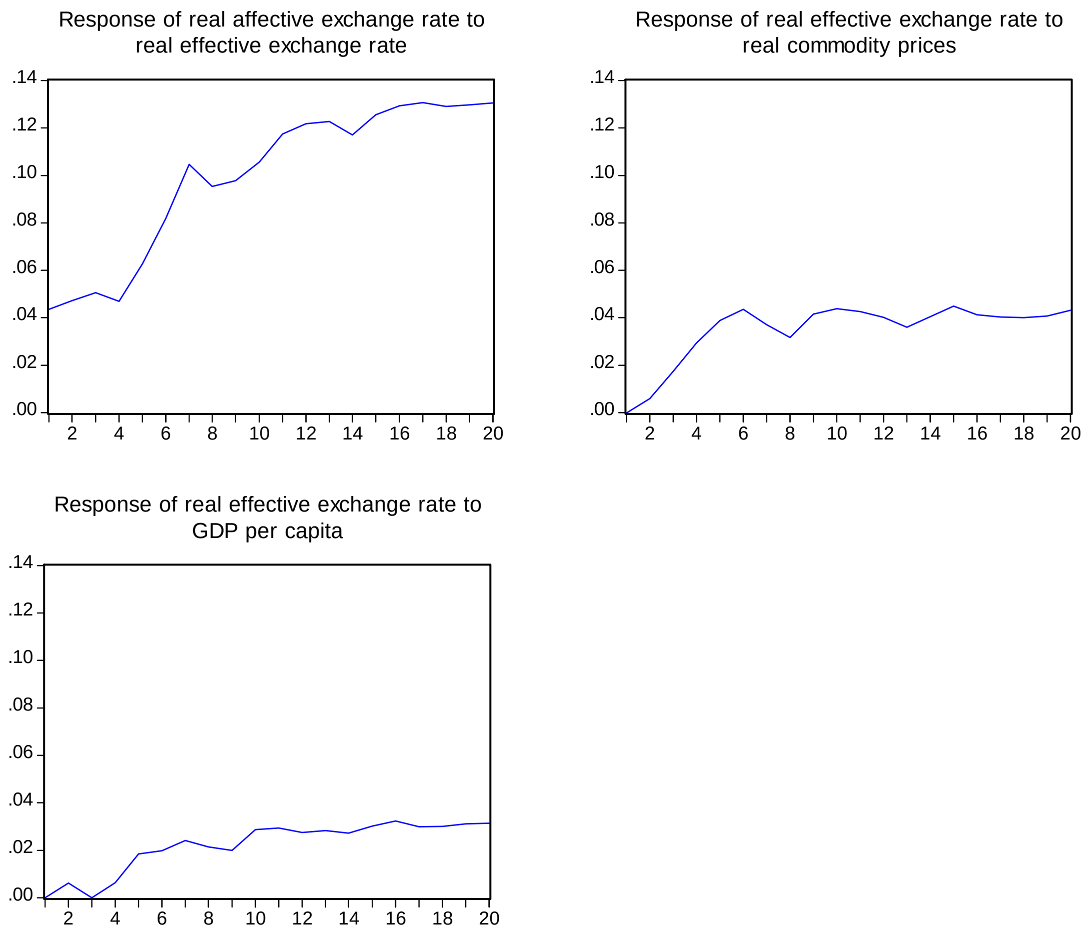
If there is a gap between the actual real effective exchange rate and its equilibrium value, the real exchange rate will converge to its equilibrium value. This requires that the real exchange rate moves to the new equilibrium value or returns from its temporary deviation to its original equilibrium value.

Since the ECM coefficient is -0.332, the cointegration relationship is stable. It shows that 33.2 percent of the deviations from the equilibrium are eliminated in the short run. This implies that the adjustment process takes 1.7 years to eliminate 50 percent of the misalignments. This speed of adjustment is slightly longer than the one obtained under fundamental approach or three-good model.

5.5.6 Impulse Responses and Variance Decomposition

Impulse responses which show the response of the real exchange rate to shocks in real commodity prices and GDP per capita are plotted in Figure 12.

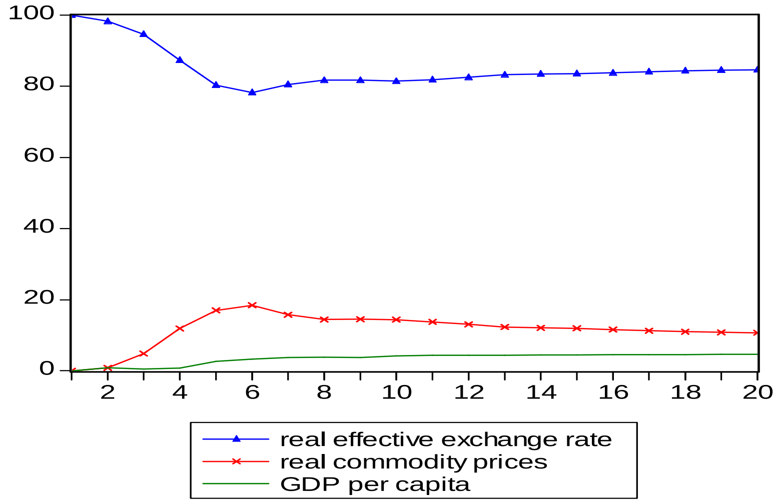
Figure 12. Impulse response: response to Cholesky standard innovations



The real exchange rate responds positively to shocks from itself as well as to shocks from real commodity prices and GDP per capita. Both variables do not return to equilibrium, which indicate that policy makers are slow in responding to shocks that affect the economy. However, given the exchange rate regime in Namibia, policy makers can do little to respond to disequilibrium in the real exchange rate because the exchange rate is determined by South Africa. Fiscal policy is the main instrument used by Namibian policymakers to adjust the economy to shocks.

Variance decomposition tests the relative importance of shocks in fundamental determinants in accounting for variations in the real exchange rate. The variance decomposition is plotted in Figure 13.

Figure 13. Variance decomposition of the real exchange rate



The results of the variance decomposition show that from the first to the second period real exchange accounts for 100 and 98 percent. From period 6 the real exchange rate accounts for over 80 percent of the variations in the real exchange rate. The real commodity prices account for zero percent of the variations in the exchange rate during the first and second period. It increased to 18 percent in period 6. It accounted for just over 10 percent of the variations in the real exchange rate from the 6th to 20th period. Real GDP per capita accounted for zero percent of the variations in the real exchange rate during the first 3 periods. It accounted for over 4 percent between period 6 and 20.

5.5.7 Robustness of the VECM Results

Several diagnostic statistics have been performed on the VECM to assess robustness of the results. The results are robust because they passed all diagnostic statistics. The diagnostic test results are presented in Table 9.

Table 9. Diagnostic statistics of the VECM

	H_0	Test	Statistic	Probability	Decision
Serial correlation	No serial correlation	LM test-χ^2 (lag 4)	12.133	0.206	No serial correlation
Normality	Error terms are normally distributed	JB-Joint	17.458	0.008	Errors are normally distributed
		Kurtosis – Joint	16.954	0.000	
		Skewness - Joint	0.504	0.918	
Heteroscedasticity	No heteroscedasticity	χ^2	154.501	0.519	No heteroscedasticity

The diagnostic test results show that there is no serial correlation and no heteroscedasticity. The error term is white noise even though there is lack of normality because of kurtosis. Paruolo (1997) states that if normality is rejected because of kurtosis the Johansen results are not affected as long as the skewness is fine (see also Sichei *et al.* 2005: 24).

5.5.8 Equilibrium Real Exchange Rate

The estimated long-run relationship allows the equilibrium real exchange rate to be computed. Like in the fundamental approach, the equilibrium real exchange rate was computed by imposing the estimated long-run coefficients on the permanent values of the fundamentals. The values of the permanent fundamentals were obtained by using Hodrick Prescott filter. The Hodrick-Prescott filter with a smoothing factor of 100 was used to smooth the variables (real commodity prices and GDP per capita). The actual and equilibrium real exchange rate are plotted in Figure 14.

