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ESSAYS ON PURCHASING POWER PARITY, REAL EXCHANGE RATE, AND OPTIMUM CURRENCY AREAS

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Dedication

To my mother, Rhona Kalinda,

and to the memory of my father, Simeon Mweene Kalinda,

and my brother, Wilfred Kampekete Kalinda.

Abstract

This thesis contains three separate papers. Paper I tests whether the theory of Purchasing Power Parity holds in a selected sample of twenty African countries. The paper employs a panel unit root test to test whether the real exchange rates in the panel are mean reverting or not. The test employed is the Im *et al* (1997) test. Results show that the null of a unit root is rejected for the three real exchange rate indices, namely, the import-based and trade-weighted multilateral indices, and the bilateral indices, while for the export-based indices, the null hypothesis is not rejected. That is, Purchasing Power Parity is confirmed for the import-based and trade-weighted multilateral indices, and the bilateral indices, while it is rejected for the export-based multilateral indices. After performing the demeaning adjustment to account for cross-sectional dependence, our results show that the null hypothesis of a unit root is rejected for the import-based multilateral indices and the bilateral indices, while the null is not rejected for the trade-weighted multilateral indices. Purchasing Power Parity is therefore only confirmed for the import-based multilateral indices and bilateral indices, while it is rejected for the trade-weighted multilateral indices.

Paper II analyses the main determinants of the real exchange rate in Zambia. It first gives a brief review of the Zambian economy and a review on real exchange rate studies. Then an illustrative model is presented. The study employs cointegration analysis in estimating the long-run determinants of the real exchange rates for imports and exports, and of the internal real exchange rate. The finding is that terms of trade, government consumption, and investment share all influence the real exchange rate for imports, while terms of trade, central bank reserves and trade taxes influence the real exchange rate for exports in the long-run. The internal real exchange rate is influenced by terms of trade, investment share, and the rate of growth of real *GDP* in the long-run. Error-correction models are then estimated.

Besides the difference of the fundamentals mentioned above, aid and openness are found to impart short-run effects on the real exchange rate indices. The coefficients of adjustment are found to be -0.38, -0.79 and -0.80 respectively for the real exchange rates for imports and exports, and for the internal real exchange rate.

Paper III investigates whether the East African Community, comprising of Kenya, Tanzania, and Uganda, constitutes an optimum currency area or not. The East African Community has been revived, and one of the long-term objectives of the Community is to have a common currency. The paper employs the Generalised Purchasing Power Parity method, and various criteria suggested by the theory of Optimum Currency Areas to investigate the optimality of the Community as a currency area. While the various indices that we calculated based on the theory of Optimum Currency Areas gave mixed verdicts, the Generalised Purchasing Power Parity method supports the formation of a currency union in the region. Using the Generalised Purchasing Power Parity method, we were able to establish cointegration between the real exchange rates in East Africa for the period 1981 to 1998, and even for the period 1990 to 1998. This finding suggests that the three countries tend to be affected by similar shocks.

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Beatrice Kalinda Mkenda
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Contents

Paper III: Is East Africa an Optimum Currency Area?

Introduction and Summary

This thesis contains three separate empirical papers. The papers are, by and large, connected in the sense that they all deal with aspects of real exchange rate issues.

In the first paper, we undertake to empirically test whether the theory of Purchasing Power Parity (*PPP*) holds in a selected sample of African countries. The essence of the *PPP* theory is that the nominal exchange rate between a given country and her trading partners reflects the relative price levels between that country and her trading partners. The theory of *PPP* has remained important in spite of the mixed verdict in empirical tests. A number of models assume implicitly or explicitly that *PPP* holds, and also, *PPP* is used as a yardstick for determining over- and under-valuation of currencies (Holmes, 2000).

The easy appeal of *PPP* has gone hand in hand with extensive empirical analysis to verify whether the theory indeed holds in the real world. The initial wave of empirical analysis found little support for *PPP* except for few cases of hyperinflationary countries (see Froot and Rogoff, 1995). The second wave of studies were inspired by new developments in econometrics that enabled the testing of unit roots of series and testing any possible long-run relationship between the series through cointegration analysis (Froot and Rogoff, 1995; Rogoff, 1996). Even then, it was mostly with long-horizon data that econometric analysis supported the *PPP* theory. Since many countries do not have records on trade and exchange rates spanning centuries, it followed that the use of long-horizon data remained limited to a few countries. African countries, for example, gained their independence from the middle of the last century, which means that the data in these countries can not span more than fifty years.

New developments in econometrics have led to a fresh wave of studies that utilise both panel data and times series econometrics to test the *PPP* theory. These developments mean that a cross-sectional dimension can be added to the time series to provide rich data for verifying the *PPP* theory. This is what the first paper attempts to do with regards to African countries. Paper I thus tests whether *PPP* holds in twenty selected African countries. These countries are; Burkina Faso, Burundi, Congo Republic, Côte d'Ivoire, Egypt, Ethiopia, Gabon, The Gambia, and Ghana. Others are; Kenya, Madagascar, Mauritius, Morocco, Niger, Nigeria, Sierra Leone, South Africa, Tanzania, Zambia, and Zimbabwe. The countries were chosen because of data availability. The paper utilises the panel data unit root test, which was developed by Im *et al* (1997). Three versions of the real exchange rate are employed in the analysis. Most studies in the literature merely employ bilateral real exchange rates for testing whether *PPP* holds. The study goes a step further by calculating import-based, export-based, and trade-based multilateral real exchange rates, and also bilateral real exchange rates for the twenty African countries.

In the empirical process, the study employs a demeaning procedure for the panel. This is because cross-sectional dependence may be present in the data, and may thus make the test produce results that falsely support *PPP*. After demeaning the data for which *PPP* is found to hold, the results are supportive of Purchasing Power Parity for the import-based multilateral indices and bilateral indices, while it is rejected for the trade-weighted multilateral indices.

The second paper focuses on the widely used concept of the real exchange rate. The real exchange rate features prominently in *IMF*/World Bank sponsored economic reforms in Africa. The thrust of these reforms has been the effort to reverse the macroeconomic imbalances. Some studies have attributed the poor performance of developing countries to misaligned real exchange rates (see Cottani *et al*, 1990; Ghura and Grennes, 1993). An important empirical issue is in

determining both the short-run and the long-run determinants of the real exchange rate. The task is not made any easier by the fact that the long-run real exchange rate is a rather difficult concept (Montiel and Hinkle, 1999). Furthermore, it is now recognised that there is no single index that can appropriately capture the real exchange rate in developing countries (Montiel and Hinkle, 1999). The approach adopted in this study is to calculate three separate indices of the real exchange rate as suggested by Hinkle and Nsengiyumva (1999*b*,*c*). The calculation of separate real exchange rates for imports and exports is dictated by the fact that the Zambian economy is affected by fluctuations in the terms of trade due to its heavy reliance on copper exports. Thus, in order to calculate a real exchange rate that would take account of the terms of trade effects, some adjustment in the calculation of the real exchange rate is needed. We thus calculated a real exchange rate for exports to supplement the real exchange rate for imports. We further used national accounts data to calculate an overall real exchange rate, referred to as an internal real exchange rate. In the computation of the real exchange rates for imports and exports, we also used different nominal exchange rates. For the real exchange rate for imports, we used the parallel market exchange rate for the period for which the data was available. The use of the parallel market exchange rate is recommended in cases where the parallel market is pervasive (Edwards, 1989), as was the case in Zambia. Importers could thus use the parallel market rate for their foreign exchange requirements. As for the real exchange rate for exports, we used the official exchange rate because the main exporters were converting their foreign exchange earnings into local currency at the official exchange rate.

The paper then uses cointegration analysis and error-correction models to estimate the long-run and short-run determinants of the real exchange rate for Zambia, and this is done for each of the three versions of the real exchange rate discussed above. The long-run fundamentals that we found for the real exchange rate for imports are terms of trade, investment share and government consumption, while

for the real exchange rate for exports, the following fundamentals performed well; terms of trade, central bank reserves, and trade taxes as a percentage of *GDP*. For the internal real exchange rate, we found the following fundamentals; terms of trade, investment share, and the growth rate of real *GDP*. We then estimated error-correction models for the real exchange rates.

The final part of the empirical analysis was to estimate the degree of misalignment in each of the real exchange rate indices. In order to estimate the degree of misalignment, we used the long-run estimates of the fundamentals to get the fitted values of the equilibrium real exchange rates, which we then decomposed into their temporary and permanent movements using the Hodrick-Prescott filter. The equilibrium real exchange rates were taken to be the permanent movements in the filtered series. We then calculated the misalignment as the deviation of the actual real exchange rates from the equilibrium real exchange rates.

The third paper is about the assessment of whether the East African Community, which comprises of Kenya, Tanzania and Uganda, constitutes an optimal currency area. There is a strong drive for some regions in the world to form currency unions. Since the launching of the euro, there have been talks of setting up common currencies between Russia and Belarus, and also between Australia and New Zealand (*BBC Monitoring Service*, 2000). The *ECOWAS* countries in West Africa, *SADC* of Southern Africa, and the East African Community, are all talking of establishing currency unions (*EAC, n.d*; *ECOWAS, n.d*).

Within the economics literature, criteria have been proposed for assessing the optimality of a currency area in a given region. The first major effort in this direction is credited to Mundell (1961), who brought up the subject in the then fixed versus flexible exchange rate discussion (Rockoff, 2000). The literature on optimal currency areas subsequently flourished (McKinnon, 1963; Kenen 1969;

Tavlas, 1993). Enders and Hurn (1994) proposed and employed cointegration analysis on the real exchange rates of countries proposing to form a currency area in assessing the optimality of the currency area. The third paper in this thesis is mainly inspired by the work of Enders and Hurn (1994).

One of the long-term objectives of the East African Community is to establish a currency union. The paper therefore investigates whether the Community constitutes an optimum currency area. A number of indices that are suggested in the theory of optimum currency areas are used to examine the issue, and also, the Generalised Purchasing Power Parity (*G-PPP*) approach (Enders and Hurn, 1994) is employed.

On applying the traditional indices for optimality of currency areas, conflicting verdicts are obtained. While some indices suggest that the three East African countries constitute an optimum currency area, others suggest otherwise. However, a more conclusive result is obtained from the *G-PPP* theory. The *G-PPP* theory postulates that counties can qualify to form a currency union if they tend to experience similar economic shocks. This means the fundamentals that drive the real exchange rates in the concerned countries would exhibit common trends, and thus the real exchange rates would be cointegrated.

On conducting cointegration analysis on the real exchange rates of the East African countries, the finding was that the real exchange rates are cointegrated. This indicates that the three countries tend to experience similar economic shocks. When the sample was restricted to the more recent period of 1990 to 1998, cointegration analysis gave even stronger support for the formation of a currency union. Indeed, this is the period that Kenya, Uganda and Tanzania are all actively involved in market-oriented economic reforms promoted and supported by the *IMF* and the World Bank. Whether indeed these countries do form a monetary

union is a different matter. But there seems to be some political will and public support for more integration of the East African economies.

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An Empirical Test of Purchasing Power Parity in Selected African Countries - a Panel Data Approach

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Abstract

The paper tests whether the theory of Purchasing Power Parity holds in a selected sample of twenty African countries. The paper employs a panel unit root test to test whether the real exchange rates in the panel are mean reverting or not. The test employed is the Im *et al* (1997) test. Results show that the null of a unit root is rejected for the three real exchange rate indices, namely, the import-based and trade-weighted multilateral indices, and the bilateral indices, while for the export-based indices, the null hypothesis is not rejected. That is, Purchasing Power Parity is confirmed for the import-based and trade-weighted multilateral indices, and the bilateral indices, while it is rejected for the export-based multilateral indices. After performing the demeaning adjustment to account for cross-sectional dependence, our results show that the null hypothesis of a unit root is rejected for the import-based multilateral indices and the bilateral indices, while the null is not rejected for the trade-weighted multilateral indices. Purchasing Power Parity is therefore only confirmed for the import-based multilateral indices and bilateral indices, while it is rejected for the trade-weighted multilateral indices.

Keywords: Purchasing Power Parity, Real Exchange Rate, Africa, Panel Data.

JEL Classification: C33; F44; O55.

1 Introduction

This paper aims at testing one of the most controversial theories in international economics - Purchasing Power Parity (hereafter, *PPP*). The theory in its various versions relates the exchange rate between any two currencies to the relative price levels in the respective countries. The implication is that a country with inflation higher than that of her trading partners will tend to have a depreciating currency. Although at times *PPP* has often failed to stand empirical tests and its theoretical content of exchange rate determination has been questioned, it has continued to be pervasive in macroeconomic models. *PPP* is still implicit and also explicit in many models of exchange rate determination, and is also used as a yardstick of openness of an economy in macroeconomic models. On the policy front, *PPP*-based benchmarks have been used to assess levels of exchange rates in a bid to establish the need, extent and the direction of adjustment.

The pervasiveness of *PPP* in economics has gone hand in hand with the literature on the empirical tests of the theory. Most of these tests have been done in developed countries. Very few such studies have been done in Africa. This paper is an attempt at testing the theory on a panel of twenty African countries. In this regard, it is worth highlighting some striking features of the economies of the African countries included in our study.

The first feature is that virtually all the African countries rely on exporting primary products for foreign exchange earnings. The products are agricultural, such as coffee in the cases of Kenya and Tanzania, and cocoa in the case of Ghana; minerals, in the case of Zambia, Zimbabwe, and South Africa; and oil in the case of Nigeria. When these countries sell their products on the international market, individually, they do not command a large share of the market. As such, they are basically price-takers, who cannot influence the price of their products.

The second striking feature is that except for South Africa, and to some extent Zimbabwe, manufacturing activities, although they exist, are marginal. Most African countries, upon getting their independence invested in import-substituting industries that heavily relied on imported inputs. As foreign exchange earnings dwindled due to falling prices of their exports on the international market, their industries collapsed. Due to weak manufacturing industries, these countries rely on importing manufactured goods from industrialised countries. In the import market, African countries are also price-takers, but the difference is that they can decide not to buy products from countries where prices are higher. In some cases, however, when aid is tied to products from donor countries, they do not have much of a choice.

The third feature is that inter-country trade between African countries is small. Trade is not only hampered by small manufacturing activities, but also by lack of developed infrastructure to connect different countries, and other transaction costs. The high transaction costs and poor infrastructure lead to trade being regionally based as proximity to one another reduces some of the transaction costs. For example, in Table A in the appendix, we can identify some regional-based trade: West African countries such as Nigeria and Côte d'Ivoire feature prominently in trading with other West African countries; Kenya in East Africa trades with other East African countries, while South Africa dominates trade with other countries in Southern Africa.

The last feature pertains to exchange rate regimes. Tables B and C in the appendix classifies the exchange rate regimes that the countries pursued during the sample period. It is important to point out that most of these countries have changed regimes over time, although the current trend is that they are adopting more

flexible regimes (see also Nagayasu, 1998). We will not discuss the changes on a detailed level, but we shall merely point out the broad features.

Before the 1980s, most of the currencies were fixed and not convertible. As such, foreign exchange markets were dominated by controls and rationing. The most popular currency which they pegged their currencies to was the United States dollar. However, after mid 1980s, most of the countries undertook structural adjustment programmes to restructure their economies. One of the major policy recommendations of the programmes was that the countries had to devalue their currencies to make their exports more competitive. By the late 1980s and into the 1990s, most countries liberalised their economies, by moving towards market-determined exchange rates and by lowering tariffs in order to encourage more trade. However, although economic liberalisation seems to have swept the whole of Africa, there still remains some controls in some of the countries.

In light of these particular attributes of African countries, it is of interest to investigate the following issue:

- Given that African countries trade mostly with industrialised countries, to what extent are changes in the nominal exchange rates in African countries influenced by their price levels relative to that of their trading partners?

It should be noted that in the literature, *PPP* is more likely to hold among countries with similar consumption patterns. African countries and industrialised countries can hardly be said to have similar consumption patterns. On the other hand, African countries have tended to have high inflation, mostly two digits, compared to their main trading partners who have had low inflation. Generally, *PPP* has been found to hold in high inflation countries (Rogoff, 1996).

For a long period of time, most African countries pursued fixed and controlled exchange rate regimes. In other words, the exchange rates were fixed by decree of the state. Thus, rationing, rather than market forces, was used to deal with shortages. This seems to rule out any relevance of official nominal exchange rates in testing for *PPP*. However, these countries undertook occasional devaluations and it might be that these devaluations, even though overdue in almost all cases, were responsive to price differentials *vis a vis* the trading partners.

To examine this pertinent issue, the paper is structured as follows; the second section reviews the history and theory of the *PPP* doctrine. Section three dwells on the methodological issues involved in testing the *PPP* theory and the evidence on *PPP*. The results and empirical analysis are reported in section four, and section five summaries and concludes the paper.