Figure 14. Actual and equilibrium real exchange rate

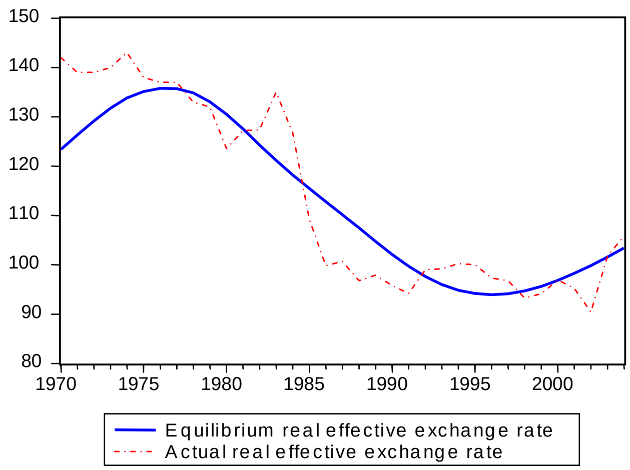
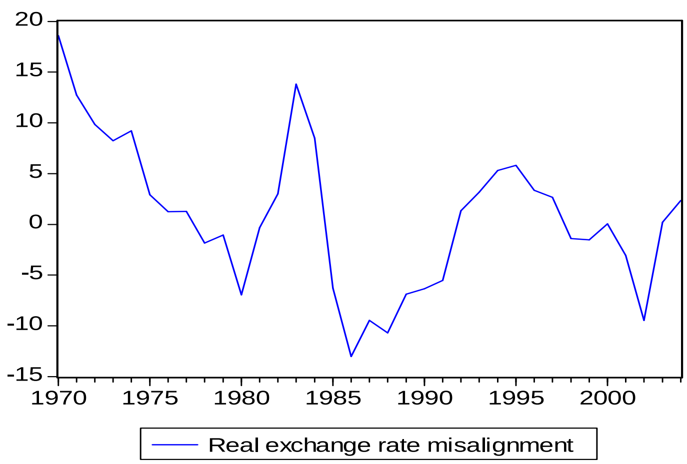


Figure 14 shows that the real exchange rate has been on a depreciating trend since the 1970s. The real exchange rate was overvalued during the periods 1970-1977, 1982-1984, and 1992-1997. It was undervalued during the periods 1978-1981, 1985-1991 and 1998-2002. Misalignment of the real exchange rate is plotted in Figure 15.

Figure 15. Real exchange rate misalignment



The highest overvaluation of the real exchange rate was in 1970 and 1983, while the highest undervaluation took place in 1986. Misalignment was relatively low between 1990 and 2004.

5.6 Conclusion

This chapter estimated the equilibrium real exchange rate and the resulting real exchange rate misalignment for Namibia. The estimation was based on the three-good model and the Cashin *et al*. model of real exchange rate and commodity prices. The equilibrium real exchange rate for both models (three-good and Cashin *et al*.) was estimated using the Johansen FIML. According to the three-good model, the real exchange rate is determined by openness, government expenditure, resource balance, terms of trade and the ratio of investment to GDP. An increase in both variables causes real exchange rate depreciation. The results are consistent with the *a priori* expectations.

The variance decomposition analysis showed that real exchange rate accounted for about 30 percent of the variations in itself, while terms of trade account for about 50 percent of the variations in the real exchange rate. The ratio of investment to GDP accounts for just under 30 percent between periods 4 and 8 and under 10 percent of the variations of the real exchange rate. Government expenditure, resource balance, and openness account (each) for just under 10 percent of the variations of the real exchange rate.

The estimation results illustrates that the real exchange rate was overvalued for the periods 1970-1972, 1982-1985 and 1999-2004. The highest overvaluation was during the periods 2002, 2004 and 1985. The real exchange rate was undervalued during the periods 1973-1981, 1986-1991 and 1996-1998, and the highest undervaluation happened in 1980. The highest real exchange rate misalignment occurred in 1980 and 2002 to 2004. The speed of adjustment shows that it takes 1.07 years to eliminate 50 percent of the deviations from equilibrium.

The estimation results from the model of the real exchange rate and commodity prices show that an increase in commodity prices causes real exchange rate appreciation and this confirms the theory and findings of the literature. An improvement in technology proxied by GDP per capita is also associated with real exchange rate appreciation. The impulse responses show that both variables do not return to equilibrium and this may suggests that policy has been slow in responding to shocks that affect the economy. Variance decomposition revealed that commodity prices account for about 20 percent of the variation in real exchange rate, while GDP per capita accounts for less than 5 percent. The speed of adjustment is 1.7 years and this is longer than the one obtained under the three-good model. The estimation showed that real exchange rate was overvalued during the periods 1972-1977, 1982-1984 and 1992-1997. The results have implications for monetary and exchange rate policies. From the literature on exchange rate, the nature of the real shocks determines the behaviour of the real exchange rate and not the type of exchange rate regime. If real shocks have a dominant influence on the real exchange rate, a commodity exporting country can have either a flexible nominal exchange rate regime which facilitates the slow change of relative inflation rate, or can have price and wage flexibility in order to facilitate the maintenance of nominal exchange rate peg.

In proposing a monetary regime for small commodity exporting countries, Frankel (2003) argues that small countries that want a nominal anchor and concentrate on the production of a mineral or agricultural commodity, should peg their currencies to the prices of those commodities. For these countries, movements in the value of their currencies which result from fluctuations in the world commodity market would not be an external source of volatility. Frankel (2003: 69) stated that in these cases, insulation which is normally thought to be provided only by flexible exchange rate is instead provided by pegging to the prices of commodities. Since Namibia is a commodity exporting country, this argument suggests that the country is a good candidate for pegging its currency to the prices of the main commodities exported. However, it is important to state that the monetary authorities of Namibia affirmed their commitment to the CMA as long as South Africa continues to pursue prudent economic policies. A determination of whether South African monetary and exchange rate policies are sound falls outside the scope of this study. It is also important to note that countries are moving towards regional integration. Namibia is a proponent of the regional integration in Southern Africa. The Southern African Development Community (SADC) is aiming at establishing a monetary union in 2016 and a move by Namibia out of the CMA will not be consistent with SADC's objective.

CHAPTER 6. EMPIRICAL RESULTS OF REAL EXCHANGE RATE MISALIGNMENT AND ECONOMIC PERFORMANCE

6.1 Introduction

This chapter estimates the impact of real exchange rate misalignment (which was computed in Chapter 5) on some measure of economic performance. It then applies the VAR methodology to test the impact of these misalignments on some measures of economic performance. The chapter is organised as follows. Section 6.2 discusses the methodology for testing the impact of real exchange rate misalignment on economic performance. Section 6.3 presents the results of misalignment computed from the three-good model. Section 6.4 presents results for misalignments computed from the Cashin *et al*. model, and Section 6.5 concludes.

6.2 Impact of Real Exchange Rate Misalignment on Namibia's Economic Performance and Competitiveness

In order to investigate the effect of the real exchange rate misalignment on the competitiveness of the Namibian economy impulse-response and variance decomposition analysis of cointegrated VAR between the real exchange rate misalignment and some measures of competitiveness will be established. Measures of competitiveness will be proxied by export performance, capital outflows, unit labour costs and the performance of the agricultural sector. Impulse response analysis shows the behaviour of competitiveness in response to one unit increase in the real exchange rate misalignment. The variance decomposition analysis shows the percentage of variations in competitiveness accounted for by the real exchange rate misalignments. The VAR methodology was employed by Asfaha and Huda (2002) to investigate the impact of real exchange rate misalignment on the competitiveness of the South African economy. To explain the VAR methodology, this study uses covariance stationary bivariate dynamic simultaneous equations model of *x* and *y* (see Enders, 2004: 240-318; Giannini, 1992: 1-82):

$$x_t = \gamma_{10} - b_{xy} y_t + \gamma_{11} x_{t-1} + \gamma_{12} y_{t-1} + \varepsilon_{xt}$$
$$y_t = \gamma_{20} - b_{yc} x_t + \gamma_{21} x_{t-1} + \gamma_{22} y_{t-1} + \varepsilon_{yt} \qquad (24)$$

Where ;

Mean (Expected value):

$$\begin{pmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{pmatrix} = E\begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix} = \begin{bmatrix} E(\varepsilon_{xt}) \\ E(\varepsilon_{yt}) \end{bmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \qquad (25)$$

Var-covariance matrix:

$$E[\varepsilon_{xt}\varepsilon'_{yt}] = \begin{bmatrix} E(\varepsilon_{xt}^2) & E(\varepsilon_{xt}\varepsilon_{yt}) \\ E(\varepsilon_{yt}\varepsilon_{xt}) & E(\varepsilon_{yt}^2) \end{bmatrix} = \begin{bmatrix} \sigma_x^2 & 0 \\ 0 & \sigma_y^2 \end{bmatrix} = M \qquad (26)$$

Distribution:

$$\begin{pmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{pmatrix} \sim iid\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_x^2 & 0 \\ 0 & \sigma_y^2 \end{pmatrix}\right] \qquad (27)$$

In this case both variables are potentially endogenous. The sample consist of observation from $t = 1,...,T$, with initial values (x_0, y_0). Equation (24) above is called a structural VAR because it is assumed to be derived from some underlying economic theory. The exogenous error terms $(\varepsilon_{xt}, \varepsilon_{yt})$ are independent and are interpreted as structural innovations.