2 Theoretical Framework of the Purchasing Power Parity Doctrine

As explained above, the essence of *PPP* is that the price levels in the respective countries influence the exchange rate between two currencies. The *PPP* theory's origin has been traced to the 16th century Salamanca School of Spain. During the nineteenth century, classical economists, including Ricardo, Mill, Goschen and Marshall, endorsed and developed more or less qualified *PPP* views. The theory, in its modern form, is credited to Cassel, a Swedish economist, who developed and popularised its empirical version in the 1920s (Rogoff, 1996).

Cassel's idea was that the nominal exchange rate should reflect the purchasing power of one currency against another. His proposal was that a purchasing power

exchange rate existed between any two countries, and it is measured by the reciprocal of one country's price level against another. Cassel wrote that:

> At every moment the real parity between two countries is represented by this quotient between the purchasing power of the money in the one country and the other. I propose to call this parity 'the purchasing power parity'. As long as anything like free movement of merchandise and a somewhat comprehensive trade between the two countries takes place, the actual rate of exchange cannot deviate very much from this purchasing power parity (Isard, 1995:58).

Cassel developed the idea after the collapse of the world financial system during World War I. Before the war, countries followed the gold standard, whereby their currencies were convertible to gold at fixed parities. This implied that relative gold values reflected the exchange rate between any two countries. However, after the war broke out, it was difficult to maintain the gold standard as speculators worried about countries that would devalue so as to gain seignorage revenues. The gold standard was thus abandoned, and countries had to decide how to reset exchange rates with minimal disruptions to prices and government revenues. Cassel thus promoted the use of *PPP* as a basis for setting relative gold parities. He suggested that cumulative inflation rates from 1914 be calculated, and then be used to calculate the exchange rate changes needed to maintain *PPP* (Rogoff, 1996; Dornbusch, 1994).

The Purchasing Power Parity theory is developed on the basis of *the law of one price* (*LOP*). The law states that once converted to a common currency, the same good should sell for the same price in different countries. In other words, for any good *i*,

$$\langle 1 \rangle \quad P_i = SP_i^*$$

where, P_i is the domestic price for good *i*, P_i^* is the foreign price for good *i*, and *S* is the domestic nominal exchange rate.

The *LOP* assumes that there is perfect competition, there are no tariff or other trade barriers, and no transportation costs. In practice, due to the existence of trade barriers and transportation costs that drive a wedge between prices in different countries, the law cannot hold exactly (Rogoff, 1996; Froot and Rogoff, 1995).[1]

Absolute purchasing power parity, *APPP*, is a generalisation of the law of one price. It postulates that given the same currency, a basket of goods will cost the same in any country. Formally,

$$\langle 2 \rangle \quad P = SP^*$$

thus;

$$\langle 3 \rangle \quad S = \frac{P}{P^*}$$

where, *P* and P^* are the prices of the identical basket of goods in the domestic and foreign countries respectively, and *S* is the exchange rate, or the domestic currency price of foreign currency.[2] Absolute purchasing power parity is unlikely to hold exactly for the same reasons that the law of one price fails to hold.

[1]Rogoff (1996) writes that the wedge depends on the tradability of the goods. For goods which are highly traded, such as gold, the law holds quite well, whereas for non-traded goods such as Big Macs, factors such as non-traded inputs, value-added taxes and profit margins militate against the law.

[2]In empirical tests however, no attempt is made to compare identical baskets of goods. Instead, different countries' *CPIs* and *WPIs* are used (Froot and Rogoff, 1995). The use of these indices to test for *APPP* can most definitely lead to results not supporting *APPP* because different countries use different compositions of goods in the baskets for constructing price indices. Also, since the weights assigned to goods are not necessarily standard, it makes it less likely that *APPP* measured in this way will hold.

It is easy to see the intuition behind the *PPP* theory and why in practice it may not appear to hold. One way of circumventing the obstacles that make it impossible for *PPP* to hold in its absolute version is to resort to the rate of change of both the exchange rates and the national price levels. Despite transport costs and other trade barriers, the change in the exchange rate between two countries' currencies is likely to be influenced by the change in the price level of one country relative to the other country's price level, if indeed *PPP* is plausible. It is in this context that Relative Purchasing Power Parity, *RPPP*, another version of *PPP* was introduced. It states that the rate of growth in the exchange rate offsets the differential between the rate of growth in home and foreign price indices. Formally, this is represented by,

$\langle 4 \rangle \quad \ddot{A}P = \ddot{A}S.\ddot{A}P^{*}.$

If the increase in domestic prices is faster relative to that of the foreign country, then the exchange rate will depreciate.

3 Empirical Evidence on Purchasing Power Parity

Even though *PPP* may be attractive because of both its simplicity and intuitive appeal, empirical tests have produced mixed verdicts. To a great extent, economists have tended to find weaknesses with the methodology employed in studies that have rejected *PPP*. Thus, they have seized every opportunity offered by new developments in econometrics to test *PPP*. Broadly, we can identify four classes of approaches that have been used in testing *PPP*.

The first approach is based on a simple test of *APPP* and *RPPP* using the following two equations;

$$\langle 5 \rangle \quad s_t = b_0 + b_1(p_t - p_t^*) + u_t$$

and

$$\langle 6 \rangle \quad \Delta s_t = b_0 + b_1(\Delta p_t - \Delta p_t^*) + u_t .$$

All variables are in logs and s is the nominal exchange rate, p and p^* are domestic and foreign price levels respectively, and t denotes time. In either equation, *PPP* holds if b_1 is statistically not different from one.

This approach has been employed in hyperinflationary countries in the 1920's, with results that supported *PPP*. However, attempts to apply the same test in the post-Bretton Woods era produced results which rejected *PPP* (Frenkel, 1981).

This approach has several shortcomings. The first one is that with the benefit of modern time series techniques, we know that regressions using the equations above should have involved running tests for stationarity in the variables and conducting cointegration analysis. Another shortcoming is that *PPP* does not define a causal direction between the exchange rate and the price level as implied by the models specified above. As such, any choice of a dependent variable is arbitrary and potentially susceptible to simultaneity bias.

The second approach for testing the *PPP* theory is built on the following premise; for various reasons, exchange rates fluctuate more than the price levels. Due to this, *PPP* can hardly hold at any particular instance. The only way that *PPP* can prove to hold is in its long-run behaviour. This will be manifested by a tendency of

a fluctuating exchange rate reverting towards a constant mean. Let the real exchange rate (e) be defined as;

$$\langle 7 \rangle \quad e = \frac{SP^*}{P}.$$

The test for *PPP* can be done indirectly; by testing the mean reversion of the real exchange rate. If the real exchange rate exhibits mean reversion, then we cannot reject the *PPP* hypothesis. If, on the other hand, the real exchange rate does not exhibit mean reversion, it means that it is not stationary. In this case, *PPP* is rejected. The following equation provides a framework for testing mean reversion:

$$\langle 8 \rangle \quad \Delta e_t = a + g e_{t-1} + u_t$$

where, u_t is a white noise error term. The null hypothesis is that the real exchange rate has a unit root, that is, $\gamma = 0$. Failure to reject the null hypothesis implies that the real exchange rate is not stationary, and thus does not exhibit mean reversion. In this case, *PPP* will be rejected.

Applied to industrialised countries during the floating exchange era, many studies failed to reject the hypothesis that real exchange rates follow a random walk (Rogoff, 1996). One reason given for this kind of result is that the small sample size of data employed did not render sufficient power to reject the null. Tests that employed "long-horizon" data sets (some of these data sets span centuries), for example, Frankel (1990) and Edison (1987), tended to give results in support of *PPP* (see Rogoff, 1996; and Froot and Rogoff, 1995). One caveat is in order; most of these studies made use of data sets from wealthy nations because of the availability of long-horizon data. This produces what has been called "survivorship" bias; countries that have been poor are not included, even though

inclusion of such countries could alter the results (Froot and Rogoff, 1995). Indeed, African countries are on average 40 years old as nations and thus are not capable of generating long-horizon data sets.

Cointegration analysis offers another approach for testing the *PPP* theorem. The world of economics is endowed with literature employing this approach, for example, Layton and Stark (1990), Fisher and Park (1991), Enders (1988), Kim (1990), Patel (1990), Taylor (1988), Ardeni and Lubian (1989), Liu (1992) and others (see Froot and Rogoff, 1995; Rogoff, 1996). Cointegration analysis can be used to test for the existence of a long-run equilibrium relationship between variables. This kind of analysis is particularly attractive in relation to the test of *PPP* because, for example, in case of the Johansen procedure, the need for "appointing" a dependent variable is dispensed off.

Cointegration analysis has also produced mixed results in testing for *PPP*. When a very large sample of data is used, for example, Kim (1990), *PPP* was supported and even parameter estimates were very close to the unit value predicted by *PPP*. On a small sample though, results have not been that good and at times, parameter estimates of implausible magnitude have been obtained (Froot and Rogoff, 1995).

The last approach, and the one we will use in this paper, involves panel data analysis. The panel data approach uses both time series and cross-sectional observations to increase the sample size. In this way, even "young" nations like African countries can be pooled to produce a reasonably large sample. Several studies have been conducted in this area with results that support *PPP*, that is, real exchange rates are mean reverting. These studies include Wu (1996), MacDonald (1996), Frankel and Rose (1995), Oh (1996), and Holmes (2000).

For a long time, one shortcoming in the use of panel data analysis for testing *PPP* was that the time series technique of unit root tests did not permeate the panel data analysis. However, of late, a number of procedures to test for unit roots in panel data have been developed. These procedures have been employed in testing for *PPP*, and in general, due to the increased power of the test arising from the cross-section dimension of the data sets used, the tests are supportive of long-run *PPP*. Below, we briefly review some of the studies that have employed the panel data unit root test.

One study by Papell (1997) used panel data analysis to test for long-run *PPP*. The main purpose of the study was to examine how much evidence there was against unit roots during the current float for industrialised countries. The following equation was estimated by Feasible Generalised Least Squares (*FGLS*);

$$\langle 9 \rangle \quad \Delta e_{jt} = m_j + a e_{jt-1} + \sum_{i=1}^{k} c_{ji} \Delta e_{jt-i} + e_{jt}$$

where, e is the real exchange rate, and j indexes the countries in the panel. Monte Carlo methods were used to compute exact finite sample critical values for the test statistics for the study. Papell's study found strong evidence against the unit root hypothesis for monthly data, but not for quarterly data.

Another study that employed a fairly new panel unit root test is the one by Coakley and Fuertes (1997). They used the Im *et al* (1997) panel unit root test, which is more powerful than the Levin, Lin and Chu (*LLC*) procedure, to analyse real exchange rate data for the G10 countries and Switzerland. They used monthly data for the period 1973-96 of bilateral rates and wholesale and consumer prices. Since

cross-sectional dependence[3] in disturbances is expected in panels on real exchange rates if a common currency such as the *US* dollar is used as a base, they allowed for this by using the demeaning adjustment proposed by Im *et al* (1997). The demeaning procedure involves subtracting cross-section means from the observed data, as follows; $e_{it} - \frac{1}{N}\sum_{i=i}^{N} e_{it}$. Their findings were that for the wholesale price series, the *t*-bar statistics rejected the null of a unit root in the real exchange rates at the 95 percent critical value, while for the consumer price series, the null was rejected at the 90 percent level only. They thus concluded that the real exchange rates in their panel are stationary in all cases, and hence rendered support for long-run *PPP*.

MacDonald's (1996) study used the *LLC* procedure to test for stationarity on two annual data sets for the post-Bretton Woods era, namely 17 *OECD* real exchange rates using wholesale price indices, and 23 *OECD* real exchange rates using consumer price indices. As a preliminary exercise, standard Augmented Dickey Fuller (*ADF*) tests were performed on the data sets. The standard *ADF* test indicated little evidence of rejection of the null of a unit root, with only three *WPI*-based real exchange rates and two *CPI*-based real exchange rates being stationary at 5 percent. When the panel unit root test was conducted on the panel, it was found that regardless of the chosen deterministic specification, that is, constant or

[3]O'Connell (1998) raised the issue of cross-sectional dependence, while acknowledging that these points were first noted by Hakkio, that cross-sectional dependence may arise due to the following: (1) by construction, bilateral real exchange rates may contain two parts (which can be induced by the choice of a numeraire country such as the *US*) namely, independent variation in the value of the dollar, and independent variation in *US* price index; and (2) by any economic shocks that influence prices or exchange rates. Cross-sectional dependence can have an impact on the statistical properties of panel unit root tests. O'Connell further showed how size and power could be affected when cross-sectional dependence is not accounted for; the power to reject the unit root was greatly diminished, raising significance levels of tests with nominal size of 5 percent to as much as 50 percent. The implication was that studies not accounting for cross-sectional dependence are likely to falsely reject a unit root.

constant plus trend, and price measure used, the real exchange rates were stationary.

Wu (1996) also used the *LLC* test to test for unit roots for 18 *OECD* countries. Pooled data on real exchange rates between the *US* and the *OECD* countries for the current float was used to test the hypothesis that each series contains a unit root against the alternative that the various series are stationary. When standard *ADF* and Phillips and Perron (*PP*) tests were done on monthly individual real exchange rates, the null was not rejected at conventional significance levels. However, when the panel-based test was performed, the null was rejected at the 1 percent level. The same conclusion was obtained for quarterly and annual data, providing further support for the validity of long-run *PPP* for the post-Bretton Woods period.

Other studies that have employed panel data techniques and are supportive of long-run *PPP* are; Frankel and Rose (1996), Oh (1996), Lothian (1997), Jorion and Sweeney (1996) and Kuo and Mikkola (1998). Another study by Sarno and Taylor (1998) employed two multivariate unit root tests using panel data. The study provided support for *PPP* for the post-Bretton Woods period for which the validity of *PPP* has been most controversial. They employed the tests on monthly data on bilateral real dollar exchange rates among the G5 countries for the period 1973 to 1996. Both tests enabled them to find "unequivocal evidence of mean reversion in all of the real exchange rates examined."

In Africa, two recent studies have showed that *PPP* holds. Nagayasu (1998) examined the validity of long-run *PPP* using data for 16 African countries. The data used was annual, covering the period 1981-94. The study applied a panel cointegration technique that was pioneered by Pedroni (1995), and the panel unit root test developed by Im *et al* (1997) to the parallel market exchange rates

expressed in *US* dollars and *CPIs*. The findings of the study were that the test for unit root and cointegration in individual countries showed that *PPP* is invalid. However, more reliable results were obtained in the panel context, where the null of non-cointegration was rejected, confirming the semi-strong form of long-run *PPP* in the 16 African countries.[4]

The other study on African countries by Krichene (1998) used *PPP* to study exchange rate and price interdependence in five East African countries, namely Burundi, Kenya, Rwanda, Tanzania, and Uganda. The study employed monthly data of bilateral real exchange rates for the period covering 1979(1)-1996(12). The findings of the study were that bilateral real exchange rates revert to long-run equilibrium. Other findings of the study were that the tests for unit roots in bilateral real exchange rates rejected the null hypothesis of unit root, hence supporting absolute *PPP* in the cases of Burundi and Kenya, Burundi and Rwanda and Kenya and Rwanda. The result suggested that arbitrage and trade worked well due to the importance of bilateral trade, proximity of their markets, and rapid transmission of information on prices and profit opportunities. In the cases of Tanzania and Uganda, the null hypothesis of unit root could not be rejected for the whole sample period, owing to exchange rate misalignments. However, the null hypothesis was rejected when a sub-period covering 1986(1)-1996(12) was used.

Krichene (1998) also used a cointegration model to study the existence of unrestricted stationary relations linking bilateral nominal exchange rates and price levels by relaxing the homogeneity and symmetry assumptions of *PPP*. Overall, the findings were that the validity of the weaker version of *PPP* could not be rejected, implying that the nominal exchange rates and price levels tend to revert to a long-run equilibrium relation.

[4] The semi-strong form of *PPP* only requires a symmetry restriction on prices, unlike the strong form that requires parameter and homogeneity restrictions (Nagayasu, 1998).

Using the results of the study, Krichene (1998) concluded that nominal exchange rates in the five countries have adjusted to inflation differentials, and that intra-regional trade has played a key role in re-establishing competitiveness in the region. Furthermore, large real shocks have not had a lasting impact on competitiveness because of similar growth patterns and absence of persistent productivity differentials.

Our study differs from the two studies above in that besides using bilateral real exchange rates, we also use multilateral real exchange rate indices to test for *PPP*. The use of multilateral real exchange rate indices allows us to include more trading partners than bilateral indices. As such, multilateral indices are more broad and may be more relevant for policy evaluation than bilateral indices (see Edwards, 1989). Our study is, therefore, an improvement over other studies that only use bilateral rates. Furthermore, unlike Nagayasu (1998), our study accounts for cross-sectional dependence by demeaning (see O'Connell, 1998). Not accounting for cross-sectional dependence can lead to biased results that may give false support for *PPP*.

4 Empirical Analysis and Results

In this section, we present the data used in the analysis, the methodology, and the results.

4.1 The Data

The data used in this study is taken from the International Financial Statistics (*IFS*) Yearbook (1997) and the *IFS CD-ROM*. The exchange rate used is the period average. The data is annual, covering the period from 1965 to 1996, involving

twenty African countries. The countries and their exchange rate arrangements are given in Table C in the appendix. Four indices were constructed, namely, an export-based multilateral index, an import-based multilateral index, a bilateral index, using the *USA* as the numeraire country, and a trade-weighted multilateral index.

The construction of the multilateral indices of the real exchange rates was done as follows (see Edwards (1989) for different measures of the real exchange rate);

$$\langle 10 \rangle \quad MRER_{jt} = \frac{\sum_{i=1}^{k} a_i E_{it} P_{it}^{*}}{P_{jt}}$$

where, $MRER_{jt}$ is the multilateral real exchange rate index for country j in period t, E_{it} is the index of the nominal exchange rate between country i and country j in period t; $i = 1,\ldots,k$ denotes the k partner countries that are used in the construction of the index. In our case, the five largest trading partners on the export and import sides were considered for the export-based and import-based indices respectively, while the five largest trading partners for both exports and imports combined were considered for the trade-weighted index. The weight corresponding to partner i in the construction of the index is denoted by a_i, while P_{it}^{*} is the price index of partner i in period t. The price index of the home country in period t is given by P_{jt}. The multilateral indices were constructed using the trade weights for three years of trade data, that is, for 1975, 1985 and 1995. Table A in the appendix gives the trading partners used for the twenty countries in constructing the multilateral indices, and their export, import and trade weights.

The bilateral indices were constructed as follows;

$$\langle 11 \rangle \quad BRER_{it} = \frac{E_{iUSA} WPI_{USA}}{CPI_{it}}$$

where, $BRER_{it}$ is the bilateral rate for country i in period t; E_{iUSA} is the nominal exchange rate between country i and the USA; WPI_{USA} is the wholesale price index for the USA; CPI_{it} is the consumer price index for country i in period t.

Table 1 reports some descriptive statistics of the data set. The Pearson correlation coefficients show that the export-based and import-based indices have a high and positive significant correlation with the trade-weighted indices. Also, the export-based and import-based indices are positively correlated with each other. However, the Pearson correlation coefficients show that the bilateral indices are not linearly related to the export-based, import-based and trade-weighted indices. This confirms Edwards' (1991) view that bilateral rates and multilateral rates may not be related, and that they may even move in opposite directions.

Table 1: Summary Statistics and Correlation Analysis

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
LMTRER	640	4.4151	0.4784	1.9607	6.2780
LMRERX	640	4.4226	0.4729	1.9650	6.5968
LMRERM	640	4.4139	0.4521	2.2192	5.9438
LBRER	640	3.6221	2.0894	-0.1084	7.5119

Pearson Correlation Coefficients

	LMTRER	*LMRERX*	*LMRERM*	*LBRER*
LMTRER	1.00000			
	(0.0)			
LMRERX	0.97462	1.00000		
	(0.0001)	(0.0)		
LMRERM	0.93307	0.86677	1.00000	
	(0.0001)	(0.0001)	(0.0)	
LBRER	-0.01316	-0.00982	0.05432	1.00000
	(0.7397)	(0.8041)	(0.1699)	(0.0)

Notes: RER - real exchange rate; LMTRER - Log of Trade-weighted RER; LMRERX - Log of Multilateral RER (export-based); LMRERM - Log of Multilateral RER (import-based); LBRER - Log of Bilateral RER.

4.2 The Panel Unit Root Test

In this study, we shall employ a panel unit root test to test for long-run *PPP* in our panel of twenty African countries. The test that we will use is the one developed by Im *et al* (1997).[5] It is conducted as follows. For a panel of N countries (i = 1,2,...,N), the real exchange rate can be written as an Augmented Dickey Fuller (*ADF*) regression of order p_i as;

$$\langle 12 \rangle \quad \Delta e_{it} = a_i + b_i e_{i,t-1} + \sum_{j=1}^{p_i} r_{ij} \Delta e_{i,t-j} + e_{it}, \qquad i = 1,...,N; t = 1,...,T.$$

In order to test for unit roots, the null and alternative hypotheses respectively, are given as;

$$\langle 13 \rangle \quad H_0 : b_i = 0 \quad \textit{for all } i$$
$$H_1 : b_i < 0, \quad i = 1,2,...,N_1, b_i = 0, i = N_1 + 1, N_1 + 2,...,N.$$

The way the alternative hypothesis is formulated in the test makes allowance for the fact that b_i can differ across groups. This formulation is more general than the homogeneous one, which is given by $b_i = b < 0$ for all i, and is used in the *LLC* test.

Using the above equation, a standardised *t*-bar statistic is calculated, based on the average of individual unit root *t*-statistics. The standardised *t*-bar statistic is used when the disturbances in the underlying *DF* regressions are not serially correlated.

[5]Other studies that have employed the test are by Coakley *et al* (1996), Coakley and Kulasi (1997), Coakley and Fuertes (1997), and Holmes (2000).

When there is serial correlation in the disturbances,[6] as was the case in our panel, a *modified* version of the *t*-bar statistic is calculated, which is expressed as follows:

$$\langle 14 \rangle \quad y_{\bar{t}} = \frac{\sqrt{N}\left\{\bar{t}\,NT(p,r) - \frac{1}{N}\sum_{i=1}^{N} E\left[t_{iT}(p_i, 0)\middle| b_i = 0\right]\right\}}{\sqrt{\frac{1}{N}\sum_{i=1}^{N} Var\left[t_{iT}(p_i, 0)\middle| b_i = 0\right]}}$$

where,

$$\langle 15 \rangle \quad \bar{t}\,NT(p,r) = \frac{1}{N}\sum_{i=1}^{N} t_{iT}(p_i, r_i).$$

In equation 15, $t_{iT}(p_i, r_i)$ is the individual *t*-statistic for testing $b_i = 0$, and in equation 14, the values $E[t_{iT}(p_i,0) \mid b_i=0]$ and $Var[t_{iT}(p_i,0) \mid b_i=0]$ are tabulated by Im *et al* (1997). The values are evaluated by stochastic simulations for various lags, time periods, and with and without time trends. Under the null hypothesis of a unit root, the modified *t*-bar statistic has a standard normal distribution.

In our estimation, the appropriate lag length was selected by a procedure recommended by Enders (1994). We started by choosing a relatively long lag length and then pared down the model by using the *t*-test statistic. That is to say, if the *t*-statistic on the highest lag was insignificant, we dropped the lag length by one, and then we re-estimated the equation. The process was repeated until the lag was significant.

[6]Im *et al* (1997) have also devised a standardised *LM*-bar statistic and its modified version in case of serially correlated disturbances. In this paper however, we only use the modified *t*-bar statistic since it performs better than the *LM*-bar test (Im *et al*, 1997).

4.3 The Results

Table 2 reports the results of the unit root tests for individual countries. The results show that for the import-based index, three out of the twenty countries' real exchange rates are stationary, while for the export-based and trade-weighted indices, only one out of the twenty is stationary. For the bilateral index, the null hypothesis of a unit root was rejected only for one country.

Table 2: Individual Unit Root Tests

Country	Multilateral Index (Export-based)		Multilateral Index (Import-based)		Multilateral Index (Trade-weighted)		Bilateral Index	
	b_i	*ADF/DF*	b_i	*ADF/DF*	b_i	*ADF/DF*	b_i	*ADF/DF*
Burkina Faso	-0.361(0)	**-2.233**	-0.233(0)	**-1.547**	-0.263(0)	**-1.705**	-0.631(2)	**-2.950**
Burundi	-0.161(2)	**-2.048**	-0.052(0)	**-0.716**	-0.154(2)	**-2.131**	-0.107(0)	**-1.208**
Congo Rep.	-0.331(0)	**-2.442**	-0.744(0)	**-4.033**	-0.584(0)	**-3.400**	-0.389(0)	**-2.648**
Côte d'Ivoire	-0.240(0)	**-1.756**	-0.393(1)	**-2.867**	-0.424(1)	**-2.558**	-0.259(0)	**-2.086**
Egypt	-0.288(1)	**-2.725**	-0.293(1)	**-2.774**	-0.294(1)	**-2.780**	-0.330(1)	**-2.903**
Ethiopia	-0.085(0)	**-0.727**	-0.061(0)	**-0.522**	-0.082(0)	**-0.673**	-0.083(0)	**-0.706**
Gabon	-0.147(0)	**-1.197**	-0.087(0)	**-0.762**	-0.122(0)	**-1.035**	-0.225(0)	**-1.812**
The Gambia	-0.122(2)	**-1.580**	-0.649(0)	**-3.626**	-0.128(2)	**-1.601**	-0.273(2)	**-2.141**
Ghana	-0.125(1)	**-1.808**	-0.132(1)	**-1.663**	-0.123(1)	**-1.781**	-0.123(1)	**-1.794**
Kenya	-0.200(0)	**-1.985**	-0.398(0)	**-2.242**	-0.554(0)	**-2.908**	-0.188(0)	**-1.727**
Madagascar	-0.048(0)	**-0.774**	-0.046(0)	**-0.770**	-0.265(3)	**-2.413**	-0.056(0)	**-0.845**
Mauritius	-0.052(0)	**-1.182**	-0.074(0)	**-1.614**	-0.054(0)	**-1.353**	-0.178(1)	**-2.040**
Morocco	-0.030(0)	**-1.078**	-0.090(0)	**-1.669**	-0.066(0)	**-1.573**	-0.127(1)	**-1.772**
Niger	-0.200(0)	**-1.554**	-0.497(1)	**-3.136**	-0.440(1)	**-2.854**	-0.145(0)	**-1.430**
Nigeria	-0.204(1)	**-2.392**	-0.213(1)	**-2.493**	-0.207(1)	**-2.432**	-0.186(1)	**-2.226**
Sierra Leone	-0.266(0)	**-2.262**	-0.221(0)	**-2.303**	-0.262(0)	**-2.487**	-0.424(0)	**-2.995**
South Africa	-0.693(3)	**-3.637**	-0.811(3)	**-3.601**	-0.834(3)	**-3.806**	-0.539(3)	**-2.834**
Tanzania	-0.146(1)	**-2.128**	-0.130(1)	**-1.981**	-0.131(1)	**-2.023**	-0.092(1)	**-1.596**
Zambia	-0.389(0)	**-2.642**	-0.226(0)	**-1.939**	-0.404(0)	**-2.659**	-0.247(0)	**-2.023**
Zimbabwe	-0.113(0)	**-1.574**	-0.126(0)	**-1.569**	-0.126(0)	**-1.570**	-0.174(0)	**-1.807**

Note: The figures in parentheses are lag lengths

However, a more reliable panel unit root test was performed, and the results are reported in Table 3. The results show that the null hypothesis of a unit root is rejected for three indices, namely the multilateral import-based index, the bilateral index, and the trade-weighted multilateral index at the 95 percent significance

level.[7] This means that these three real exchange rate indices are stationary, implying that *PPP* holds. However, the null hypothesis is not rejected for the export-based multilateral index.

Table 3: Panel Unit Root Tests (The Im et al Test)

	Modified t-bar Statistic ($j_{t\text{-}bar}$)	
	Original Data	*Demeaned Data*
Export-based *RER*	-1.513	-
Import-based *RER*	-1.913**	-2.338**
Trade-weighted *RER*	-2.163**	-0.476
Bilateral *RER*	-1.682**	-2.414**

Notes: ** *Significant at 95 percent. The 95 percent critical value is –1.65.*

The fact that the panel unit root test produced different outcomes for the import- and export-based multilateral indices can probably be explained as follows. Most African countries rely on primary products (that is, agricultural products, mineral resources, and other raw materials) for exports. The world market mostly determines the prices of export products. The volume of exports of these products is therefore unlikely to be influenced by the domestic price levels of these African countries. In short, export proceedings are not directly influenced by the relative price levels of exporting and importing countries, at least in the short to medium term. On the other hand, imports to most of these African countries are to some extent, dependent on the purchasing power of the people. That is to say that both the domestic price level and the price level of the trading partner are likely to influence the demand for foreign exchange through import demand. In this situation therefore, it is more likely that *PPP* would hold.

[7] For the bilateral index however, the null hypothesis was barely rejected at the 95 percent level.

We next performed the demeaning adjustment on the indices for which the null hypothesis of a unit root was rejected. We did this in order to remove the effect of cross-sectional dependence, which, according to O'Connell (1998), may cause the test to falsely support *PPP*. But before performing the demeaning adjustment, we tested for the significance of the time effects (λ_t), given that the individual effects (μ_i)[8] are not absent ($\lambda_t=0 \mid \mu_i \neq 0$). We found that the null hypothesis that time effects are absent given that individual effects are not, was rejected at 5 percent – the observed values for the bilateral index, import-based and trade-weighted multilateral indices are 4.112, 2.011, and 1.701 respectively, while the critical value is 1.46.[9] This means that the time effects are significant, and if they are not incorporated in the model to be estimated, as is the case in the panel unit root test, their effect is captured or retained in the error term. The presence of time effects in the error terms causes the variance-covariance matrix of the disturbance term to be non-diagonal. In order to remove their effect, a demeaning adjustment is recommended. The demeaning procedure involves subtracting cross-section averages from the observed data.

The results of the unit root test for individual countries for the demeaned indices are in Table D in the appendix.[10] These results are used for the panel unit root test, and are reported in Table 3. The null hypothesis of a unit root is rejected at 5 percent for the import-based index and the bilateral index. As for the trade-weighted index, the null hypothesis is not rejected. This implies that after

[8]Time effects (λ_t) are unobservable variables introduced through a dummy to capture the effects that are specific to each time period but are the same for all cross-sectional units, while individual effects (μ_i) are the time-invariant individual specific variables, that are also captured by a dummy (see Baltagi, 1995; or Hsaio, 1986).

[9]The *F-test* statistics for testing whether time effects are absent for the import-based and trade-weighted multilateral indices are smaller in absolute terms. This could indicate that the construction of a multilateral index reduced cross-sectional dependence to some extent, although not completely.

[10]The *F-test* statistics for testing whether the time effects are absent after demeaning showed that cross-sectional dependence was accounted for, as the time effects were insignificant.

demeaning, that is, accounting for cross-sectional dependence, *PPP* does not hold for the trade-weighted index, but it holds for the import-based and bilateral indices. The failure to reject the null hypothesis of a unit root in the trade-weighted multilateral index is due to the influence of exports. As we have seen above, for the export-based index, *PPP* did not hold. It is worth noting that before removing cross-sectional dependence, the null hypothesis of a unit root was rejected at the 5 percent level for the trade-weighted index. The fact that the removal of cross-sectional dependence made it impossible to reject the null hypothesis of a unit root is consistent with the observation that the presence of cross-sectional dependence makes it easier for panel unit root tests to accept *PPP* (O'Connell, 1998).

In connection to the above empirical results, a few conclusions can be drawn. Firstly, given that *PPP* holds in the import-based and bilateral indices shows that at least *PPP* cannot be completely written off.

Secondly, the fact that *PPP* seems to hold in the bilateral index and import-based multilateral index suggests that devaluations were probably influenced by the price differentials between African countries and their trading partners. As noted earlier, most of the countries in our study had devalued their currencies during the time their exchange rates were fixed. This could have been necessitated by the widening price differentials with their trading partners, the industrialised countries.

Lastly, we have seen that *PPP* holds between African countries and industrialised countries that trade with them. It is plausible, as pointed out above, that in the import-based index, *PPP* is more likely to hold than in the export-based index because individually, each of the countries is a price-taker for the primary good it exports. As such, individually, they are not able to influence export prices, and also, given that the export prices are fixed, the price differentials do not directly influence the exchange rates of African countries.

5 Summary and Conclusions

The *PPP* hypothesis is an important assumption in most models in international economics. Although its validity has at times failed to pass empirical tests, *PPP* does however, highlight the plausible factors that are behind exchange rate movements (Krugman and Obstfeld, 1997). It has also been used as a basis for assessing levels of exchange rates, and in comparing income levels between countries. This continuing importance of *PPP* in economics merits further tests to establish its validity. As econometric methods undergo more development and refinement, better techniques for undertaking empirical tests of *PPP* become available. This study employs one of the latest techniques, the panel unit root test, for testing *PPP* in African countries.

A number of methods for testing for long-run *PPP* have evolved over time. However, of late, panel-based tests seem to have dominated the literature. Panel-based tests that have been done by most researchers have tended to offer support for long-run *PPP*, unlike cointegration tests, which are criticised for having low power. Panel-based tests are the best choice for African countries because it is hardly 40 years since most of these countries gained their political independence. Therefore, the relevant data are available for, at best, 40 years. Panel data, however, boosts the number of observations by including a cross-section dimension. Moreover, as pointed out by O'Connell (1998), panel data provides a more powerful test for long-run *PPP*.