The ε_{xt} are interpreted as capturing unexpected shocks to *x* that are uncorrelated with ε_{yt} (the unexpected shocks *y*). In other words, ε_{xt} represents all factors other than *y* that influence *x*. The same interpretation can be given to ε_{yt} i.e. it represents all factors that influence *y* other than *x*. b_{xy} represents the effects of current (contemporaneous) *y* on *x* and b_{yx} represents the effects of current (contemporaneous) *x* on *y*. The endogeneity of x_t and y_t in Equation (24) is determined by the values of b_{xy} and b_{yx}. The reduced form

VAR is obtained by transferring contemporaneous relationships to the left-hand side of Equation (24):

$$
\begin{aligned}
x_t + b_{xy} y_t &= \gamma_{10} + \gamma_{11} x_{t-1} + \gamma_{12} y_{t-1} + \varepsilon_{xt} \\
b_{yc} x_t + y_t &= \gamma_{20} + \gamma_{21} x_{t-1} + \gamma_{22} y_{t-1} + \varepsilon_{yt}
\end{aligned}
\qquad (28)
$$

This is written in matrix form as:

$$
\begin{bmatrix} 1 & b_{xy} \\ b_{yx} & 1 \end{bmatrix} \begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} x_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix} \qquad (29)
$$

Equation (28) can also be written in compact form as:

$$B_0 z_t = \gamma_0 + \Gamma_1 z_{t-1} + \varepsilon_t$$

where;

$$B_0 = \begin{bmatrix} 1 & b_{xy} \\ b_{yx} & 1 \end{bmatrix}$$

$$z_t = \begin{bmatrix} x_t \\ y_t \end{bmatrix}$$

$$\gamma_0 = \begin{bmatrix} \gamma_{10} \\ \gamma_{21} \end{bmatrix}$$

$$\Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}$$

$$\varepsilon_t = \begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix}$$

In order to get z_t on the right hand side, pre-multiply with B_0^{-1}

$$B_0^{-1} B_0 z_t = B_0^{-1} \gamma_0 + B_0^{-1} \Gamma_1 z_{t-1} + B_0^{-1} \varepsilon_t$$

$$B_0^{-1} B_0 = I$$

$$z_t = B_0^{-1} \gamma_0 + B_0^{-1} \Gamma_1 z_{t-1} + B_0^{-1} \varepsilon_t \qquad (30)$$

When written in matrix form matrix form, Equation (30) is the same as:

$$\begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} 1 & b_{xy} \\ b_{yx} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \end{bmatrix} + \begin{bmatrix} 1 & b_{xy} \\ b_{yx} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} x_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} 1 & b_{xy} \\ b_{yx} & 1 \end{bmatrix}^{-1} \begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix} \quad (31)$$

This is a reduced form of the structural VAR and is also referred to as standard VAR model. If the inverse of B_0 exists Equation (30) can be written as:

$$z_t = a_0 + A_1 z_{t-1} + e_t, \; e_t = B_0^{-1}\varepsilon_t \sim iid(0, \sigma^2) \quad (32)$$

This is the equation used when estimating of Johansen cointegration method.
$E\left[e_{xt} e'_{yt}\right] = B_0^{-1} M B_0^{-1'} = \sigma^2$

The reduced form parameters are:
$a_0 = B_0^{-1}\gamma_0$
$A_1 = B_0^{-1}\Gamma_1$

If the process z_t is stationary it has a Wold decomposition form of:

$$z_t = \mu + \Pi(L)e_t, \qquad \Pi(L) = \sum_{k=0}^{\infty} \Pi_k L^k, \Pi_0 = I \quad (33)$$

It is important to note that $e_t = B_0^{-1}\varepsilon_t$, $\varepsilon_t \sim iid(0, M)$ are the structural exogenous shocks,

$$z_t = \mu + \Pi(L) B_0^{-1} \varepsilon_t \quad (34)$$

Equation (34) can be rewritten as an orthogonal vector moving average form:

$$z_t = \mu + \eta(L)\varepsilon_t, \; \eta(L) = \Pi(L) B_0^{-1}, \eta_0 = B_0^{-1} \quad (35)$$

$\eta(L) = B_0^{-1} + \Pi_1 B_0^{-1} L + \Pi_2 B_0^{-1} L^2 + ...$

$\eta(L) = \eta_0 + \eta_1 L + \eta_2 L^2 + ...$
or $\eta_i = \Pi_i B_0^{-1}$

and this can be rewritten in a matrix form as:

$$\begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} \mu_x \\ \mu_y \end{bmatrix} + \begin{bmatrix} \eta_{xx,0} & \eta_{xy,0} \\ \eta_{yx,0} & \eta_{yy,0} \end{bmatrix} \begin{bmatrix} \varepsilon_{xt} \\ \varepsilon_{yt} \end{bmatrix} + \begin{bmatrix} \eta_{xx,1} & \eta_{12,1} \\ \eta_{yx,1} & \eta_{yy,1} \end{bmatrix} \begin{bmatrix} \varepsilon_{xt-1} \\ \varepsilon_{yt-1} \end{bmatrix} + \ldots\ldots. \tag{36}$$

This illustration gives z_t as a function of past values of the orthogonal shocks ε_t instead of the nonorthogonal shocks e_t. Iterating out *k* periods, yields:

$$\begin{bmatrix} x_{t+k} \\ y_{t+k} \end{bmatrix} = \begin{bmatrix} \mu_x \\ \mu_y \end{bmatrix} + \begin{bmatrix} \eta_{xx,0} & \eta_{xy,0} \\ \eta_{yx,0} & \eta_{yy,0} \end{bmatrix} \begin{bmatrix} \varepsilon_{x,t+k} \\ \varepsilon_{y,t+k} \end{bmatrix} + \ldots + \begin{bmatrix} \eta_{xx,k} & \eta_{xy,k} \\ \eta_{yx,k} & \eta_{yy,k} \end{bmatrix} \begin{bmatrix} \varepsilon_{x,t} \\ \varepsilon_{y,t} \end{bmatrix} + \ldots. \tag{37}$$

This yields structural dynamic multipliers which can be interpreted as:

$$\frac{\partial x_{t+k}}{\partial \varepsilon_{x,t}} = \eta_{xx,k} \tag{38}$$

This is the effect of one unit change in the structural innovations of x_t at period *t* (ε_{xt}) on consumption at period *t+k* (x_{t+k}).

$$\frac{\partial x_{t+k}}{\partial \varepsilon_{y,t}} = \eta_{xy,k} \tag{39}$$

It is the effect of one unit change in the structural innovations of y_t at period *t* (ε_{yt}) on x_t at period t+k (x_{t+k}).

$$\frac{\partial y_{t+k}}{\partial \varepsilon_{x,t}} = \eta_{yx,k} \tag{40}$$

This is the effect of 1 unit change in the structural innovations of x_t at period *t* (ε_{xt}) on income at period *t+k* (y_{t+k})

$$\frac{\partial y_{t+k}}{\partial \varepsilon_{y,t}} = \eta_{yy,k} \tag{41}$$

This is the effect of 1 unit change in the residuals of income at period t (e_{yt}) on income at period $t+k$ (y_{t+k}). Equations (38) to (41) show that in this bivariate model there four impulse response functions.

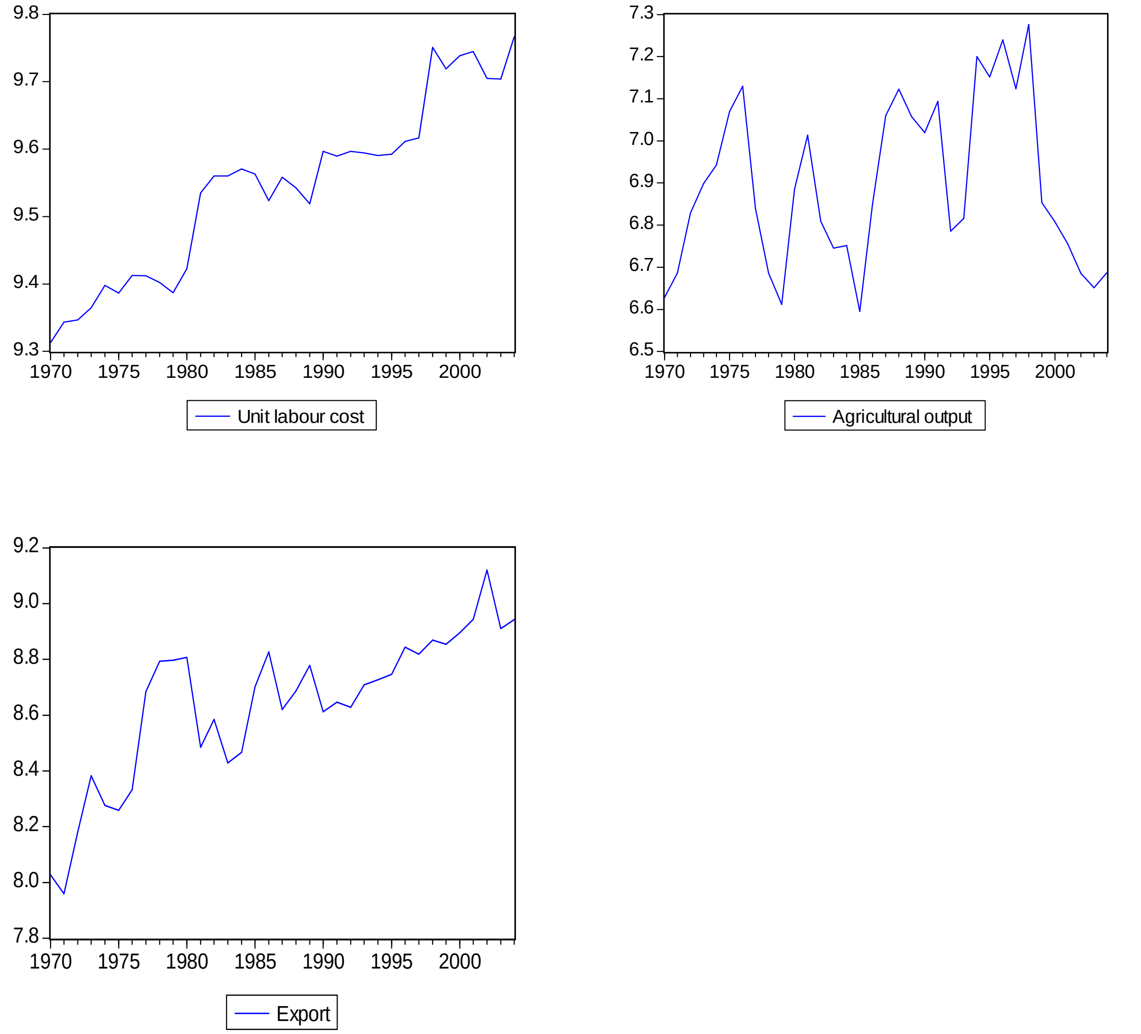
6.3 Real Exchange Misalignment Computed from the Three-Good Model (Fundamental Approach)

The three variables (export, agricultural sector and unit labour costs) are plotted in Figure 16. It shows that the unit labour cost in Namibia has risen since 1970. Export has also increased since 1970. The performance of the agricultural sector was erratic between 1970 and 2004.