In testing for long-run *PPP*, we formulated three multilateral real exchange rate indices, namely, import-based, export-based, and trade-weighted. We also constructed a bilateral index. We decided to construct multilateral indices because of the argument in the literature that bilateral indices, by construction, can introduce cross-sectional dependence in the error term. Cross-sectional

dependence, if not controlled, can lead to biased results, mostly leading to tests rejecting the null too frequently, hence giving false support for *PPP* (Kuo and Mikkola, 1998). Thus, in a bid to eliminate the problem of cross-sectional dependence, we formulated the three multilateral indices. However, the *F-test* indicated that cross-sectional dependence was present in the multilateral indices. This is due to the fact that the trading partners are similar across the countries (see Table A in the appendix).

In this paper, we sought to test the *PPP* hypothesis in twenty African countries using a fairly new technique – the Im *et al* (1997) panel unit root test. While the most widely used panel unit root test is the *LLC* test, we chose to use the Im *et al* (1997) test due to a number of advantages it has over the *LLC* test. These are; firstly it is more powerful than the *LLC* test, (Coakley and Fuertes, 1997), and as such, it performs better (Im *et al*, 1997). Secondly, the Im *et al* (1997) test allows for some of the individuals in the panel to have unit roots under the alternative hypothesis (*cf.* equation 13). The *LLC* test, on the other hand, assumes that all individuals are identical with respect to the presence and absence of a unit root, thus rendering it more restrictive (Levin *et al*, 1997). The third advantage is that while both tests acknowledge cases where disturbances may be correlated, the Im *et al* (1997) test explicitly sets out a way of dealing with correlated errors across groups – the demeaning procedure, while the *LLC* test does not.

In our study, the Im *et al* (1997) test was able to reject the null of a unit root for three indices, namely the multilateral import-based and trade-weighted indices, and the bilateral index, while it was unable to reject the null for one index, the multilateral export-based index. It appears therefore that *PPP* based on the import-based and trade-weighted multilateral indices, and the bilateral index holds in the selected African countries. However, after demeaning, we found that the null hypothesis was not rejected for the trade-weighted multilateral index. Probably the

reason why *PPP* did not hold in the export-based multilateral index is that most African countries rely on primary products for exports, whose prices are determined in the world market. As such, domestic price levels in Africa have little, if any, influence on the volume of exports in the short-run. The fact that *PPP* was found to hold in the import-based index is an indication of some extent of price elasticity of imports.

Although the *PPP* framework has certain limitations, there is no doubt that it is still appealing as a starting point for quantitative exercises regarding assessing the appropriate level for new parities of exchange rates (Isard, 1995). Thus, *PPP* can help policymakers to assess the appropriateness of exchange rate levels in Africa, or as Isard (1995) puts it,

> if used intelligently, along with other approaches to assessment, *PPP* calculations can have significant diagnostic value.

Besides using a fairly new panel unit root test, this study has also used multilateral indices to test for *PPP*. Most studies on *PPP* use bilateral indices, with the *US* chosen as a base country. The use of multilateral indices is more desirable in terms of policy evaluation. As Edwards (1989) remarked, a failure to use a broad multilateral real exchange rate index can result in misleading and incorrect inferences.

Appendix

TABLE A: COUNTRIES INCLUDED IN CONSTRUCTION OF INDICES AND THEIR IMPORT, EXPORT, AND TRADE SHARES

	Export-based	**Import-based**	**Trade-based**
BURKINA FASO	1975: Côte d'Ivoire (.58), France (.23), Italy (.08), UK (.07), Germany (.04); 1985: France (.60), Italy (.15), Spain (.07), Germany (.10), Japan .(07); 1995: France (.38), Italy (.25), Thailand (.17), Portugal (.11), Indonesia (.09).	1975: France (.56), Côte d'Ivoire (.26), USA (.09), Germany (.05), Netherlands (.03); 1985: Côte d'Ivoire (.39), France (.38), USA (.13), Netherlands (.06), Germany (.04); 1995: France (.48), Côte d'Ivoire (.34), Nigeria (.07), Japan (.06), USA (.05).	1975: France (.49), Côte d'Ivoire (.34), USA (.07), Germany (.05), UK (.04); 1985: France (.42), Côte d'Ivoire (.36), USA (.12), Netherlands (.05), Germany (.05); 1995: France (.52), Côte d'Ivoire (.31), Nigeria (.06), Japan (.06), USA (.05).
BURUNDI	1975: USA (.56), Germany (.27), France (.08), Belgium (.05), Netherlands (.04); 1985: Germany (.41), Finland (.39), USA (.08), Belgium (.07), UK (.05); 1995: UK (.54), Switzerland (.21), Kenya (.09), Tanzania (.09), Germany (.07).	1975: Belgium (.44), Germany (.18), France (.16), UK (.13), USA (.09); 1985: Iran (.25), Belgium (.25), France (.20), Germany (.19), Japan (.11); 1995: Belgium (.35), France (.22), Germany (.18), Japan (.13), Netherlands (.12).	1975: USA (.29), Belgium (.27), Germany (.22), France (.13), UK (.09); 1985: Germany (.32), Belgium (.20), Finland (.18), Iran (.17), France (.13); 1995: Belgium (.28), UK (.27), France (.18), Germany (.16), Kenya (.11).
CONGO REPUBLIC	1975: France (.36), Italy (.34), USA (.17), UK (.09), Germany (.04); 1985: USA (.62), Spain (.19), France (.11), Italy (.04), Belgium (.04); 1995: USA (.35), Italy (.24), Netherlands (.19), France (.14), Spain (.07).	1975: France (.68), Germany (.11), Gabon (.10), USA (.07), Netherlands (.04); 1985: France (.69), Italy (.11), USA (.07), Germany (.07), Spain (.06); 1995: France (.57), USA (.17), Netherlands (.12), Italy (.07), Belgium (.07).	1975: France (.53), Italy (.21), USA (.13), Germany (.07), UK (.06); 1985: USA (.46), France (.29), Spain (.15), Italy (.06), Germany (.04); 1995: USA (.30), France (.28), Italy (.19), Netherlands (.17), Spain (.06).
CÔTE D'IVOIRE	1975: France (.43), Netherlands (.17), USA (.16), Germany (.14), Italy (.10); 1985: Netherlands (.29), France (.28), USA (.20), Italy (.16), UK (.07); 1995: France (.32), Denmark (.23), Netherlands (.23), Italy (.13), Germany (.09).	1975: France (.63), USA (.12), Germany (.09), Italy (08), Nigeria (.08); 1985: France (.51), Nigeria (.20), USA (.12), Japan (.09), Germany (.08); 1995: France (.54), Nigeria (.21), USA (.10), Germany (.08), Japan (.07).	1975: France (.54), USA (.14), Germany (.12), Netherlands (.11), Italy (.09); 1985: France (.38), Netherlands (.23), USA (.18), Italy (.13), Nigeria (.08); 1995: France (.44), Denmark (.17), Netherlands (.16), Nigeria (.12), Italy (.11).
EGYPT	1975: Italy (.40), Netherlands (.20), France (.14), UK (.13), Saudi Arabia (.13); 1985: Italy (.45), France (.29), Netherlands (.10), Greece (.08), Japan (.08); 1995: USA (.35), Italy (.30), Germany (.14), Netherlands (.11), Spain (.10).	1975: USA (.39), France (.22), Germany (.17), Italy (.12), UK (.09); 1985: USA (.31), Germany (.23), Italy (.18), France (.16), Japan (.12); 1995: USA (.44), Germany (.21), Italy (.14), France (.14), Netherlands (.07).	1975: USA (.37), France (.22), Germany (.17), Italy (.14), UK (.10); 1985: Italy (.26), USA (.24), France (.20), Germany (.19), Japan (.11); 1995: USA (.42), Germany (.19), Italy (.18), France (.13), Netherlands (.08).

Table A continued…			
ETHIOPIA	1975: USA (.32), Saudi Arabia (.21), Germany (.19), Egypt (14), Japan (.14); 1985: Germany (.31), USA (.22), Japan (.20), Italy (.16), France (.11); 1995: Germany (.50), Japan (.18), Italy (.15), USA (.10), UK (.07).	1975: Saudi Arabia (.23), Japan (.22), Italy (.20), Germany (.19), Iran (.16); 1985: Italy (.32), Germany (.22), UK (.19), Japan (.13), France (.13); 1995: Italy (.31), USA (.23), Germany (.17), Japan (.16), UK (.13).	1975: USA (.23), Saudi Arabia (.23), Germany (.20), Japan (.19), Italy (.15); 1985: USA (.32), Italy (.22), Germany (.20), UK (.13), Japan (.12); 1995: Germany (.27), Italy (.26), USA (.19), Japan (.17), UK (.11).
GABON	1975: France (.44), USA (.33), UK (.10), Germany (.07), Italy (.06); 1985: France (.42), USA (.34), Spain (.17), UK (.04), Morocco (.03); 1995: USA (.75), France (.15), Japan (.05), Portugal (.03), Morocco (.02).	1975: France (.81), Belgium (.05), USA (.05), Germany (.04), Netherlands (.04); 1985: France (.65), USA (.14), Germany (.08), Japan (.07), UK (.06); 1995: France (.67), USA (.10), Netherlands (.09), Japan (.07), UK (.07).	1975: France (.57), USA (.25), UK (.07), Germany (.06), Italy (.05); 1985: France (.50), USA (.28), Spain (.13), UK (.05), Germany (.04); 1995: USA (.60), France (.28), Japan (.06), Netherlands (.04), Portugal (.02).
GAMBIA, THE	1975: UK (.55), Netherlands (.23), France (.09), Italy (.07), Portugal (.06); 1985: Ghana (.66), Switzerland (.15), France (.07), UK (.06), Belgium (.06); 1995: UK (.44), France (.38), USA (.06), Netherlands (.06), Spain (.06).	1975: UK (.57), Japan (.13), Germany (.12), Italy (.09), Netherlands (.09); 1985: UK (.30), France (.23), USA (.22), Germany (.13), Netherlands (.12); 1995: UK (.29), Côte d'Ivoire (.28), France (.16), Belgium (.14), Germany (.13).	1975: UK (.59), Netherlands (.18), France (.09), Italy (.08), Germany (.06); 1985: Ghana (.46), UK (.18), France (.16), USA (.12), Italy (.08); 1995: UK (.33), Côte d'Ivoire (.23), France (.20), Belgium (.13), Germany (.11).
GHANA	1975: UK (.27), USA (.21), Netherlands (.20), Switzerland (.16), Germany (.16); 1985: UK (.33), USA (.25), Japan (.18), Germany (.14), Netherlands (.09); 1995: UK (.29), Germany (.24), USA (.23), France (.16), Japan (.08).	1975: USA (.29), UK (.27), Germany (.20), Nigeria (.12), Japan (.12); 1985: UK (.43), Germany (.18), USA (.15), Japan (.12), Nigeria (.12); 1995: UK (.33), Nigeria (.31), Germany (.15), USA (.11), Netherlands (.10).	1975: UK (.30), USA (.27), Germany (.20), Japan (.14), Switzerland (.09); 1985: UK (.40), USA (.20), Germany (.17), Japan (.15), Netherlands (.08); 1995: UK (.37), Germany (.22), USA (.18), France (.12), Netherlands (.10).
KENYA	1975: Italy (.28), UK (.23), Tanzania (.21), Germany (.19), USA (.09); 1985: UK (.38), Germany (.25), USA (.16), Pakistan (.13), Netherlands (.08); 1995: UK (.30), Germany (.24), Tanzania (.18), Pakistan (.15), Netherlands (.13).	1975: UK (.34), Iran (.25), Japan (.15), Germany (.13), Saudi Arabia (.13); 1985: UK (.32), Japan (.22), Germany (.18), USA (.15), Saudi Arabia (.13); 1995: UK (.29), Japan (.20), RSA (.19), India (.18), Germany (.14).	1975: UK (.35), Germany (.17), Iran (.20), Italy (.15), Japan (.13); 1985: UK (.38), Germany (.23), USA (.17), Japan (.14), Saudi Arabia (.08); 1995: UK (.34), Germany (.19), Japan (.17), RSA (.16), India (.14).
MADAGASCAR	1975: France (.44), USA (.25), Germany (.15), Malaysia (.08), Japan (.08); 1985: France (.48), USA (.18), Japan (.14), Indonesia (.10), Germany (.09); 1995: France (.58), USA (.13), Germany (.13), Japan (.08), Italy (.08).	1975: France (.68), Germany (.14), USA (.07), Japan (.06), Italy (.05); 1985: France (.62), Germany (.12), USA (.11), UK (.08), Saudi Arabia (.07); 1995: France (.68), Japan (.09), Singapore (.09), Germany (.07), Iran (.07).	1975: France (.60), Germany (.14), USA (.14), Japan (.07), Italy (.05); 1985: France (.58), USA (.15), Germany (.11), Japan (.10), Netherlands (.06); 1995: France (.64), Germany (.11), USA (.10), Japan (.09), Italy (.06).

Table A continued…			
MAURITIUS	1975: UK (.82), USA (.06), France (.06), Canada (.04), Germany (.02); 1985: UK (.49), France (.23), USA (.17), Germany (.07), Italy (.04); 1995: UK (.43), France (.26), USA (.19), Germany (.07), Italy (.05).	1975: UK (.33), RSA (.18), Iran (.17), France (.17), Japan (.15); 1985: France (.32), RSA (.22), UK (.20), Japan (.15), Germany (.12); 1995: France (.29), RSA (.25), India (.19), UK (.15), Japan (.11).	1975: UK (.67), France (.11), RSA (.08), Iran (.07), Germany (.06); 1985: UK (.41), France (.28), USA (.14), Germany (.09), RSA (.08); 1995: UK (.34), France (.30), USA (.15), RSA (.12), Germany (.09).
MOROCCO	1975: France (.44), Italy (.15), Belgium (.14), UK (.14), Germany (.13); 1985: France (.51), Spain (.16), India (.12), Italy (.12), Belgium (.09); 1995: France (.51), Spain (.16), India (.14), Italy (.10), Japan (.09).	1975: France (.56), Germany (.15), USA (.14), Spain (.08), Italy (.07); 1985: France (.40), Saudi Arabia (.25), Spain (.12), Netherlands (.12), USA (.11); 1995: France (.45), Spain (.17), USA (.13), Germany (.13), Italy (.12).	1975: France (.55), Germany (.15), Italy (.11), USA (.10), Spain (.09); 1985: France (.46), Saudi Arabia (.19), Spain (.14), Netherlands (.12), Italy (.09); 1995: France (.49), Spain (.18), Italy (.11), USA (.11), Germany (.11).
NIGER	1975: France (.71), Nigeria (.24), USA (.03), UK (.01), Germany (.01); 1985: France (.80), Nigeria (.13), USA (.04), Italy (.02), Japan (.01); 1995: France (.80), Greece (.10), Canada (.04), Nigeria (.03), Turkey (.02).	1975: France (.57), USA (.23), Germany (.09), Netherlands (.06), UK (.05); 1985: France (.47), Nigeria (.20), Italy (.14), Côte d'Ivoire (.11), UK (.08); 1995: France (.50), USA (.21), Côte d'Ivoire (.16), Germany (.06), Netherlands (.06).	1975: France (.65), Nigeria (.17), USA (.11), Germany (.04), UK (.03); 1985: France (.63), Nigeria (.17), Italy (.08), Côte d'Ivoire (.06), USA (.05); 1995: France (.67), USA (.14), Côte d'Ivoire (.10), Greece (.05), Germany (.04).
NIGERIA	1975: USA (.40), UK (.19), Netherlands (.15), France (.15), Netherlands Antilles (.11); 1985: USA (.33), Germany (.23), France (.18), Italy (.17), Spain (.09); 1995: USA (.61), Spain (.14), France (.09), India (.08), Germany (.08).	1975: UK (.35), Germany (.22), USA (.16), Japan (.15), France (.12); 1985: UK (.35), USA (.20), Germany (.19), France (.16), Japan (.10); 1995: UK (.27), USA (.24), Germany (.21), France (.17), Netherlands (.11).	1975: USA (.32), UK (.27), Germany (.15), France (.14), Netherlands (.12); 1985: USA (.29), Germany (.22), France (.17), UK (.17), Italy (.15); 1995: USA (.54), France (.12), Germany (.12), Spain (.12), UK (.10).
SIERRA LEONE	1975: UK (.59), Netherlands (.14), USA (.13), Japan (.08), Germany (.06); 1985: Belgium (.36), Germany (.21), UK (.17), USA (.15), Netherlands (.11); 1995: Belgium (.59), USA (.19), Spain (.12), UK (.06), Germany (.04).	1975: UK (.48), Nigeria (.16), Germany (.13), Japan (.12), USA (.11); 1985: Nigeria (.32), UK (.28), Germany (.21), Japan (.10), Netherlands (.09); 1995: UK (.36), India (.19), Côte d'Ivoire (.18), USA (.16), Netherlands (.11).	1975: UK (.55), USA (.12), Netherlands (.12), Japan (.11), Germany (.10); 1985: Belgium (.26), UK (.24), Germany (.22, Nigeria (.15), USA (.13). 1995: Belgium (.38), UK (.23), USA (.19), India (.10), Côte d'Ivoire (.10).
SOUTH AFRICA	1975: UK (.37), Japan (.20), Germany (.18), USA (.18), Switzerland (.07); 1985: USA (.29), Japan (.26), UK (.20), Netherlands (.13), Switzerland (.12); 1995: UK (.30), Japan (.19), USA (.18), Germany (.16), Zimbabwe (.16).	1975: UK (.27), Germany (.26), USA (.25), Japan (.16), France (.06); 1985: Germany (.29), USA (.24), UK (.21), Japan (.17), France (.08); 1995: Germany (.31), USA (.22), UK (.20), Japan (.19), Iran (.08).	1975: UK (.32), Germany (.23), USA (.22), Japan (.17), France (.06); 1985: USA (.27), Japan (.22), Germany (.22), UK (.21), Netherlands (.08); 1995: Germany (.27), UK (.25), USA (.21), Japan (.19), Italy (.08).

Table A continued…			
TANZANIA	1975: UK (.31), Germany (.21), Singapore (.20), Kenya (.14), USA (.14); 1985: Germany (.39), UK (.28), Indonesia (.12), Singapore (.11), Netherlands (.10); 1995: Germany (.25), Japan (.22), India (.22), Belgium (.17), UK (.14).	1975: UK (.26), USA (.25), Saudi Arabia (.21), Germany (.14), Kenya (.13); 1985: UK (.27), Japan (.19), Italy (.19), Germany (.19), Iran (.15); 1995: UK (.26), Kenya (.25), Japan (.19), Saudi Arabia (.17), India (.13).	1975: UK (.29), USA (.23), Germany (.17), Saudi Arabia (.16), Kenya (.15); 1985: UK (.29), Germany (.25), Italy (.17), Japan (.17), Iran (.12); 1995: UK (.25), Japan (.22), Kenya (.20), India (.17), Germany (.16).
ZAMBIA	1975: UK (.30), Japan (.23), Germany (.19), Italy (.17), France (.11); 1985: Japan (.47), Italy (.18), France (.14), USA (.12), India (.09); 1995: Japan (.33), Saudi Arabia (.24), Thailand (.24), India (.09), Singapore (.09).	1975: UK (.33), USA (.21), Saudi Arabia (.19), Japan (.15), Germany (.12); 1985: UK (.30), Saudi Arabia (.28), Japan (.16), USA (.16), Zimbabwe (.10); 1995: RSA (.43), UK (.18), Zimbabwe (.14), Japan (.14), USA (.11),	1975: UK (.36), Japan (.22), Germany (.17), Italy (.14), USA (.11); 1985: Japan (.37), UK (.20) USA (.16), Saudi Arabia (.15), Italy (.12); 1995: Japan (.30), RSA (.24), Thailand (.17), Saudi Arabia (.17), UK (.12).
ZIMBABWE	1975: RSA (1); 1985: UK (.27), RSA (.23), Germany (.21), USA (.17), Italy (.12); 1995:RSA (.29), UK (.23), Germany (.19), Japan (.18), Italy (.11).	1975: RSA (1); 1985: RSA (.37), UK (.21), USA (.20), Germany (.14), Japan (.08); 1995: RSA (.73), UK (.08), USA (.07), Japan (.07), Germany (.05).	1975: RSA (1); 1985: RSA (.30), UK (.24), USA (.19), Germany (.17), Italy (.09); 1985: RSA (.58), UK (.13), Japan (.11), Germany (.10), USA (.08).

Source: Compiled from Direction of Trade Statistics Yearbook, IMF, various issues.

TABLE B: CLASSIFACATION OF EXCHANGE RATE REGIMES*

	BF	BR	CG	CD	EG	ET	GB	GM	GH	KE	MD	MT	MR	NR	NG	SL	SA	TZ	ZM	ZB
1965	na	US$	na	na		US$	na	UK£	UK£	UK£	FF	UK£	FF	na	UK£	UK£	UK£	UK£	UK£	Other
1966																				
1967											MF									
1968																				
1969											FF									
1970																				
1971					US$															
1972									US$	US$					US$		US$	US$	US$	
1973													MF				UKS			
1974															Other					
1975										SDR							MF			
1976												SDR						SDR	SDR	
1977					MF															
1978																SDR				
1979																				
1980																		Other		
1981									MF											
1982											Other									
1983												Other				MF				
1984		SDR														US$			Other	
1985															MF	SDR				
1986								MF	US$										MF	
1987																MF				
1988									MF	Other						US$			US$	
1989																			SDR	
1990																				
1991																MF		MF	MF	
1992																				
1993																				
1994		Other								MF		MF			US$					
1995																				
1996																				

*Notes: Format adapted from Nagayasu (1998). See Table C in the appendix for an abridged account of the exchange rate regimes; FF – French Franc, SDR – Special Drawing Rights; UK£ - Pound Sterling, US$ - US Dollar, MF – More Flexible exchange rate regime, Other – Other currency composites to which the exchange rates are pegged; *Refer to Table C in the appendix for the full names of countries.*

TABLE C: LIST OF COUNTRIES IN THE SAMPLE AND THEIR EXCHANGE RATE ARRANGEMENTS*

COUNTRY	**EXCHANGE RATE ARRANGEMENTS**
BURKINA FASO (BF)	NA
BURUNDI (BR)	1964: The Burundi Franc (FBu) linked to Belgian Franc; Multiple rate existed; 1965: Link to Belgian Franc broken, set to USD; devaluation in gold terms; multiple rate terminated; 1970: FBu pegged to USD; 1971: Floating of USD – de facto devaluation; 1973: Devaluation of USD, FBu realigned; 1976: Gold content fell; 1983: FBu peg to USD broken, now linked to SDR – controlled floating effective rate; 1986-91: FBu devalued and several other devaluations occurred in stages; 1992: link to SDR broken, now linked to basket of currencies, but it continued to depreciate.
CONGO REPUBLIC (CG)	NA
CÔTE D'IVOIRE (CD)	NA
EGYPT (EG)	1962 and 1971: The Egyptian Pound (LE) devalued; semi-official rate for tourists; 1973: USD devalued, LE realigned; Parallel market rate (PM) absorbed tourist rate; 1974: PM placed on controlled floating basis; 1975-76: PM devalued and depreciated; 1979: exchange structure revised, PM became official rate; 1981; three rates existed; 1984: LE devalued; 1986-88; several revisions and devaluation; 1990: devaluation; 1991: exchange rate system simplified to eliminate black market rate.
ETHIOPIA (ET)	1976: Name changed from Ethiopian Dollar to Birr (Br); official rate pegged to USD; adjustments made in buying and selling rate; 1992: devaluation of 58.6%.
GABON (GB)	NA
GAMBIA, THE (GM)	1971: de facto devaluation of USD appreciated the Gambian Dalasi (D); 1972: Dismantling of Sterling Area – depreciated the D, effective put on controlled floating basis; 1984: Link to £ changed; 1986: Link to £ broken; unit floated according to demand and supply; inter-bank market rate established, all foreign exchange controls ended; 1990: Foreign exchange bureaus permitted to operate.

Table C continued …	
GHANA (GH)	1972: The New Cedi (NC) replaced the Ghana Cedi (C), up-valued to new rate per USD; break up of Sterling Area; 1973: Devaluation of USD, NC realigned; 1977: Resident Travel Rate split into two; 1978: NC's link to USD severed, placed on controlled floating rate basis; de facto devaluation; 1979: Currency reform – travel rates merged, and devalued; 1981-86: Several devaluations; 1986 – exchange rate system revised – dual rate system; 1987: all business on auction rate; 1988: bureaus allowed to operate – eliminated black market rate; 1990: auction and bureau rate unified.
KENYA (KE)	1966: THE Kenya Shilling (KSh) replaced East African Shilling; 1971: de facto devaluation of USD, KSh appreciated; broke with £ and attached to USD; 1972: Break up of Sterling Area; 1973: USD devalued, KSh devalued in terms of gold; 1974; KSh devalued; 1975: KSh ties to USD severed, unit linked to SDR, placed unit on controlled floating basis, de facto devaluation; 1977: Break up of East African Currency Area. 1981-84: KSh cut seven times; 1985 – cumulative depreciation; 1986: KSh cut twice; 1987-88: Link to SDR severed, unit linked to basket of currencies; small devaluations effected. 1992: Free Market Export Rate established.
MADAGASCAR (MD)	1963: The Malagasy Franc (FMG) replaced CFA Franc at par; 1967: all foreign exchange controls abolished; 1968: controls re-instituted gradually; 1969: FMG cut; 1971: Dual system introduced, and realigned following de jure devaluation of USD; 1973: USD devaluation, official rate adjusted; withdrawal from French Franc Area, but still linked to Paris unit; Dual rate abolished; 1982: Unit's peg to French Franc broken, and attached to basket of currencies, effective rate managed flexibly – periodic devaluations and depreciations effected.

Table C continued …	
MAURITIUS (MT)	1934: The Mauritian Rupee (MauRe) became independent unit linked to £; 1949: devalued along with £; 1967: devaluation paralleling £; 1971-72; USD floated, Rupee appreciated; Sterling Area dissolved, Rupee allowed to float with £ - controlled floating rate; 1973: USD devaluation, unit realigned; 1976: unit's link to £ broken, linked instead to SDR; 1979: unit depreciated; dual system introduced, unit depreciated further, dual system dissolved; 1983: Unit's peg changed to trade weighted basket of currencies.
MOROCCO (MR)	1959: The Moroccan Dirham (DH) created when MF was devalued; 1961: DH became effective monetary unit; exchange fixed per French unit despite French devaluation; 1971: USD float – unit realigned to USD with 4.5% fluctuation range; 1973: USD devaluation – official rate realigned; effective rate floated in tandem with French unit; link to French Franc broken and placed on controlled floating basis; 1978: Supplementary Premium rate created – devalued unit;; 1980: Premium rate terminated; 1982-1984: changed to 5% premium; fixed percentage changed to one which changed from bank to bank, and then abolished in 1986; 1990: effective rate for unit devalued.
NIGER (NR)	NA
NIGERIA (NG)	1973: The Nigerian Naira (N) replaced £N, gold content fell paralleling USD devaluation; 1974; Unit put on controlled floating basis – rate adjusted in relation to basket of currencies; currency reforms decreed, borders closed; foreign exchange controls; 1986: Two-tier official rate established – auction rate and one set by central bank; 1987: the two rates merged, but dual system still existed – auction rate and inter-bank rate; 1988: Biweekly auctions ended; 1989: dual system officially ended; unified system – devaluation of 32%; official foreign exchange bureau rate existed; 1990: Dutch auction system used for allocations of foreign exchange; 1991; exchange rate system revised – central rate determined by central bank; 1992: exchange rate system revised – Naira free to float, effective rate devalued.

Table C continued …	
SIERRA LEONE (SL)	1964-1967: The Sierra Leonean Leone (Le) replaced West African £; unit devalued following £ devaluation; 1971: USD devaluation – unit appreciated due to link with £; 1972: End of Sterling Area – unit depreciated against USD, and rate put on controlled floating basis; 1973: USD devaluation – unit realigned; 1978: Unit's peg to £ broken, and linked to SDR; 1982: Dual exchange rate announced; 1983: Dual rate abolished, peg to SDR broken, and linked to USD; 1985: Unit linked to SDR – devalued; 1986: Rate structure scrapped in favour of flexible exchange rate system, but later abandoned and pegged to USD and re-valued later; 1988-89: Unit adjusted on several occasions; 1990: Unit reduced sharply, exchange rate system revised, and link to USD broken; effective rate determined by average of weekly commercial bank transaction, and official rate based on supply and demand in market; 1991: Licensed foreign exchange bureaus permitted to operate.
SOUTH AFRICA (SA)	1961: The South African Rand (R) replaced South African £; 1971: Floating of USD – de facto devaluation as R's link to £ was severed and pegged to USD; Later re-linked to £; 1972: Following floating of £ and dismantling of Sterling Area, Rand remained linked to £, de facto devaluation; 1973: USD devaluation, official rate realigned, R up-valued in terms of gold; 1974: effective rate established, R placed on controlled floating basis – de facto devaluation; 1975: R devalued, two-tier exchange rate system established – commercial and financial R; 1983: Two rate abolished and merged into unified floating effective rate – de facto devaluation; 1985: dual system re-established;
TANZANIA (TZ)	1966: The Tanzania Shilling (TSh) replaced east African Shilling; 1971: Floating of USD – Tanzania severed her link with £ - attached to USD – de facto devaluation; gold content of TSh reduced; 1972: Floating of £, and Sterling Area dismantled; 1973; USD devaluation, TSh devalued in gold; temporary effective rate established; and gold content later increased – up-valued official rate; 1974: TSh devalued following Kenya and Uganda; 1975: effective rate established as ties to USD were severed, and linked to SDR instead – currency placed on controlled floating basis – de facto devaluation; 1977: Break up of East African Community; 1979; effective rate devalued ad link to SDR was broken; Unit depreciated and attached to basket of currencies; 1990-91: controlled effective rate downgraded several times; 1992: licensed foreign exchange bureaux allowed to operate.

Table C continued …	
ZAMBIA (ZM)	The Zambian kwacha (K) replaced the £Z; devalued by 50%.; 1971; USD de facto devaluation – K was fixed through link to £, it began to appreciate; Unit's link to £ broken, and attached to USD – de facto devaluation; K's gold content fell, allowed to fluctuate within 4.5% range; 1972: Dismantling of Sterling Area; 1973: USD devaluation – official rate realigned; 1976: effective rate established, as K's ties to USD are severed, and linked to SDR – placed unit on controlled floating basis – de facto devaluation: 1978: link of effective rate to SDR cut to new exchange value; 1983: effective rate devalued; link to SDR broken and unit attached to basket of currencies; 1985: Rate determined by marginal clearing bid at weekly auction; 1987: Auction system discontinued; K pegged to basket of currencies, and rate to move in range 8-11US$; dual system re-introduced; exchange rate system unified and K pegged to USD; 1988: K devalued and pegged to SDR; 1989: K devalued, new bank notes; 1990: dual rate reinstated; 1991: Dual rates merged at market rate, Market rate pegged to SDR and rate against USD adjusted frequently to reflect demand and supply conditions; 1992: foreign exchange bureaux began operating.
ZIMBABWE (ZB)	1965-79: UDI – dual exchange rate was in place, the Zimbabwe Dollar ($Z) was put in fixed relation with the South African Rand, with adjustments effected at irregular intervals; 1980: Dual system abandoned; 1980-1993: Unit pegged to a trade-weighted basket of currencies.

*Note: *The exchange rate arrangements for five countries are not available; NA – Not available.*
Source: Cowitt, P.P. et al, (ed.), (1996), World Currency Yearbook.

TABLE D: Individual Unit Root Tests (Demeaned Data)

Country	**Multilateral Index (Import-based)** ***ADF/DF***		**Bilateral Index** ***ADF/DF***		**Multilateral Index (Trade-weighted)** ***ADF/DF***	
	b_i	***ADF/DF***	b_i	***ADF/DF***	b_i	***ADF/DF***
Burkina Faso	-0.144(0)	**-1.318**	-0.251(0)	**-2.014**	-0.136(0)	**-1.261**
Burundi	-0.157(0)	**-1.556**	-0.328(0)	**-2.344**	-0.142(0)	**-1.500**
Congo Rep.	-0.129(0)	**-1.321**	-0.105(0)	**-1.154**	-0.136(0)	**-1.359**
Côte d'Ivoire	-0.254(1)	**-2.574**	-0.139(1)	**-2.674**	-0.260(1)	**-2.479**
Egypt	-0.333(1)	**-3.088**	-0.299(1)	**-2.932**	-0.349(1)	**-3.161**
Ethiopia	-0.246(0)	**-1.624**	-0.318(3)	**-1.978**	-0.216(0)	**-1.616**
Gabon	-0.281(1)	**-2.455**	-0.200(3)	**-2.932**	-0.300(1)	**-2.484**
The Gambia	-0.201(0)	**-1.959**	-0.198(0)	**-1.840**	-0.104(2)	**-1.406**
Ghana	-0.163(1)	**-1.899**	-0.152(1)	**-2.010**	-0.148(1)	**-1.972**
Kenya	-0.143(0)	**-1.643**	-0.413(0)	**-2.606**	-0.160(0)	**-1.743**
Madagascar	-0.679(3)	**-2.982**	-0.429(0)	**-2.672**	-0.100(0)	**-1.254**
Mauritius	-0.106(0)	**-1.396**	-0.114(0)	**-1.239**	-0.109(0)	**-1.369**
Morocco	-0.152(1)	**-1.795**	-0.123(1)	**-1.568**	-0.113(0)	**-1.431**
Niger	-0.313(1)	**-2.719**	-0.282(0)	**-1.978**	-0.417(1)	**-3.284**
Nigeria	-0.278(1)	**-2.751**	-0.272(1)	**-2.623**	-0.249(1)	**-2.551**
Sierra Leone	-0.135(0)	**-1.503**	-0.345(0)	**-2.585**	-0.226(0)	**-2.112**
South Africa	-0.246(3)	**-2.126**	-0.252(3)	**-2.064**	-0.258(3)	**-2.139**
Tanzania	-0.176(1)	**-2.432**	-0.190(1)	**-2.546**	-0.175(1)	**-2.455**
Zambia	-0.199(0)	**-1.731**	-0.278(0)	**-2.142**	-0.206(0)	**-1.822**
Zimbabwe	-0.113(0)	**-1.509**	-0.602(3)	**-2.679**	-0.115(0)	**-1.523**

Notes: The figures in parentheses are lag lengths.