The estimation procedure is as follows. Variables are tested for stationarity first. Second, a reduced-form VAR is estimated and diagnostic tests performed. Third, Johansen cointegration test is performed. Fourth, VECM is performed and finally impulse response and variance decomposition are performed. The diagnostic tests of the VAR are presented in Table 15 in the Appendix. The diagnostic statistics show that the VAR is stable as no unit lies outside the unit circle. There is no serial correlation and no heteroscedasticity. The error term is white noise.

The variables were formally tested for stationarity or unit root. With the exception of agricultural output, all variables are non-stationary in levels. The null hypothesis of the unit root cannot be rejected for three variables. They are integrated of order one or I(1). The results of the unit root tests are presented in the Appendix.

Figure 16. Some measures of economic performance and competitiveness (varaiables in log form)



6.3.1 Testing for Reduced Rank

After testing for the unit root, the next step is to check whether the variables are cointegrated. If the variables are I(1) and cointegrated, the best way to do VAR in a non-stationary world is to use the standard Johansen test and model a vector error correction model (VECM). The parameters of interest will have standard distribution in this context. On the other hand, if the variables are non-stationary and are not cointegrated, then the VAR in first differences imposes the appropriate restrictions. The results of the cointegration test presented in Table 10 show that there is one cointegrating vector. Since the variables (export, misalignment, unit labour cost) are non-stationary in levels and there is one cointegrating vector, VAR in first differences would be inappropriately specified. VECM need to be constructed to structural analysis in the VECM context. VECM is a restricted VAR designed for use with non-stationary variables that are known to be cointegrated.

Table 10. Cointegration test between misalignment and measures of economic performance and competitiveness

Null hypothesis	**Alternative hypothesis**		**0.05 Critical value**	**Probability value** [b]
		Trace statistic		
r=0	r=1	54.795[a]	54.079	0.043
r=1	r=2	33.918	35.195	0.068
r=2	r=3	17.628	20.262	0.111
r=3	r=4	3.913	9.165	0.425
		Maximum Eigenvalue statistic		
r=0	r>0	20.876	28.588	0.348
r≤1	r>1	16.291	22.300	0.278
r≤2	r>2	13.714	15.892	0.107
r≤3	r>3	3.913	9.165	0.259

[a] Denotes rejection of the null hypothesis at the 0.05 level

[b] MacKinnon-Haug-Michelis (1999) p-values

6.3.2 Impulse response functions

In accordance with Johansen (1988), a VECM is constructed. It is important to state that the econometric analyses in this study are obtained using EViews software. One main limitation of this software is that structural factorisations are not available. However, since the default VECM orthogonalisation is Cholesky decomposition, the best approach is to order the variables based on own knowledge. The ordering of the variables is dictated by the need to have meaning impulse response functions from the VECM. The VECM orthogonalisation is the Cholesky decomposition which is lower triangular. The variables are ordered as: unit labour cost, agricultural output, misalignment and export. The first variable (unit labour cost) is not affected by any other variable in the VAR or it is the least affected contemporaneously, and the last variable (export) is the one that is affected by all variables in the VAR. The impulse response results are presented in Figure 17.

Figure 17. Impulse response of economic performance and competitiveness to misalignment

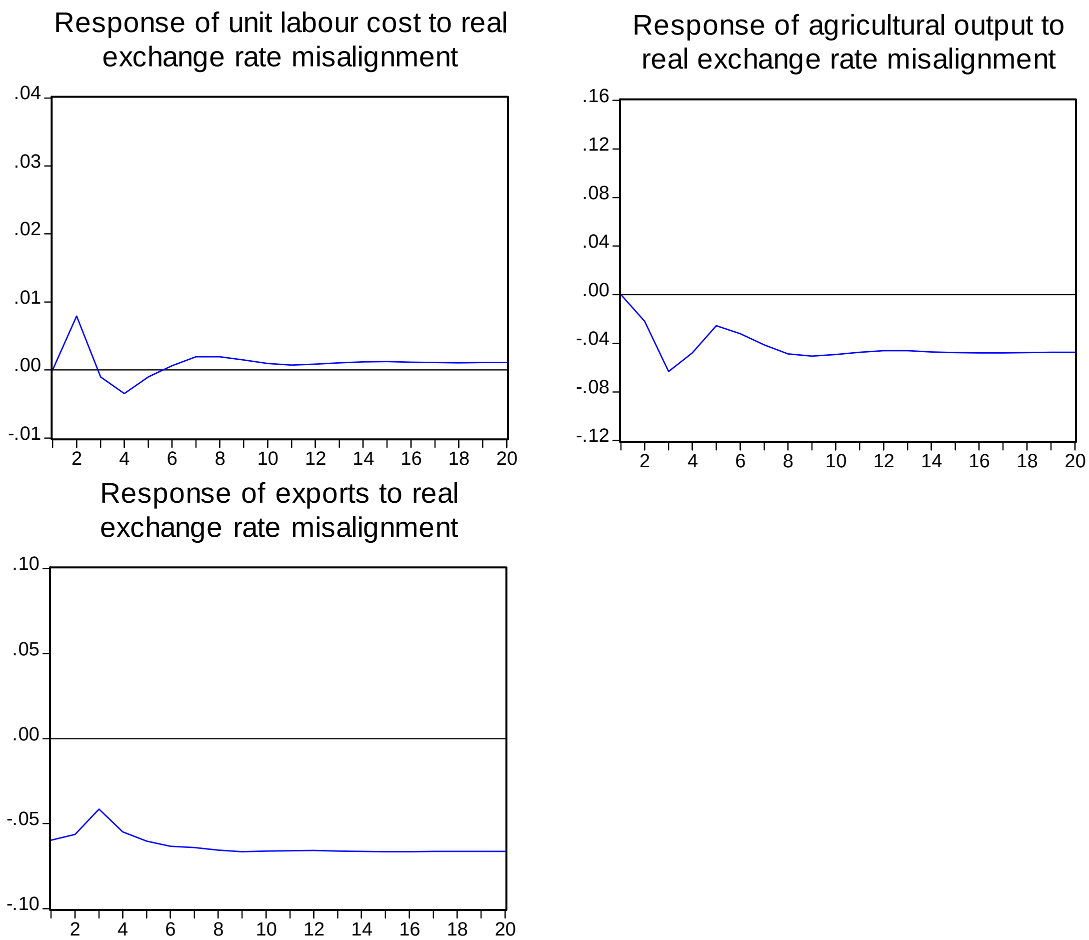
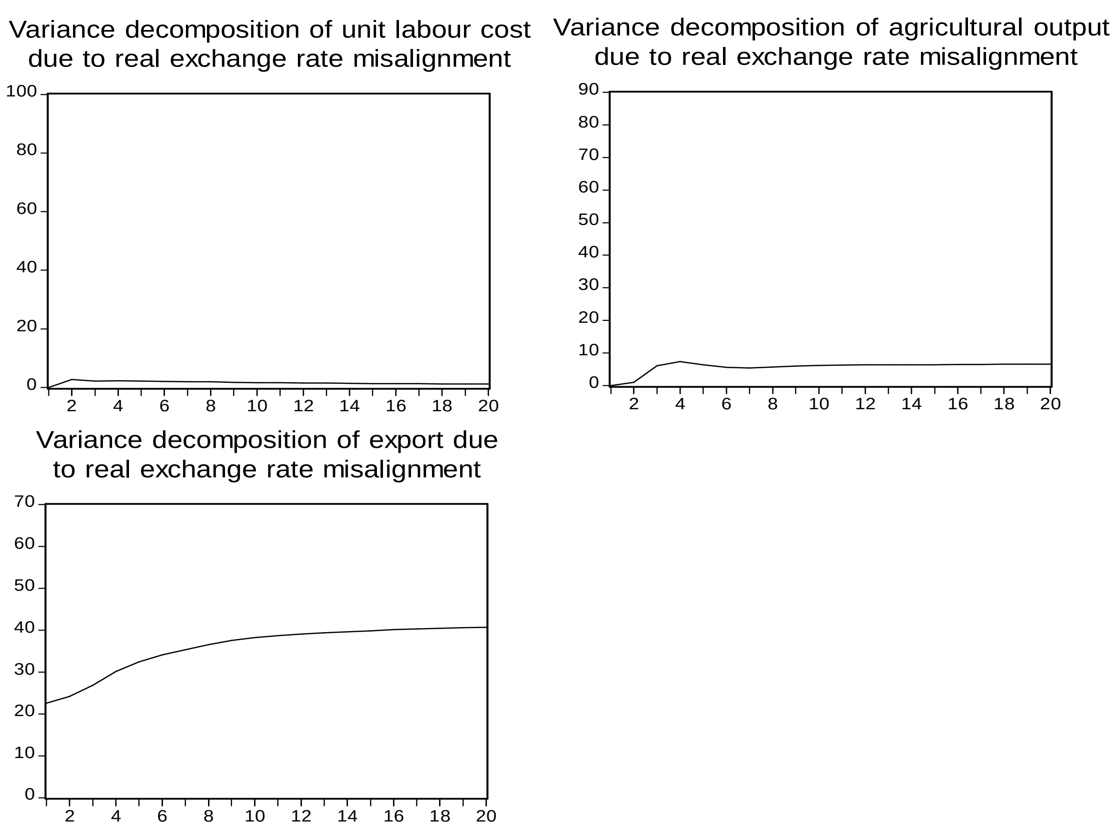