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Long-run and Short-run Determinants of the Real Exchange Rate in Zambia

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Abstract

The paper analyses the main determinants of the real exchange rate in Zambia. It first gives a brief review of the Zambian economy and a review on real exchange rate studies. Then an illustrative model is presented. The study employs cointegration analysis in estimating the long-run determinants of the real exchange rates for imports and exports, and of the internal real exchange rate. The finding is that terms of trade, government consumption, and investment share all influence the real exchange rate for imports, while terms of trade, central bank reserves and trade taxes influence the real exchange rate for exports in the long-run. The internal real exchange rate is influenced by terms of trade, investment share, and the rate of growth of real *GDP* in the long-run. Error-correction models are then estimated. Besides the difference of the fundamentals mentioned above, aid and openness are found to impart short-run effects on the real exchange rate indices. The coefficients of adjustment are found to be -0.38, -0.79 and -0.80 respectively for the real exchange rates for imports and exports, and for the internal real exchange rate.

Keywords: Real Exchange Rate, Misalignment, Cointegration, Zambia.

JEL Classification: C32; F31; O55.

1 Introduction

Zambia is a mineral-exporting country, which has heavily depended on copper earnings for its foreign exchange revenues. Since independence, the contribution of copper to export revenues has been substantial, at times over 90 percent. The dependence on copper to provide foreign exchange resources has meant that during times when copper prices have plummeted, the country has faced severe foreign exchange shortages, which in turn put pressure on the exchange rate, and on resources available to the economy. This necessitated external financing from the *IMF* and the World Bank, whose financing was conditioned on some structural adjustment measures that the government had to implement. The measures included among others, price decontrols, elimination of subsidies, and trade liberalisation. However, the centrepiece of the adjustment measures was the adjustment of the nominal exchange rate in order to correct for the real exchange rate misalignment.

Adjustment in the nominal exchange rate is often emphasised in economic reforms as a way to correct for misalignment in the real exchange rate. Misalignment in the real exchange rate occurs when the actual or observed real exchange rate deviates from the equilibrium real exchange rate (Edwards, 1988). Misalignment in the real exchange rate is caused by inappropriate macroeconomic policies or by structural factors, such as permanent shocks in the terms of trade (Edwards, 1988; Nilsson, 1998). When the real exchange rate is misaligned, it can lead to a distortion in price signals, in turn affecting the allocation of resources in the economy. In developing countries, misalignment in the real exchange rate has often taken the form of overvaluation, which adversely affects the tradables sector by lowering producers' real prices. In turn, incentives and profits are lowered, leading to declining investment and export volume. Some studies have attributed the sluggish performance of developing countries to misaligned real exchange rates (Cottani *et*

al, 1990; Ghura and Grennes, 1993; Nilsson, 1998). Indeed, a number of researchers have also pointed out the importance of the real exchange rate and why it is important to understand its main determinants (see for example, Edwards, 1988 and 1989; Elbadawi and Soto, 1997; Cottani *et al*, 1990; Elbadawi, 1994; Baffes *et al*, 1999; Ghura and Grennes, 1993; Khan and Montiel, 1996; and Aron *et al*, 1997).

This paper attempts to find the main determinants of the real exchange rate in Zambia, and once these are found, to estimate the degree of misalignment in the real exchange rate. The determinants are analysed both in terms of their impact on the long-run equilibrium real exchange rate and on their short-term effect on the real exchange rate. The empirical strategy will thus involve cointegration analysis and error-correction modelling.

This study takes into account the fact that it is difficult to obtain a unique and comprehensive index for the real exchange rate. Following Hinkle and Nsengiyumva (1999*c*), three indices for the real exchange rate are calculated and used in the analysis. These are; a real exchange rate for imports, a real exchange rate for exports, and a comprehensive internal real exchange rate calculated from national accounts data. In this sense therefore, this study is an improvement over other studies on African countries (see Edwards, 1988 and 1989; Elbadawi and Soto, 1997; Elbadawi, 1994; Baffes *et al*, 1997; Kadenge, 1998; and Aron *et al*, 1997).

Our study thus makes important contributions in several respects. To our knowledge, this is not only the first study of this type on Zambia, but also, it is the first study to have estimated the three versions of the real exchange rates. Such an attempt has been avoided for being too daunting (Hinkle and Nsengiyumva, 1999*b*). Our study also employs cointegration econometrics in the analysis of long-

run determinants of the real exchange rates. In general, the application of cointegration econometrics on real exchange rates is still in its infancy in Africa.

The paper is structured as follows; the next section gives a brief overview of the Zambian economy, including a summary of the exchange rate regimes that the country has had since independence. The third section reviews literature pertaining to real exchange rate determination. The fourth section presents an illustrative model for analysing the determinants of the real exchange rate, based on Baffes *et al* (1999). The fifth section gives the empirical findings, and the last section summarises the paper and draws some conclusions.

2 A Brief Overview of the Zambian Economy

This section gives a brief overview of the Zambian economy. It first discusses some selected macroeconomic indicators. The aim is to familiarise the reader with the key features of the economy. Secondly, it reviews the exchange rate systems that the economy has had since independence to date. Nominal exchange rate policy can be both a cause of, and a tool for correcting misalignment in the real exchange rate (Edwards 1988). For example, excess domestic credit in a fixed nominal exchange rate regime can lead to the appreciation of the actual real exchange rate (thus departing from the equilibrium real exchange rate). One way of correcting this misalignment is to devalue the currency. The importance of nominal exchange rate regimes in the analysis of real exchange rates cannot therefore be over emphasised. Lastly, it discusses how the real exchange rates have evolved over the period under study.

2.1 Selected Macroeconomic Indicators

The Zambian economy has been dominated by the production and exporting of a single primary product, copper. Although other minerals are mined, copper has remained the major source of export earnings. The importance of copper is evident in Table 1.

Table 1: Importance of Copper Mining to the Zambian Economy

	1970	1975	1980	1985	1990	1996
Mining and Quarrying as % of *GDP*	36	14	16	16	7.4	5.9
Mineral Tax as % of Government Revenue	58	13	5	8	0.1	2.3
Copper Exports as % of Total Exports	95	91	85	83	84	52
Mining Employment as % of Total Employment	17	17	17	16	15	10

Source: IMF (1997); Kalinda (1992); IFS CD-ROM.

Soon after independence, the earnings from copper exports helped to develop infrastructure, public services and import-substituting industries, and copper has continued to play a key role in the economy. However, in the 1970s, the copper prices fell, and Zambia's growth, which was founded on the high world prices of copper, also slumped. Real *GDP* per capita declined, and copper's contribution to government revenues fell (see Table 1).

The dependence on copper has had a profound influence on all sectors of the economy. First of all, since copper earnings supported the development of import-substituting industries, these industries virtually came to a stand still after the fall in copper prices. The plants exhibited excess capacity because the raw materials, equipment and spare parts could not be imported due to shortages of foreign exchange. Secondly, the government reduced its expenditure on economic and social infrastructure since the fall in copper earnings affected tax revenues. The reduction in public expenditure on social services meant a deterioration in the

quality of life. Table 2 presents some economic indicators of the Zambian economy between 1970 and 1996. As a result of this, the government resorted to the international financial institutions (*IMF* and World Bank).

Table 2: Selected Macroeconomic Indicators, 1970-96

	1970	*1975*	*1980*	*1985*	*1990*	*1996*
Urban population (% of total)	30.2	34.8	39.8	40.9	42	43.3
Total debt service (% of *GNP*)	na	7.5	11.4	6.9	6.7	8.2
Resource balance (% of *GDP*)	16.8	-19.7	-4.0	-0.8	-0.7	-6.2
Public spending on education, total (% of *GNP*)	4.5	6.7	4.5	4.7	2.2	na
Overall budget deficit, including grants (% of *GDP*)	na	-21.7	-18.5	-15.2	-8.6	0.7
Inflation, GDP deflator (annual %)	-11.4	-14.2	11.8	41.1	106.4	24.3
LME Real Copper Prices ($/lb)[1]	2.2	1.4	1.6	0.8	1.2	0.9
Gross domestic investment (% of *GDP*)	28.2	40.9	23.3	14.9	17.3	14.9
Current account balance (% of *GDP*)	na	na	-13.3	-17.6	-18.1	na
GDP growth (annual %)	4.8	-2.3	3.0	1.6	-0.5	6.5
GDP per capita (constant 1995 US$)	664.2	646.1	555.1	487.0	453.8	404.3

Notes: na – not available; LME – London Metal Exchange. [1]Deflated by the consumer price index for US.
Source: World Bank (1999), World Development Indicators CD-ROM, Kalinda (1992).

The government first resorted to the use of *IMF* funds in 1971 to help rehabilitate the copper mine in Mufulira, which got flooded. The compensatory financing facility was for *SDR*19 million. Between 1972 and 1982, a number of programmes were negotiated with the *IMF*. The programmes were meant to ease budgetary constraints, improve the balance of payments position, and diversify the economy. However, these programmes were not successful in stemming the economic downturn. In the 1983/1985 Structural Adjustment Programme (*SAP*), more wide-ranging reforms were instituted. The centrepiece of the reforms was the auctioning of foreign exchange. The exchange rate was thus emphasised as important in inducing structural adjustment (Elbadawi and Aron, 1992). In effect, adjustment in the exchange rate was meant to correct for the misalignment in the real exchange rate. In May 1987, the government abandoned the reform programme, and replaced it with a home grown programme, the New Economic Recovery

Programme (*NERP*), under the theme "Growth from Own Resources". However, the decision to go it alone only lasted for two years. In June 1989, the government returned to the *IMF*/World Bank programme due to mounting donor and domestic pressure (Mwanza *et al*, 1992).

With the return to the *IMF*/World Bank programme, a number of liberalisation measures were reintroduced, such as decontrolling the prices of all goods except that of maize, trade reforms, parastatal and civil service reforms, and also tight monetary and fiscal policies. In the initial period, the programme registered some progress. However, in 1991, the government backtracked on its reform measures as it was determined to win support in the upcoming presidential and parliamentary elections. The government put on hold the removal of subsidies on maize and fertiliser, and it also over-run its expenditure targets due to salary increments to civil servants. Besides the budget, it also relaxed on its monetary policy, and its privatisation progress was very slow. As a result of the slow progress in its liberalisation programme and general laxity in its economic management, the donors froze their support to the programme just before the 1991 elections (Bigsten and Kayizzi-Mugerwa, 2000).

The Movement for Multiparty Democracy (*MMD*) won the 1991 elections, and upon assuming power, it introduced its Economic Reform Programme (*ERP*). The main goal of the *ERP* was to arrest the economic decline, with a strong commitment to economic liberalisation (see Bigsten and Kayizzi-Mugerwa, 2000; White, 2000). The *MMD* government attracted tremendous support from the donors. It is reported that aid to the government reached its all time peak in 1992 (Bigsten and Kayizzi-Mugerwa, 2000). The considerable support that the new government attracted was due to its strong programme for economic reforms. During its first two years in power, the new government instituted reforms at a fast pace. It removed all price controls, it devalued the currency, and it rapidly

liberalised external trade and payments system. In its effort to restrain government expenditure, the government introduced a cash budget in January 1993. A cash budget system meant that the government could only spend the money it had collected in revenue, so that there can be no deficit financing. On the revenue side, the government instituted some means of increasing the flow of revenue. It set up a revenue board, the Zambia Revenue Authority (*ZRA*), to effectively collect taxes, and it later introduced *VAT* and some user fees for social services.

In its privatisation programme, the initial progress was slow. Although the Zambia Privatisation Agency (*ZPA*) was launched in 1992, it had achieved very little in its first two years. As such, the donors were pressing for more to be done. The main conflict areas were the privatisation of the national airlines, which was taking up huge subsidies, and the privatisation of the copper mines (White, 2000). The airline was finally closed, and after a number of postponed deadlines for selling off the mines, a deal was finally reached in 1999 with the Anglo-American Corporation (The Economist, 1999).

Besides the slow privatisation process, which picked up momentum in mid 1995, the donors were also concerned at the slow reforms in the public sector, and the poor governance record (White, 2000). In the public sector, the reforms were to cut the civil service by 25 percent over a three-year period so that the remunerations could be increased. However, although some retrenchments took place in 1992, the number of civil service employees actually increased between 1991 and 1996 (Bigsten and Kayizzi-Mugerwa, 2000). The huge and inefficient civil service has thus remained a serious constraint on growth.

2.2 The Nominal Exchange Rate Regimes

The main thrust in studying real exchange rates is to determine the extent of real exchange rate misalignment. Misalignment that is due to the inconsistency between macroeconomic policy and the nominal exchange rate is of particular policy interest. Countries that pursue administratively fixed exchange rate regimes are more prone to this type of misalignment. In this sub-section, we briefly document different exchange rate regimes that Zambia has gone through since independence. Table 3 summarises these systems. We can identify seven distinct exchange rate systems, ranging from fixed ones to the current market-determined exchange rate system.

From Table 3, we can see that from independence in 1964 to 1985, Zambia had a fixed exchange rate regime. During this period, the kwacha was pegged to different convertible currencies, namely the British pound, the American dollar, the Special Drawing Right (*SDR*), and to a trade weighted average of a basket of currencies of Zambia's main trading partners. When the kwacha was pegged to Zambia's trading partners, it was allowed to adjust within a narrow range, unlike in the earlier cases when no adjustment was made except for occasional devaluations. The fixed exchange rate was not maintained by an active intervention in the foreign exchange market as is the standard in market economies. Rather, the exchange rate was fixed more or less by decree, and a series of administrative controls were instituted to deal with any possible excess demand for foreign currency. Issuing of import licenses was one such administrative control.

In 1985, the government adopted the auctioning system, in order to determine the market exchange rate, to improve the allocation of foreign exchange, and to eliminate the parallel market for foreign exchange (Mailafia, 1997; Reinikka-Soininen, 1990). The auctioning of foreign exchange was part of the reforms

negotiated with the *IMF* under a wider adjustment programme. The auctioning system was a dual one in that there was an auction-determined rate, and a below-auction rate which was used for allocating foreign exchange to special needs such as debt-servicing, medical and educational supplies, oil imports, and needs for the mining company and national airline. [1]

Table 3: Exchange Rate Policy Episodes in Zambia, 1965-96

Period	*Policy*
1964-1971	Fixed to the British Pound.
1971-1976	Fixed to the American Dollar.
1976-1983	Pegged to the Special Drawing Right. The kwacha was devalued occasionally.
1983-1985	Pegged to a weighted average of a basket of currencies of Zambia's five trading partners. The kwacha was allowed to adjust within a narrow range.
1985(Oct)-1987(Jan.)	Dual exchange rate system – auction determined and below auction rate; two-tier auction.
1987(Jan)-1987(Mar.)	Fixed rate to the Dollar; then to a basket of currencies of Zambia's major trading partners; Rate allowed to float within a band of K9-K12.50/US$.
1987(Mar)-1987(May)	Dual exchange rate system – official rate and auction-determined rate; Foreign Exchange Management Committee (*FEMAC*) was to allocate foreign exchange.
1987(May)-1990(Feb.)	Fixed rate, with occasional devaluations.
1990(Feb)-1991(Apr.)	Dual exchange rate system – retail and official windows managed by *FEMAC*.
1991 to date:	The liberalised regime. The following events led up to the market-determined exchange rate:
Oct 1991	A new government, the Movement for Multiparty Democracy (*MMD*) assumed office, with a promise to accelerate the pace of liberalisation. It instituted a number of policy reforms.
Early 1992	Weekly devaluations of the kwacha were announced. A 100% retention for non-traditional exporters was announced.
September 1992	Legislation was passed to license bureaux. The bureaux became operational in October. The *OGL* list was expanded.
December 1992	*BOZ* announced that the bureau rates were to be used in its transactions. The *OGL* retail window and official foreign exchange windows were unified, although allocations to the government, *ZCCM*, and *ZIMOIL* were done outside the unified window.
June 1993	Further modifications were introduced to the *OGL*, one of which was that *BOZ* was to determine the exchange rate for *OGL* funds on the basis of the bureau rates.
January 1994	The Exchange Control Act was repealed. All capital controls were abolished, making the kwacha fully convertible.
December 1994	The *OGL* system was abolished.
1996	The *ZCCM* revenue retention scheme was abolished. The company could trade freely in the inter-bank market. The *BOZ* selling and buying rates were now determined by the average daily retail rates of commercial banks.

Source: Bank of Zambia; World Currency Yearbook (1996); Mwenda, 1996; IMF.

[1]The auctioning was done by a Dutch system in which sealed bids were submitted to commercial banks. Those who were successful bought their currency at their bid prices, while the exchange rate was determined by the marginal market-clearing bid that exhausted the supply of foreign exchange. The auctioning was conducted by the Bank of Zambia (*BOZ*) on a weekly basis.

The auctioning system's life was short. This was due to a number of factors (see Bates and Collier, 1995 for a detailed discussion of these factors). First, the auctioning of foreign exchange was seen as having caused not only the depreciation of the kwacha, but also, it was blamed for having caused inflation. As a result, it became extremely unpopular especially among urban dwellers. The second factor that contributed to the loss of support for the auctioning system among the people was that it was perceived as having benefited the rich at the expense of the poor. The third factor was that the auctioning system was mismanaged. At the time, the Bank of Zambia saw inflation as being driven by rising costs. As a result, they sought to appreciate the exchange rate by selling foreign exchange in amounts that were in excess of the amount of foreign exchange available. The intervention in the foreign exchange market by *BOZ* resulted in the following; firstly, private traders lost confidence in government commitments, which they found not to be credible, hence creating a huge demand for foreign exchange. Secondly, as a result of the huge demand created by the unfulfilled promises for foreign exchange, the exchange rate depreciated instead of appreciating as was initially intended. Thirdly, *BOZ* incurred huge losses by intervening. By agreeing to sales of foreign exchange that it did not have, it set up a forward market. However, given the depreciating kwacha, *BOZ* had to buy foreign exchange at a higher price than it sold it at. The losses that the Bank incurred were monetised, and according to Bates and Collier (1995), primary liquidity increased by 142 percent in a period of nine months from the beginning of the auctioning. Of course, such an increase in primary liquidity was inflationary. The intervention by *BOZ* in the foreign exchange market contributed to the misalignment in the real exchange rate. We shall see later that this was the case.

The auctioning system began to be dismantled in January 1987, and was replaced by a fixed exchange rate regime, in which the kwacha was first of all fixed to the dollar, and then to a basket of currencies of Zambia's major trading partners. The

rate was allowed to float within a band of K9-K12.50/US$. This system lasted until March, when a new dual exchange rate system was ushered in. In the dual system, an official rate and an auction-determined rate existed. A new structure, the Foreign Exchange Management Committee (*FEMAC*), was also introduced to allocate foreign exchange and to process import license applications. In this system, the official rate was determined on a daily basis with reference to a basket of currencies of Zambia's leading trading partners, while the auction rate was the marginal bid at which the foreign exchange offered for sale was exhausted. The requirements for oil, the mining company, the national airline, and for fertiliser were given outside the *FEMAC* system. By May 1987, *FEMAC* was abolished due to administrative inefficiencies, and the exchange rate system reverted to a fixed one.

The fixed system lasted until February 1990. During the fixed system, a number of devaluations were effected. In the meantime, *FEMAC* was being restructured to take up operations of yet another regime. In February 1990, another dual system was put in place, and was once again, managed by *FEMAC*. The new dual system involved two windows, a retail and an official one. In the retail window, importers applied for foreign exchange through their banks, while the official window, which operated with a lower rate, catered for remittances and payments for the mining company. The dual system lasted until 1991, when a number of reforms were made to liberalise the foreign exchange market. Among the reforms done was the unification of the two windows, and legislation was passed to authorise the setting up of bureaux de change. By 1994, all capital controls were removed. Thus, as a result of the unification of the rates and the liberalisation of the foreign exchange system, the exchange rate became market-determined.

The exchange rate regimes in Table 3 reflect how the government's exchange rate policy evolved over time. Due to the existence of exchange controls from the time

of independence, coupled by external macroeconomic imbalance, a black market for foreign exchange existed alongside the official market. The existence of a black market for foreign exchange is an indication of real exchange rate misalignment. In the black market, the exchange rate was freely floating. The parallel market was by and large illegal in Zambia, except prior to the auctioning when it was quasi-legalised with the introduction of the export retention schemes and "own funds" import licenses (Elbadawi and Aron, 1992). Kiguel and O'Connell (1995) observe that the parallel market was made legal between 1987 and 1988. Due to the illegal nature of the parallel market for most of the time that it existed, information on size and volume of transactions is not available. In spite of the lack of information, the importance of the parallel market is illustrated by the size of the premium. Between 1971 and 1993 for which data on the parallel market is available, the average premium was 193 percent. Figure 1 in Appendix 3 shows the evolution of the parallel market premium between 1971 and 1993.[2] The figure shows that the premium rose after the two copper price shocks of 1971 and 1974. Between 1976 and 1983, there was a slight downward trend in the premium. However, from 1984, an upward trend ensued, which coincided with the period just before the auctioning system. This period was also characterised by a further decline in the real price of copper. There was a sharp rise in 1988, a year after the break with the *IMF*. Thereafter, the premium took a steady downturn. It is notable that the government resumed its *IMF*/World Bank supported programme in 1989. The downward trend in the premium continued until it finally disappeared after the unification.

[2]The black market premium was calculated as follows; $\frac{BMR}{OR} - 1$, where *BMR* refers to the black market rate, and *OR* to the official rate.

2.3 Definition and Evolution of the Real Exchange Rate

There are two approaches commonly used to define the real exchange rate. The first one defines the real exchange rate as the ratio of the price of foreign to that of domestic goods, expressed in domestic currency (Black, 1994). This is expressed as follows;

$$\langle 1 \rangle \quad RER \equiv e \equiv E\frac{P^*}{P}$$

where, e is the real exchange rate, E is the nominal exchange rate expressed as the local currency price of a foreign currency, P^* is the foreign price level, and P is the local price level. This definition is *PPP*-based, and it is widely used in empirical studies on developed countries.

The other way of defining the real exchange rate derives from the "well known Salter-Swan non-traded goods model" (Black, 1994:285). The real exchange rate in this sense is defined as the ratio of the price of traded goods to non-traded goods (or its inverse);

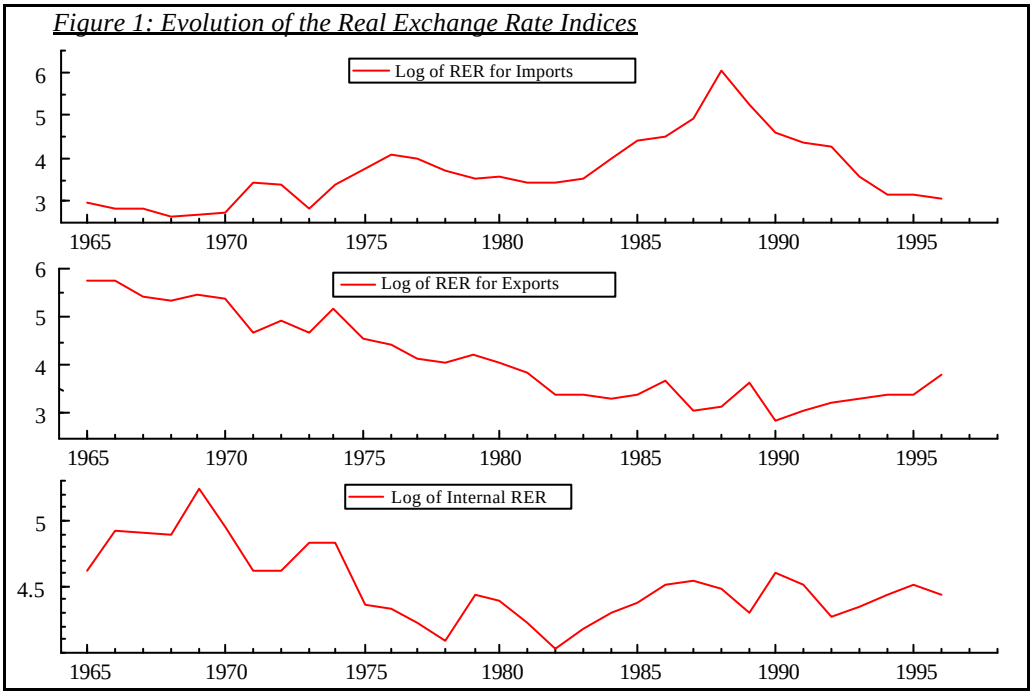
$$\langle 2 \rangle \quad RER \equiv e \equiv E\frac{P_T^*}{P_N}$$

where, P_T^* is the world price for traded goods, P_N is the (domestic) price of non-traded goods,[3] and E is the nominal exchange rate.

[3]In some cases, the real exchange rate is defined as $RER \equiv e \equiv \frac{P_N}{EP_T}$ (Edwards, 1988). If defined in this manner, an increase in e means an appreciation, while a decrease means a depreciation.

In our empirical analysis, we calculate three indices of the real exchange rate (see sub-section 5.1 for details). The first one is a multilateral real exchange rate for imports. We use the parallel market rate to calculate the multilateral real exchange rate for imports between 1971 and 1993, a period when the parallel market was widespread, while for the rest of the period, the official exchange rate is used. The second index we calculate is a multilateral real exchange rate for exports, in which we use the official market rate. The third index is calculated from national accounts data (see also Appendix 1 for details on the computation of the three indices). The evolution of the three indices is shown in Figure 1.

Figure 1: Evolution of the Real Exchange Rate Indices



A number of important features can be highlighted in Figure 1. The real exchange rate for imports was fairly stable between 1965 and 1970. It then depreciated after 1970 before appreciating between 1972 and 1973. There was a steady depreciation after 1973 up to 1976 when it appreciated until 1983. Thereafter, it started a fast depreciation, reaching an all time high in 1988, and then it appreciated thereafter. The real exchange rate for exports has shown a steady downward trend from 1965

to 1990. Thereafter, it started depreciating. The internal real exchange rate exhibits more fluctuations than the first two indices. Notable periods are in 1969 when the real exchange rate depreciated sharply, and also in 1974 and 1981 when it appreciated. In general, the trend between 1969 and 1981 was that of appreciation, and then depreciation thereafter.

In this study, we shall model the long-run fundamentals that have been behind the evolution of all the three real exchange rates, and also the short-run factors.

3 A Brief Literature Review

A recent book edited by Hinkle and Montiel (1999) offers an outstanding review on issues of real exchange rates. The book deals with measurement issues, determinants of the real exchange rate and empirical studies on real exchange rates. There are also other good reviews and analyses of the real exchange rate,[4] such as Williamson (1994) and Edwards (1988, 1989). Williamson (1994) provides a simple and excellent account of the way the concept of real exchange rate evolved through the desire by economists to determine what the equilibrium exchange rate is. Williamson himself has been central in the development and evolution of the real exchange rate concept.[5] In brief, Williamson (1994:178) pointed out that the motivation behind the preoccupation with issues of the real exchange rate has been the desire to "identify an appropriate concept of equilibrium exchange rate and estimating its value". Once an appropriate nominal exchange rate is determined, then necessary adjustments can be made to achieve it. The accepted practice now is to consider a nominal exchange rate as appropriate if it is such that the actual real exchange rate coincides with the long-run equilibrium real exchange rate.

[4]The real exchange rate is also called fundamental equilibrium exchange rate or desired equilibrium exchange rate (Williamson, 1994).

[5]See for example Feyzioglu (1997).

Whichever definition of the real exchange rate is used, the equilibrium real exchange rate is considered to be the one that is consistent with both the external and internal balance of the economy. Misalignment occurs when the real exchange rate deviates from its equilibrium path.

Studies on the determinants of the real exchange rate and the effects of real exchange rate misalignment have assumed an important part in research over the past decades. For example, Edwards (1989) developed a theoretical model of real exchange rate behaviour and devised an empirical equation of how to estimate the real exchange rate dynamics. According to him, the long-run equilibrium real exchange rate is affected by real variables only, that can be classified as internal and external fundamentals. In the short-run however, the real exchange rate may be affected by both real and nominal factors. The important fundamentals that determine the real exchange rate are the terms of trade, level and composition of government consumption, controls on capital flows, exchange and trade controls, technological progress, and capital accumulation. Edwards (1989) empirically tested his model and its main implications using pooled data for a group of twelve developing countries by analysing the relative importance of real and nominal variables in the process of real exchange rate determination in the short-run and long-run. The study found that in the short-run, real exchange rate movements are affected by both real and nominal factors. In the long-run however, only real factors affect the sustainable equilibrium real exchange rate. Edwards (1989) further investigated whether there was any link between real exchange rate misalignment and economic performance. His conclusion was that the countries whose real exchange rates were closer to equilibrium out-performed those with misaligned real exchange rates.

Edwards' (1989) work inspired a number of studies on not only the determinants

of the real exchange rate, but also on issues of misalignment of the real exchange rate. It led to increasing consensus to the effect that one of the crucial conditions for improving economic performance in less developed countries (*LDCs*) is a stable real exchange rate and one that is correctly aligned. Cottani *et al* (1990) also argued that in parts of Latin America, unstable real exchange rates inhibited export growth, while in Asia, export expansion was fostered by stable real exchange rates. On the other, in Africa, the widespread poor performance of the agriculture sector and economic growth in general could be attributed to persistently misaligned real exchange rates.

Empirical findings by other researchers have also concurred that a chronic misalignment in the real exchange rate is a major factor responsible for the poor economic performance of most developing countries[6]. For example, Ghura and Grennes (1993) used a panel of Sub-Saharan countries to investigate the impact of real exchange rate misalignment on economic performance. They too found that real exchange rate misalignment negatively affected income growth, exports and imports, and investment and savings.

The importance of the real exchange rate has led to several studies to investigate its determinants. Such studies include Ghura and Grennes (1993) for a panel of Sub-Saharan countries, Cottani *et al* (1990) and Elbadawi and Soto (1997), each on a group of developing countries, and Aron *et al* (1997) for South Africa. In these studies, the most common determinants of the real exchange rate were found to be terms of trade, openness, capital inflows and nominal devaluations.

While earlier research on the determinants of the real exchange rate used classical regression analysis,[7] of late, researchers have employed cointegration analysis.

[6]See also Sekkat and Varoudakis (1998).

[7]See for example Edwards (1989), Sekkat and Varoudakis (1998), Ghura and Grennes (1993), and Cottani *et al* (1990).

Cointegration analysis provides statistical tests for determining the existence of a long-run equilibrium in a model. It further enables the estimation of long-run steady state parameters, once equilibrium is found to exist. Cointegration analysis is thus handy in the empirical investigation of the determinants of the long-run equilibrium real exchange rate. Studies employing cointegration analysis in the empirical analysis of real exchange rates are numerous. These include, Baffes *et al* (1999) for Côte d'Ivoire and Burkina Faso, Elbadawi and Soto (1997) for seven developing countries, Feyzioglu (1997) for Finland, Kadenge (1998) for Zimbabwe, Gelband and Nagayasu (1999) for Angola, and Faruquee (1995) for *US* and Japan.

4 Theoretical Framework

Two distinct approaches to analysing the equilibrium real exchange rate have been used in the literature, and they follow each other chronologically. The first approach is based on the Casselian form of strict Purchasing Power Parity, which holds that the equilibrium real exchange rate for a given country remains constant over time. This is because nominal exchange rates were considered to adjust rapidly to any price differential between the country and its trading partners (Elbadawi and Soto, 1997). This approach is hardly used. One of the reasons for discarding it is that the strict Casselian *PPP* fails empirical tests. It is now widely accepted that absolute *PPP* does not hold, and thus the equilibrium real exchange rate defined as such, cannot be constant over time.[8]

The second approach considers the equilibrium real exchange rate as a path upon which an economy maintains both internal and external balance. The equilibrium real exchange rate is not an immutable number; it is rather influenced by some real variables.

[8]For other variants of Casselian *PPP*, see Paper I in this thesis.

4.1 The Model

We will use a model developed by Montiel (1996, cited by Baffes *et al,* 1999; and Feyzioglu, 1997) to illustrate the theoretical derivation of the real exchange rate fundamentals. We will adopt the definition of the real exchange rate that has been widely accepted and used in developing countries (Baffes *et al,* 1999; Elbadawi and Soto, 1997; and Edwards, 1989). The real exchange rate is defined as the domestic relative price of traded to non-traded goods. That is;

$$\langle 3 \rangle \quad RER \equiv e \equiv E \frac{P_T^*}{P_N}$$

where, P_T^* is the world price for traded goods (we assume a small open economy), P_N is the (domestic) price of non-traded goods, and E is the nominal exchange rate. An increase in e implies a depreciation of the real exchange rate, while a decrease implies an appreciation.

The equilibrium real exchange rate is defined as the one that occurs when the economy enjoys both internal and external balance, and these balances are sustainable with respect to all the relevant factors. Internal equilibrium is attained when the supply and demand for non-traded goods are equal;

$$\langle 4 \rangle \quad Y_N(e) = (1-a)eC + G_N, \qquad \partial Y_N / \partial e < 0$$

where,

Y_N is the production of non-traded goods,

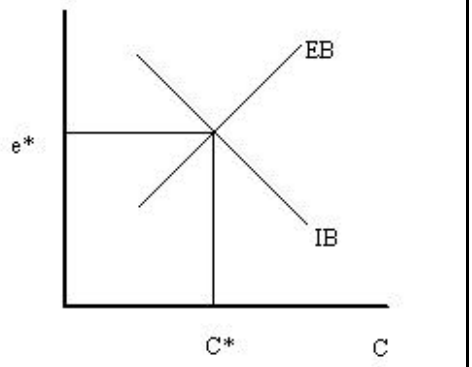
G_N is government consumption of non-traded goods,

a is the share of traded goods in total consumption, and

C is total private consumption measured in traded goods.