Figure 17 shows the response of measures of economic performance or trade competitiveness to a positive one standard deviation shock in the real exchange rate misalignment. The results show that the real exchange rate misalignment causes unit labour cost to increase. It causes a decrease in agricultural output and a decrease in export. The results are in accordance with theoretical expectation. They are also similar to those obtained by Asfaha & Huda (2002) for South Africa.

6.3.3 Variance decomposition Analysis

Figure 18 presents the forecast variance decomposition to assess the importance of the real exchange rate misalignment in accounting for variation in measures of economic performance or trade competitiveness at various time horizons. The results show that the real exchange rate misalignment accounts for a smaller percent of variation in unit labour cost and agricultural output. It accounts for about 2 percent of the variation in unit labour cost and just over 6 percent of the variation in agricultural output. The real exchange rate misalignment accounts for about 22 percent of the variation in the short run and about 40 percent of variation of export in the long run. These results can be interpreted that real exchange rate misalignment accounts for approximately 2 to 36 percent of the long-run variation in measures of economic performance or trade competitiveness of the Namibian economy.

Figure 18. Variance decomposition of measures of economic performance and competitiveness



6.4 Misalignment computed from the Cashin *et al.* Model (real exchange rate and commodity prices)

6.4.1 Univariate Characteristics of Data and Test for Reduced Rank

The estimation procedure is similar to that of the three-good model. A reduced form VAR is estimated and diagnostic tests performed. Diagnostic statistics of the VAR are presented in Table 16 in the Appendix. Secondly, the cointegration test is performed. The results of the cointegration test are presented in Table 11. Table 11 indicates that there is no cointegration between real exchange rate misalignment and measures of economic performance. Since the variables are non-stationary and there is no cointegration VAR in first differences will yield appropriate results.

Table 11. Cointegration test between misalignment and measures of economic performance and competitiveness

Null hypothesis	**Alternative hypothesis**		**0.05 Critical value**	**Probability value [b]**
		Trace statistic		
r=0	r=1	49.849	54.079	0.113
r=1	r=2	29.233	35.193	0.191
r=2	r=3	15.107	20.262	0.220
r=3	r=4	5.946	9.165	0.195
		Maximum Eigenvalue statistic		
r=0	r>0	20.616	28.588	0.367
r≤1	r>1	14.126	22.300	0.451
r≤2	r>2	9.161	15.892	0.419
r≤3	r>3	5.945	9.165	0.195

[a] Denotes rejection of the null hypothesis at the 0.05 level

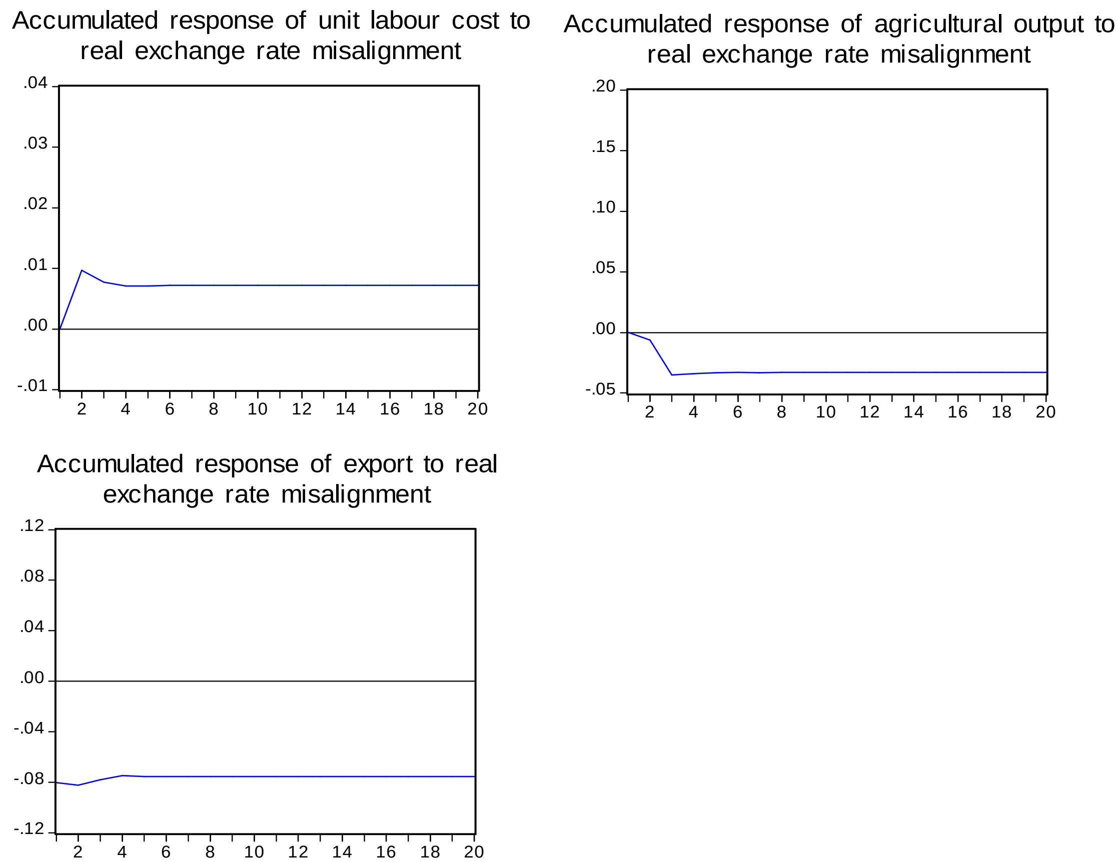
[b] MacKinnon-Haug-Michelis (1999) p-values

Unrestricted VAR in first differences is estimated because the variables are non-stationary and not cointegrated. Long-run restrictions are imposed on the variables while the short-run dynamics are freely determined. The order of the variables is the same as the one under misalignment derived from the three-good model. The long-run restrictions are that each of the three variables (unit labour cost, agricultural output and export) is only influenced by real exchange rate misalignment. For example, unit labour cost is only influenced by real exchange rate misalignment, and not by agricultural output and export. The same applies to agricultural output and export.

6.4.2 Impulse Response

The impulse responses are displayed in Figure 19. The resulting impulse responses were cumulated in order to obtain the impulse responses since the variables were entered in first differences in the VAR. The impulse responses are in line with the theory and empirical literature. They are similar to those obtained under the fundamental approach. A positive real exchange rate misalignment shock causes an increase in unit labour cost. A positive real exchange rate misalignment shock leads to a decrease in agricultural output as well as a decrease in export.

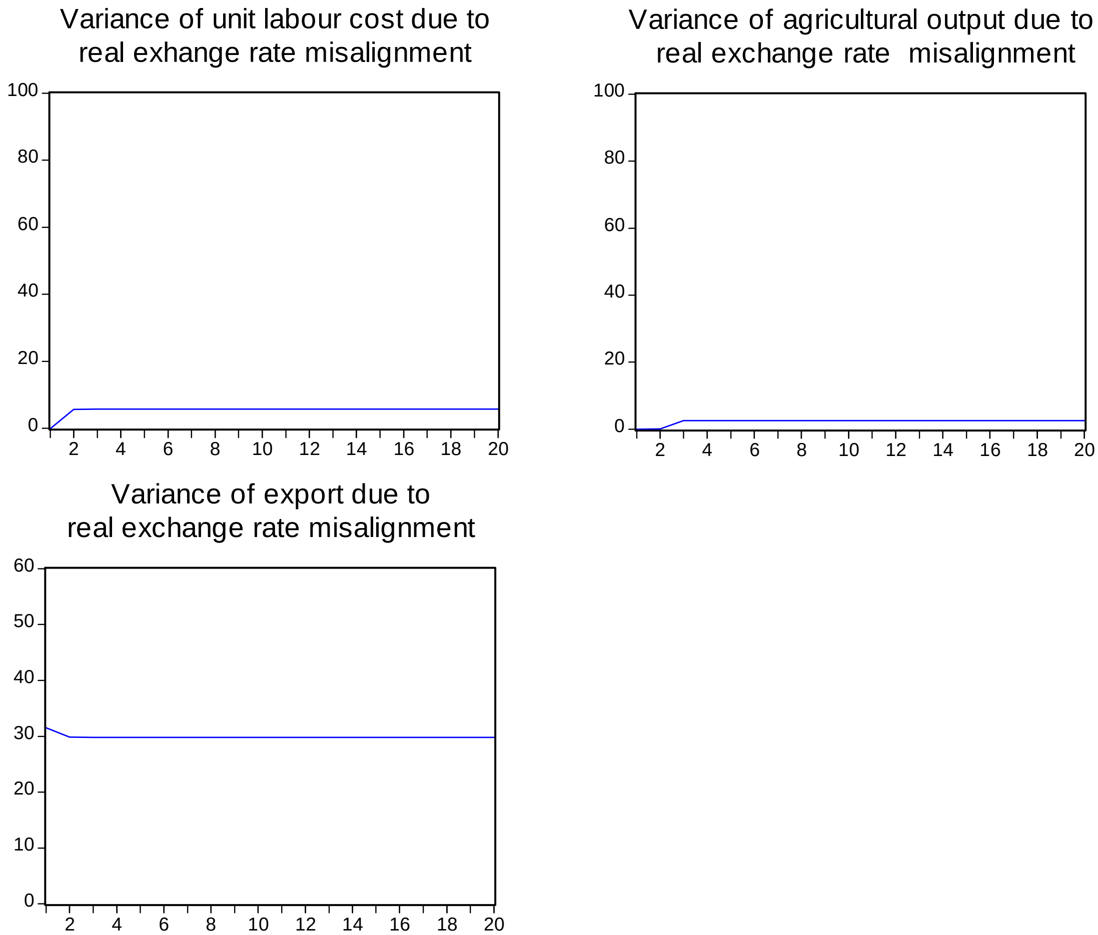
Figure 19. Impulse response: response to Cholesky one standard innovations



6.4.3 Variance Decomposition Analysis

While the impulse assesses the signs and magnitudes of responses to the real exchange rate misalignment, variance decomposition tests the relative importance of the real exchange rate misalignment shocks in accounting for variation in measures of economic performance and competitiveness. Figure 20 displays the variance decomposition of the unit labour cost, agricultural output and export. The real exchange rate misalignment accounts for about 6 percent of the variation in unit labour cost and about 3 percent of the variation in agricultural output. It accounts for about 30 percent of the variation in export. Although the signs of the response of measures of economic performance are in line with theory and empirical literature, the impact is relatively small.

Figure 20. Variance decomposition



6.5 Conclusion

This chapter investigated the impact of real exchange rate misalignment on some measures of economic performance and competitiveness. A VAR methodology was applied to Namibia to test the impact of the real exchange rate misalignment (computed in Chapter 5) on economic performance and competitiveness. The impact of the real exchange rate misalignment obtained from both the three-good model and the Cashin *et al*. model shows that the real exchange rate misalignment has a negative impact on export performance and agricultural output. It causes deterioration of competitiveness because it causes an increase in unit labour cost. The results are consistent with the findings of the empirical literature.

Despite its negative impact on economic performance and competitiveness, the real exchange rate misalignment accounts for a very small percent of variation in the unit labour cost and agricultural output. However, it accounts for about 30 to 38 percent of the variation in export.

The results confirmed that Namibia's trade competitiveness is affected negatively by real exchange rate misalignments. It is important for the country to achieve a high level of export and remain competitive in order to have a sustainable level of growth. This resulted in a number of countries adopting a growth strategy that is led by export with the aim of building a competitive economy. One such example in Namibia is the Export Processing Zones (EPZ) established in 1996, with the aim of encouraging export-oriented manufacturing industry in order to increase employment and investment in the country (Bank of Namibia, 2001). The exchange rate policy in this regard plays a vital role in the expansion of export. This study indicated that the real exchange rate misalignment hampers export and competitiveness. It is necessary for policy makers to monitor the real exchange rate and ensure that it is in line with its long run value. As suggested in Chapter 4 the real exchange rate misalignment can be corrected by having price and wage flexibility, since other policies such as devaluation cannot be used due to Namibia's membership of the CMA.

7. CONCLUSION

7.1 Introduction

This chapter presents a summary of the study, major conclusions and policy implications. The objective of this study is to estimate the equilibrium real exchange rate and the resulting real exchange rate misalignment for Namibia. It then investigated the impact of real exchange rate misalignment on measures of economic performance and competitiveness.

7.2 Methodology

The methodology in this study uses the existing literature and models to estimate the equilibrium real exchange rate and the resulting real exchange rate misalignment as well as the impact of those real exchange rate misalignments on economic performance and competitiveness.

Firstly, the background on exchange rate and monetary policy in Namibia is discussed and then the fundamental literature on the real exchange rate is reviewed and discussed extensively. After investigation of the theories and empirical literature regarding the hypotheses and signs of the coefficients of the determinants of the real exchange rate, time series techniques were applied. The econometric technique applied to estimate the equilibrium real exchange rate and the resulting real exchange rate misalignment was the Johansen (1988, 1995) full information maximum likelihood. The Johansen methodology has advantages in the sense that the estimated coefficients, the β vector can be used to prove a measure of the equilibrium real exchange rate and therefore the expression of the gap between the actual real exchange rate and its equilibrium level. It also derives estimates of the speed of adjustment of the real exchange rate to its equilibrium level.

The first step in the Johansen methodology is to test if there is cointegration between the variables and if that is so the VECM is estimated and the coefficients as well as the speed of adjustment are obtained. The permanent components of the determinants of the real exchange rate are isolated from their transitory components. The Hodrick-Prescott filter is used to smooth the variables. After smoothing the variables the coefficients are then imposed on the smoothed variables (determinants of real exchange rate) to derive the equilibrium real exchange rate. The Real exchange rate misalignment is the difference between equilibrium and actual real exchange rate.

Once the real exchange rate misalignments are computed, the next step is to use the VAR methodology to estimate the impact of the real exchange rate misalignment on measures of economic performance and performance such as export, unit labour cost and the agricultural sector.

7.3 Literature

Chapter 2 discussed the fundamental literature on the real exchange rate, the analytical and the theoretical model for estimation of the equilibrium real exchange rate for Namibia. The three-good model defines the real exchange rate as a function of fundamentals variables which can be classified into external and domestic. External fundamentals include variables such as terms of trade, international transfers, and world real interest rates. Domestic fundamentals are those variables which can directly be influenced by policy decisions and those that cannot be affected by policy decisions. These variables include import tariffs, import quotas, export taxes, exchange and capital control, subsidies and composition of government expenditure. Technology is also part of domestic fundamentals but non-policy related.

Increases in tariffs and import quota are expected to cause real exchange rate appreciation. Relaxation of capital control may affect the long-run path of the real exchange rate positively or negatively. This depends on whether liberalisation of capital increases or decreases the inflow of capital. Trade restrictions normally proxied by openness refer to the country's trade policy stance and this is mainly reflected in tariffs and quotas may influence the real exchange rate. Increase in trade restrictions increase the domestic prices of tradables and thus results in both income and substitution effects. Trade restrictions can depreciate or appreciate the equilibrium real exchange rate depending on whether the income or substitution effect dominates. The impact of government expenditure can cause real exchange rate appreciation or depreciation. This depends on the composition of government expenditure. Increase in the ratio of investment to GDP will increase spending, deteriorate the current account and cause real exchange rate depreciation. However it is noted that the expected sign is ambiguous and it depends on the relative ordering of the factor intensity across sectors.

Chapter 3 discussed the relationship between commodity prices and real exchange rate. Despite the fact the three-good model or fundamental approach is the most widely used in empirical estimation, it has been criticised for relying mainly on terms of trade. The model of the real exchange rate and commodity prices suggests that since developing countries rely more on the export of primary commodities, commodity prices can have a significant impact on the real exchange rate of developing countries. Terms of trade is very broad, and commodity prices could be a better explanatory variable of the changes in real exchange rates of developing countries. Namibia is a commodity exporting country and it is more likely that commodity prices have a potential to explain a greater part in its real exchange rate movement.

Chapter 4 reviewed the literature and models for assessing the impact of real exchange rate misalignment on economic performance. Real exchange rate misalignment has now become a central issue in the economies of developing countries. It has a detrimental effect on the economy and can result in welfare and efficiency costs. It was found out that it can cause reduction in export and can wipe out the agricultural sector. It can also cause capital flight. Countries such as Namibia that have exports dominated by primary commodities experience the highest real exchange rate misalignment compared to those with few primary commodities in their exports or well diversified exports. Different methodologies and models that can be used to investigate the impact of real exchange rate misalignment on economic performance were discussed. A number of studies tested the impact of real exchange rate misalignment on economic performance and competitiveness. Regardless of which measure is used, real exchange rate misalignment has a negative impact on economic performance.

7.4 Empirical Results

The methodology outlined in Section 7.2 is implemented in this study to estimate the equilibrium real exchange rate and resulting real exchange rate misalignment for Namibia. The estimation was based on the three-good model which models the real exchange as a function of fundamentals and the Cashin *et al*. model of real exchange rate and commodity prices. The equilibrium real exchange rate for both models (three-good and Cashin *et al*.) was estimated using the Johansen FIML. According to the three-good model, the real exchange rate is determined by openness, government expenditure, resource balance, terms of trade and ratio of investment to GDP. An increase in both variables causes the real exchange rate to depreciate. The results are in line with the *a priori* expectation.

Variance decomposition analysis showed the real exchange rate accounts for about 30 percent of the variation in itself, while terms of trade account for approximately 50 percent of the variation in the real exchange rate. Investment to GDP ratio accounts for just under 30 percent between periods 4 and 8 and under 10 percent for the rest of the periods. Government expenditure, openness and resource balance each account for just less than 10 percent of the variation in real exchange rate.

The real exchange rate (estimated from the three-good model) was overvalued during the periods 1970-1972, 1982-1985, 1992-1995 and 1999 to 2004. It was undervalued for the periods 1973-1981, 1986-1991 and 1996 to 1998. The highest real exchange rate misalignment was in 1980 and 2002-2004. The speed of adjustment is 1.07 years for 50 percent of the misalignment or deviation to be eliminated.

The estimation results from the model of the real exchange rate and commodity prices show that an increase in commodity prices cause real exchange rate appreciation and this confirms the theory and findings of the literature. An improvement in technology proxied by GDP per capita is also associated with real exchange rate appreciation. The impulse responses show that both variables do not return to equilibrium and this may suggests that policy has been slow in responding to shocks that affect the economy. Variance decomposition revealed that commodity prices account for about 20 percent of the variation in real exchange rate, while GDP per capita accounts for less than 5 percent. The speed of adjustment is 1.7 years and this is longer than the one obtained under the three-good model. The estimation showed that real exchange rate was overvalued during the periods 1972-1977, 1982-1984 and 1992 -1997.

After computation of the real exchange rate misalignment, the VAR methodology was implemented to examine the impact of real exchange rate misalignment on some measures of economic performance and competitiveness.

A VAR methodology was applied to Namibia to test the impact of real exchange rate misalignment (computed in Chapter 5) on economic performance and competitiveness. The impact of the real exchange rate misalignment obtained from both the three-good model and the Cashin *et al*. model shows that the real exchange rate misalignment has a negative impact on export performance and agricultural output. It causes deterioration of competitiveness because it causes an increase in unit labour cost. The results are consistent with those of the empirical literature.

Despite its negative impact on economic performance and competitiveness, the real exchange rate misalignment accounts for a very small percent of variation in unit labour cost and agricultural output. However, it accounts for about 30 to 38 percent of the variation in export and this is not really significant.

7.5 Overall Conclusion and Policy Implications

This study estimated the equilibrium real exchange rate and resulting real exchange rate misalignment using a theoretical model and application of time series econometric techniques. The analysis revealed that the long-run real exchange rate is not constant as postulated by the purchasing power parity. When there are changes in the variables that affect the country's internal and external balance, there will also be changes in the equilibrium real exchange rate. The three-good model or fundamental approach revealed that the real exchange rate needed to achieve equilibrium when the ratio of investment to GDP, terms of trade and openness are high will not be the same when these variables are low. The equilibrium real exchange rate depends on these fundamental variables.

Since Namibia is a commodity exporting country, fluctuations in the prices of commodities can have a greater role in the determination of the country's real exchange rate. The investigation revealed that this is indeed the case. Real prices of commodity exports have an impact on the real exchange rate. An increase in commodity prices causes the real exchange rate to appreciate. The results also confirmed the postulation of the Balassa-Samuelson hypothesis that increase in productivity results in real exchange rate appreciation. This confirms again that the real exchange rate is not constant. It responds to changes in the variables that affect internal and external balance. It is also important to note that there is not one single equilibrium real exchange rate, but a path of equilibrium real exchange rates over time. Only permanent changes in determinants can drive the real exchange rate.

The impulse response analysis from the estimated Cashin *et. al* model showed that the real exchange rate does not return to equilibrium immediately in response to shocks in the fundamentals. This suggests that there could be some structural rigidities that prevent the system from returning to equilibrium. However, given the fact that Namibia cannot use the exchange rate a policy instrument, there is not much that policy makers can do because monetary policy is limited. The exchange rate and monetary policies are determined by the South African Reserve Bank. Shocks to the Namibian economy have to be absorbed by using fiscal policy as a means of adjustment. Both models' results showed that Namibia's real exchange rate was misaligned. The impact of real exchange rate misalignment on economic performance was tested. The results confirmed that Namibia's economic and trade competitiveness are affected negatively by real exchange rate misalignments. The results also confirm the theory and literature postulating that keeping the real exchange rate at wrong levels results in the reduction of the country's welfare. Misalignment causes reduction in export and reduces the performance of the agricultural sector. Although agriculture accounts for about 7 percent of Namibia's GDP, the Labour Survey of 2000 revealed that it remains the largest employer accounting for 30 percent of the total employment. The poorest Namibians live in rural areas and are dependent on agriculture for employment. A real exchange rate which is not realistic harms the poorest. A realistic real exchange rate is conducive to rural prosperity and can have a positive effect on growth and income distribution.

It is important for the country to achieve a high level of export and remain competitive in order to have a sustainable level of growth. This resulted in a number of countries adopting a growth strategy led by export in order to build a competitive economy. One such example in Namibia is the Export Processing Zones (EPZ) established in 1996, with the aim of encouraging export-oriented manufacturing industry in order to increase employment and investment in the country (Bank of Namibia, 2001). Exchange rate policy in this regard plays an important role in the expansion of export. This study indicated that real exchange rate misalignment hampers export and competitiveness. The analysis has shown that maintaining the real exchange rate out of equilibrium reduces Namibia's welfare. This suggests that it is important for policy makers to monitor the real exchange rate and its determinants regularly to ensure that it does not send wrong signals to economic agents.

Real exchange rate misalignment can be corrected or reduced by changing the nominal exchange rate and adjusting the actual real exchange rate to the long-run equilibrium real exchange rate. Changes in the fundamentals could be used to move the actual real exchange rate to equilibrium. Misalignment can also be corrected by having price and wage flexibility, and other policies such as devaluation. The monetary arrangements in the CMA imply that Namibia cannot change the nominal exchange rate or devalue the currency to correct for misalignment. Although pegging to nominal anchor has the advantage of achieving price stability and credibility, it prevents the monetary policy from responding to the needs of the economy. The country loses monetary independence and the exchange rate policy as an instrument of adjustment to shocks. In a flexible exchange rate regime a country has monetary independence and when unemployment is high and growth is low, the monetary authority can increase money growth by lowering interest rates. The currency depreciates and asset prices increases and this would mitigate the downturn in economic performance. Furthermore, deterioration in the world market for a country's export should result in depreciation of the local currency. This would stimulate production and encourage economic growth without any deliberate action by the monetary authority. Under a pegged exchange rate system or nominal rigid anchor depreciation of the local currency cannot happen.

It was stated that Namibia and South Africa suffer from different shocks because the two economies have different compositions of exports and GDP. Namibia has linked its monetary policy rigidly to the South African rand through the CMA. The implication of this linking is that exogenous fluctuations in the rand create movements in the country's monetary conditions which may not be favourably related to the needs of Namibia. The Bank of Namibia stated that the CMA has enabled Namibia to maintain price and financial stability, but monetary policy is determined by one country (South Africa) in this *de facto* monetary union. This makes it difficult for Namibia to adjust its nominal exchange rate and correct real exchange rate misalignment. A more equitable solution where decision making power is exercised by all member states is needed. This argument is supported by Alweendo (2004). The theory of optimum currency area suggests that the loss of the exchange rate as an instrument of correcting shocks (or real exchange rate misalignment) can be reduced if labour is mobile between countries. Labour mobility between Namibia and South Africa is very low and cannot be used as an instrument of adjustment. Alternatively, policies that promote wages and price flexibility need to be pursued in order to enable the economy to adjust to shocks.

It is important for the economy to respond to shocks that affect economy. In the Namibian context the most important shocks are the sustained changes in the prices of export commodities. If policymakers do not adjust to these shocks it could result in real exchange rate misalignment. Some flexibility would be required if real exchange rate misalignment is to be avoided.

In his proposal for monetary policy regimes for small commodity exporters, Frankel (2003) suggested that small countries that want nominal anchor and are concentrating on the production of mineral or agricultural commodity, should peg their currencies to the prices of those of commodities. In this case, movements in the value of their currencies that result from fluctuations in world commodity market would not be an external source of volatility. Namibia's export is concentrated on the export of few products (fish, beef, diamonds, uranium, copper and other mineral products) and this may suggests that the country is a good candidate for pegging its currency to the prices of commodity exports. Alternatively, it is suggested that as a commodity exporting country, Namibia can have either a flexible nominal exchange rate regime which facilitates slow change of relative inflation rate or price and wage flexibility to facilitate the maintenance of a nominal exchange rate peg. This may contribute in addressing the current problem of real exchange rate misalignment. The implication of pegging to the prices of commodities is that Namibia should leave the CMA. However, it is important to state that this move will go against efforts towards regional integration such as the plan to establish a monetary union in SADC by 2016. That is because Namibia is a proponent of regional integration.

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9. APPENDIX

Data description

The data covers the period 1970 to 2004. Annual data were used since quarterly data are not available for some series.

LAGRIC. The log of agricultural output. The data were from 1970 to 1980 were obtained from Hartman (1986) and Cornwell, Leistner and Esterhuysen (1991). Data between 1981 and 2004 were obtained from various issues of the annual reports and quarterly bulletins of the Bank of Namibia. The data are converted to real using 1995 as a base year.

LRCOMP. The log of real commodity prices. The real commodity price index was constructed to reflect the role of primary products in Namibia's trade structure. The variable was computed as the weighted average of Namibia's main commodities export nominal prices (beef, fish, metals or uranium ore, copper and live animals which are mainly sheep) deflated by trade weighted price index from developed countries. Diamond, which is the main commodity exported by Namibia is excluded because its price series is not available. This study follows Cashin *et al*. (2004) to construct the commodity price variable. The construction of the real commodity price is as follows:

The average total value of primary commodity export is calculated for the period 1980 to 2004. The weights of the five commodities are calculated by dividing the average value of each individual commodity export by the average total value of primary commodity export. The data on individual and total commodity exports is sourced from the Central Bureau of Statistics of Namibia and the Bank of Namibia. Once the individual commodity exports are calculated, they are held fixed over time and are used to weight the individual price indices of the same commodities, which are obtained from IMF's International Financial Statistics, to form a geometric weighted average index of USA dollar based nominal commodity-export prices. The base year is set at 1995. The real commodity price is then obtained by deflating the nominal commodity price index by the index of unit value of developed country manufactured exports.

LEXPORT. The log of total export of goods and services. The data was obtained from the Central Bureau of Statistics of Namibia and Bank of Namibia. The data before 1980 was sourced from Hartman (1986), and Cornwell, Leistner and Esterhuysen (1991). The data was converted into real using the consumer price index and the base year was set at 1995.

LREER. The log of real effective exchange rate. The REER is calculated by using the geometric average formula as: $REER=NEER*(CPI/CPIF)^{wj}$, where NEER is the nominal effective exchange rate, CPI is domestic consumer price index, *wj* is the weight of the respective trading partner, and CPIF is the consumer price index of respective trading partners. The main trading partners are South Africa, Japan, United Kingdom, Germany, USA, and Spain. These data are also published by the Bank of Namibia and the International Monetary Fund (IMF). An increase in REER is an appreciation and a decrease is depreciation.

LGOV. The log of government expenditure. The data between 1970 and 1979 is obtained from Hartman (1986), and Cornwell, Leistner and Esterhuysen (1991). The data for the period 1980 to 2004 is sourced from the Bank of Namibia and Central Bureau of Statistics of Namibia.

LINVGDP. The log of gross domestic investment to GDP. The data between 1970 and 1979 is obtained from Hartman (1986), and Cornwell, Leistner and Esterhuysen (1991). The data for the period 1980 to 2004 is sourced from the Bank of Namibia and Central Bureau of Statistics of Namibia.

LOPEN. The log of openness of the economy. This variable is used as a proxy for trade and exchange restriction. It is computed as the sum of export and imports divided by

GDP. Data between 1970 and 1979 is obtained from Hartman (1986), and Cornwell, Leistner and Esterhuysen (1991). The data for the period 1980 to 2004 is sourced from the Bank of Namibia and Central Bureau of Statistics of Namibia.

LTOT. Log of terms of trade. This variable is computed as the ratio of export price index to import price index and it is used to represent changes in international economic environment. This data is obtained from the Bank of Namibia and Central Bureau of Statistics of Namibia. Data for computation of this variable is also obtained from the Bank of Namibia and Central Bureau of Statistics of Namibia. Data between 1970 and 1979 is obtained from Hartman (1986), and Cornwell, Leistner and Esterhuysen (1991).

MISALIGNMENT. Real exchange rate misalignment computed as the difference between actual and equilibrium real exchange rates.

LRESBAL. Log of resource balance. It is computed as (IMPORTS-EXPORT)/GDP. It is used as a proxy for capital flows and controls. The data was obtained from Cornwell, Leistner and Esterhuysen (1991) and the Bank of Namibia.

LPERCAPI. Log of real GDP per capita. This variable is used as a proxy for productivity or technology. The data was obtained from Cornwell, Leistner and Esterhuysen (1991) and the Bank of Namibia.

LTUNITCOT. Log of total unit labour cost. Since wages and salaries are not available for the Namibian economy, total remuneration of employees was taken as a proxy for wages. Remuneration of employees was divided by total output of the Namibian economy. The data was obtained from the Central Bureau of Statistics. Data for the period 1970 to 1979 was taken from Cornwell, Leister and Esterhuysen (1991).

Table 12. Unit root test

Variable	Model	ADF	Joint Test(F-statistic)	Conclusion
LAGRIC	constant and trend	-2.595	2.925	
	constant	-2.773*		I(0)
LRCOMP	constant and trend	-3.669**		I(0)
LEXPORT	constant and trend	-3.079	3.654	
	constant	-2.283	2.020	
	none	1.077		I(1)
LREER	constant and trend	-0.824	Φ_3=1.065	
	constant	-1.417		
	none	-1.144	Φ_1=1.629	I(1)
LGOV	constant and trend	-1.515	Φ_3=2.207	
	constant	-1.543		
	none	7.678	Φ_1=2.382	I(1)
LINVGDP	constant and trend	-2.044	Φ_3=1.606	
	constant	-1.723		
	none	-0.548	Φ_1=1.700	I(1)
LOPEN	constant and trend	-2.058	Φ_3=3.838	
	constant	-0.280		
	none	-1.146	Φ_1=2.087	I(1)
LTOT	constant and trend	-3.291*		I(0)
MISALIGNMENT	constant and trend	-0.367	Φ_3=2.686	
(Fundamental	constant	-0.614		
model)	none	0.731	Φ_1=0.377	I(1)
MISALIGNMENT	constant and trend	-2.939	Φ_3=3.618	
(Cashin *et al*)	constant	-3.058**		I(0)
LPERCAPI	constant and trend	-2.022	Φ_3=2.009	
	constant	-1.495		
	none	0.974	Φ_1=0.494	I(1)
LRESBAL	constant and trend	-3.888**		I(0)
	constant			
	none			
LTUNITCOST	constant and trend	-3.158	Φ_3=5.862	
	constant	-0.921		
	none	2.044	Φ_1=1.993	I(1)

*/**/*** Significant at 10/5/1 percent significance level

Critical values for the Φ_3 and Φ_1 are from Dickey and Fuller (1981: 1063)

"General to specific" iterative procedure in Enders (2004: 213) is used

Table 13. Diagnostic statistics on the VAR of the fundamentals approach model

	H_0	Test	Statistic	Probability
Serial correlation	No serial correlation	LM test-χ^2 (lag 3)	21.932	0.145
Normality	Error terms are normally distributed	JB-Joint	14.107	0.079
		Kurtosis – Joint	13.739	0.008
		Skewness – Joint	0.369	0.989
Heteroscedasticity	No heteroscedasticity	χ^2	227.711	0.706

Table 14. Diagnostic statistics of the reduced for VAR of the Cashin *et al.* model

	H_0	Test	Statistic	Probability
Serial correlation	No serial correlation	LM test-χ^2 (lag 4)	14.314	0.112
Normality	Error terms are normally distributed	JB-Joint	6.077	0.415
		Kurtosis – Joint	4.936	0.177
		Skewness – Joint	1.140	0.767
Heteroscedasticity	No heteroscedasticity	χ^2	154.229	0.265

Table 15. Diagnostic statistics of the VAR on the real exchange rate misalignment and economic performance from the fundamental appproach model

	H_0	Test	Statistic	Probability
Serial correlation	No serial correlation	LM test-χ^2 (lag 1)	18.735	0.283
Normality	Error terms are normally distributed	JB-Joint	9.076	0.334
		Kurtosis – Joint	2.273	0.689
		Skewness - Joint	6.803	0.147
Heteroscedasticity	No heteroscedasticity	χ^2	94.173	0.133

Table 16. Diagnostic statistics of the VAR on real exchange rate misalignment and economic performance from the Cashin *et al* model

	H_0	Test	Statistic	Probability
Serial correlation	No serial correlation	LM test-χ^2 (lag 1)	18.735	0.283
Normality	Error terms are normally distributed	JB-Joint	9.076	0.336
		Kurtosis – Joint	2.273	0.683
		Skewness – Joint	6.803	0.147
Heteroscedasticity	No heteroscedasticity	χ^2	94.173	0.133