Equation 4 thus characterises the internal balance (*IB*) in Figure 2, where the real exchange rate is inversely related to consumption. This is because if we start from a position of internal balance, a rise in private spending creates an excess demand for non-tradable goods at the original real exchange rate. In order to restore equilibrium, a real appreciation is required, which would switch supply toward non-tradable goods, and demand toward tradable goods.

Figure 2: Internal and External Balance



Again, following Baffes *et al* (1999), external balance is defined by the following equation of the current account balance;

$$\langle 5 \rangle \quad \dot{f} = Y_T(e) - G_T - aC + z - rf$$

where,

f is net foreign assets, and $\dot{f}$ is change in net foreign assets over time,

$Y_T(e)$ is the domestic supply of traded goods,

G_T is government spending on traded goods,

z is net aid inflows and rf is external debt service.

Equation 5 therefore states that the external balance equals the trade balance (that is, domestic output of traded goods net of local consumption of these goods), net aid inflows and less costs on foreign debt.

At equilibrium, $\dot{f} = 0$, along which we can obtain a relationship between private consumption and the real exchange rate depicted as *EB* in Figure 2. The *EB* line slopes upwards because if we started from a position of external balance, a rise in private spending would generate a current account deficit at the original real exchange rate. In order to restore equilibrium, the real exchange rate must depreciate. The depreciation would switch demand toward non-tradable goods, and supply toward tradable goods.

The intersection of *EB* and *IB* produces the equilibrium real exchange rate. At such an intersection, both the internal and external balance are achieved. This is also achieved by setting the right hand side of equation 5 to zero, and combining this with equation 4. This gives,

$$\langle 6 \rangle \quad e^* = e^*(G_N, G_T, r^* f^* + z)$$

where, a star on the variables refers to steady-state values of endogenous variables. The steady-state values of r^*f^* are solved by assuming that the country faces an upward-sloping supply curve of net external funds and that households optimise over an infinite horizon. The final expression for the equilibrium real exchange rate becomes,

$$\langle 7 \rangle \quad e^* = e^*(G_N, G_T, z, r_W)$$

where, r_W is the world interest rate.

The derivation above is for illustrative purpose. It serves to show how the fundamentals (for example, government consumption, terms of trade, investment share, and technical progress) influence the movement of the real exchange rate. For practical application, extensions to the model above can be made in many ways. For example, Baffes *et al* (1999) discuss extensions to the model involving rationing of foreign credit, changes in the domestic relative price of traded goods, and short-run rigidities in domestic wages and prices. An interesting extension in the case of Zambia relates to changes in the terms of trade and trade policy. Changes over time in the terms of trade or trade policy require the real exchange rate to be disaggregated into two; the real exchange rate for imports, and the real exchange rate for exports (see Hinkle and Nsengiyumva, 1999*c*). The equilibrium real exchange rates for imports and exports would then be a function of the fundamentals in equation 7, along with terms of trade (x) and trade policy (h), as in equation in 8.

$$\langle 8 \rangle \quad e^* = e^*(G_N, G_T, z, r_W, x, h).$$

In the empirical literature, researchers focus on fundamentals that are relevant for their particular situations. For example, Edwards (1988:6) identified the following class of fundamental determinants that are domestic and susceptible to policy impact; the composition of government expenditure, import tariffs, import quotas, export taxes, exchange and capital controls and other taxes and subsidies. Other fundamentals may include terms of trade, change in technology, world real interest rates and so on. Below we discuss some of these determinants and try to identify their impact on the real exchange rate.

Terms of trade and Trade Policy

Terms of trade are defined as the relative price of exports to imports. The impact of a change in the terms of trade on the real exchange rate is theoretically ambiguous (see Elbadawi and Soto, 1997, Aron *et al,* 1997, Baffes *et al,* 1999, and Edwards. 1989). This is because the direct income effect operating through the demand for non-tradables may dominate the indirect substitution effect that operates through the supply of non-tradables. For example, to illustrate the impact of the direct income effect, let the price of exports increase, and the price of imports stay constant. This will increase the income of a country whose price of exports has increased (an improvement in the terms of trade). In turn, the increased income raises the demand for all goods, imports and non-tradables. Since the price of imports is given, the higher demand would not affect the price of imports. However, the price of non-tradable goods would increase due to the high demand, and hence a real exchange rate appreciation will occur. If a deterioration in the terms of trade occurred, it may lead to the opposite effect; reducing income and demand for all goods and hence resulting in a depreciation in the real exchange rate.

Sometimes, the indirect substitution effect may dominate the direct income effect, leading to opposite results of any terms of trade effects analysed above. For example, an improvement in terms of trade may provide sufficient foreign exchange resources to producers of non-tradable goods in the economy. Being one of the factors influencing production, the increased resources may then enable the producers to increase their production of non-tradable goods, hence lowering its price. The improvement in the terms of trade may thus lead to a depreciation in the real exchange rate. If terms of trade deteriorated, the producers would face foreign exchange constraints and hence their procurement of inputs for producing non-tradables would be constrained. The constraints in the procurement of inputs would then reduce production and increase the price of non-tradables, leading to

an appreciation in the real exchange rate. In Elbadawi and Soto's (1997) study of seven developing countries, in three cases, an improvement in the terms of trade appreciated the real exchange rate, while in four cases, an improvement in the terms of trade depreciated the real exchange rate. Feyzioglu (1997) also found that an improvement in the terms of trade appreciated the real exchange rate for Finland.

Trade policy is another variable which affects the real exchange rate. A reduction, for example, in an import tariff can decrease the domestic price of imports, which are a part of tradables. This can in turn decrease the local currency price of tradables, leading to an appreciation in the real exchange rate. An increase in import tariffs can have the opposite effect. That is, it can raise the domestic price of imports, thereby depreciating the real exchange rate. However, the demand for imports and consequently for foreign exchange will increase, leading to a depreciation in the real exchange rate. In their study of Côte d'Ivoire and Burkina Faso, Baffes *et al* (1999) found results consistent with the theory; that reforms that are aimed at liberalising trade are consistent with a depreciated real exchange rate.

Government consumption spending also affects the real exchange rate. The impact of government consumption depends on whether such consumption is predominantly on traded goods or non-traded goods. Following Edwards (1989), we will illustrate this by assuming two periods, 1 and 2. We can further simplify the illustration by assuming away distortionary taxes. Let us assume an increase in government consumption of non-tradables in period 1. Assume further that borrowing from the public or international sources finances this. The equilibrium real exchange rate will be affected in two possible ways. Period 1 may witness an increase in demand for goods and services, which will lead to an increase in the price of non-tradables. This will lead to an appreciation in the equilibrium real exchange rate. However, in period 2, the government may have to hike taxes to pay the debt. This may reduce

disposable income, and hence reduce aggregate demand. Such a movement will reduce the price of non-tradables, and thus lead to a depreciation in the equilibrium real exchange rate. From this, it may be noted that it is not possible to tell *a priori* the effect of changes in government consumption of non-tradables on the equilibrium real exchange rate. The same situation obtains in analysing the impact of changes in government consumption of tradables on the equilibrium real exchange rate (Edwards, 1989). Edwards (1989) found that an increase in government consumption appreciated the real exchange rate in four of the equations he estimated for a group of twelve developing countries, while in the other two equations, an increase in government consumption depreciated the real exchange rate.

Capital inflows affect the relative price of tradables to non-tradables, and hence the real exchange rate. For example, if there is an exogenous capital inflow, it can increase the demand for non-tradable commodities, hence raising its price in the process. This would in turn appreciate the real exchange rate. In his study of twelve developing countries, Edwards (1989) found that an increase in capital inflows appreciated the real exchange rate, as expected.

Central bank reserves indicate the capacity of the bank to defend the currency (Aron *et al*, 1997). As such, an increase in reserves has the effect of appreciating the real exchange rate, while a decrease in reserves depreciates the real exchange rate. In their study of the determinants of the real exchange rate for South Africa, Aron *et al* (1997) found results consistent with theory; an increase in reserves appreciated the real exchange rate.

Investment share's effect on the real exchange rate depends on whether an increase in investment changes the composition of spending on traded and non-traded goods. If an increase in the share of investment in *GDP* changes the composition of

spending towards traded goods, it would lead to a depreciation in the real exchange rate (Baffes *et al,* 1999; Edwards, 1989). On the other hand, a change towards non-traded goods appreciates the real exchange rate. For example, Baffes *et al* (1999) found that an increase in the share of investment in *GDP* depreciated the real exchange rate in Côte d'Ivoire. Edwards (1989) also found that increases in the share of investment in *GDP* resulted in a depreciation in the real exchange rate in his study of twelve developing countries.

The growth rate of real Gross Domestic Product is normally used in empirical studies to proxy technological progress (Edwards, 1989). Ricardo is said to have been the first one to postulate a negative relationship between economic growth and the relative price of tradable to non-tradable goods. Other authors also pointed out the tendency for the relative price of tradables to non-tradables to decline over time. For example, Balassa indicated that the rate of productivity growth is higher in countries with higher rates of growth, and that within these countries, the productivity gains are higher in the tradable sector (Edwards, 1989).

Edwards (1989) formally incorporated the effect of technological progress in his model. According to his model, the effect of technological progress on the real exchange rate depended on two things; how technological progress affected different sectors, and the type of progress considered, whether product augmenting or factor augmenting (Edwards, 1989:48). If any productivity shock occurred, it would have a positive income effect, which would in turn generate a positive demand pressure on non-tradable goods. The increased demand would increase the price of non-tradables, and hence lead to an appreciation in the real exchange rate. However, technological progress could also depreciate the real exchange rate. This could happen if technological progress resulted in supply effects and if these more than offset the demand effects. The implication is that technological progress could appreciate or depreciate the real exchange rate. Edwards (1989) found that an

increase in technological progress depreciated the real exchange rate in all his regressions. Aron *et al* (1997), on the other hand, found that an increase in technological progress appreciated South Africa's real exchange rate.

5 Empirical Analysis

This section discusses the data, estimation and empirical results.

5.1 The Data

The data in this study was obtained from the *IFS CD-ROM*, *OECD CD-ROM*, publications from the Bank of Zambia, the Ministry of Finance and the United Nations. The description of the variables used is given in Appendix 1. All the variables are in logs, except for the growth rate of real Gross Domestic Product, which proxies technological progress. The data used is annual, covering the period 1965 to 1996.

In most theoretical studies, the real exchange rate is defined as the ratio of the prices of tradable to non-tradable goods. In practice, however, the prices of tradable and non-tradable goods are difficult to get. Instead, proxies are used, and often, foreign wholesale price indices are used to proxy the prices of tradables, and consumer price indices are used to proxy prices of non-tradable goods. Hinkle and Nsengiyumva (1999*c*) have noted that this measure of the real exchange rate may be appropriate to use in situations where the terms of trade facing a particular country under study are stable. It therefore makes its use for developing countries inappropriate, since most of them export primary products whose prices fluctuate substantially. They recommend that if it is used in developing countries, it should be used to proxy the real exchange rate for imports, and a separate real exchange

rate should be calculated for exports.[9] In our study, we calculate the real exchange rates for imports and exports, and an overall internal real exchange rate using national accounts data. We use the methods suggested by Hinkle and Nsengiyumva (1999*b*,*c*).

We used the parallel market exchange rate between the *US* dollar and the kwacha in our computation of the multilateral real exchange rate for imports for the period 1971 to 1993 during which the parallel market was pervasive. Before 1971, the data for the parallel market is not available, and as such, we use the official rate. After 1993, the parallel market disappeared with the liberalisation of the foreign exchange market. For calculating the real exchange rate after 1993, we used the market-determined rate.

The parallel market was pervasive, as indicated by the parallel market premium. Hence the parallel market exchange rate must have been relevant to economic agents in trade decisions. Edwards (1989) notes that in cases where the parallel market for foreign exchange is widespread, the official exchange rate is irrelevant in constructing real exchange rate indices (see also Hinkle and Nsengiyumva, 1999*a*). Edwards (1989) recommends the use of parallel market exchange rates in such cases. However, for calculating the multilateral real exchange rate for exports, we used the official exchange rate. This is because unlike the importers who could easily use the parallel market for their foreign currency needs, the main exporters, such as *ZCCM*, had to convert their foreign exchange earnings into local currency at the official exchange rate.

We could not find data for the price of tradable and non-tradable goods, and thus we follow the convention and use the wholesale price index for the trading partners

[9]Hinkle and Nsengiyumva (1999*b*) provide a method for calculating the real exchange rate for exports, which we adopt in this study. Given their observation that they do not know of any study that has employed this method empirically, our study is probably the first to implement it.

as a proxy for the price of tradable goods, and the consumer price index for Zambia as a proxy for non-tradable goods. See Appendix 1 for details on how we calculated the real exchange rates for imports (*lrerm*) and exports (*lrerx*), and the internal real exchange rate (*lrera*).

The variables used for fundamentals were determined by three considerations; theory, availability of data, and whether the variable fits well in the model in statistical terms. The long-run fundamentals that we attempted in our estimation are; terms of trade, investment share, government consumption, the growth rate of real *GDP*, openness, trade taxes as a percentage of *GDP*, central bank reserves, government deficit as a percentage of *GDP*, world real interest rates, foreign price level, resource balance, and aid. The fundamentals that performed well in our estimation of the real exchange rate for imports are; terms of trade, investment share, and government consumption, while in the estimation of the real exchange rate for exports, the following variables performed well; terms of trade, central bank reserves, and trade taxes as a percentage of *GDP*. For the internal real exchange rate, the following variables performed well; terms of trade, investment share, and the growth rate of real *GDP*. We could not obtain data on government consumption disaggregated into tradables and non-tradables. We therefore follow a common practice of using aggregate government consumption (see Elbadawi, 1994).

The order of integration of the variables is reported in Table 4. We used the Augmented Dickey Fuller (*ADF*) test for the purpose, with sufficient lags to whiten the residuals. The results show that all the variables, except the nominal exchange rate (which is integrated to order two), are integrated to order one, denoted as *I(1)*.

Table 4: Unit Root Test of the Variables; Annual Data, 1965-1996

Variable	*Trend*	*Lags*	*ADF/DF*	*LM Test for Serial Correlation*	*Order of Integration*
Lrerm	No	0	-1.494	F(1,28) = 2.198 [0.149]	I(1)
ΔLrerm	No	0	-4.355**	F(1,27) = 0.844 [0.366]	I(0)
Lrerx	No	1	-2.036	F(1,25) = 1.459 [0.238]	I(1)
ΔLrerx	Yes	0	-8.128**	F(1,26) = 2.329 [0.139]	I(0)
Lrera	No	0	-2.028	F(2,27) = 1.638 [0.213]	I(1)
ΔLrera	No	1	-5.764**	F(2,24) = 0.567 [0.575]	I(0)
Ltot	No	2	-1.387	F(2,23) = 1.241 [0.308]	I(1)
ΔLtot	No	1	-5.343**	F(2,24) = 1.327 [0.284]	I(0)
Lgcons	Yes	0	-1.319	F(2,26) = 0.362 [0.699]	I(1)
ΔLgcons	Yes	0	-6.257**	F(2,25) = 0.716 [0.498]	I(0)
Lishare	Yes	0	-2.517	F(2,26) = 0.216 [0.807]	I(1)
ΔLishare	No	0	-7.049**	F(2,26) = 1.092 [0.351]	I(0)
Gry	Yes	0	-3.358	F(2,25) = 2.273 [0.124]	I(1)
ΔGry	No	1	-5.353**	F(2,24) = 1.448 [0.255]	I(0)
Loexr	Yes	4	0.872	F(2,18) = 0.036 [0.965]	I(2)
ΔLoexr	Yes	4	-2.664	F(2,17) = 0.816 [0.459]	I(1)
ΔΔLoexr	No	3	-4.237**	F(2,19) = 2.013 [0.161]	I(0)
Lcbresy	No	0	-1.709	F(2,27) = 0.343 [0.713]	I(1)
ΔLcbresy	Yes	0	-7.914**	F(2,25) = 0.364 [0.699]	I(0)
Lttaxy	No	0	-2.229	F(2,27) = 0.418 [0.663]	I(1)
ΔLttaxy	No	2	-4.004**	F(2,22) = 2.959 [0.073]	I(0)
Lopen	No	0	-3.253	F(2,26) = 0.219 [0.804]	I(1)
ΔLopen	No	3	-3.749**	F(2,20) = 0.041 [0.962]	I(0)
Lrms	Yes	0	-1.410	F(2,26) = 0.298 [0.745]	I(1)
ΔLrms	Yes	0	-5.354**	F(2,25) = 0.726 [0.494]	I(0)
Laid	Yes	3	-3.189	F(2,20) = 1.120 [0.346]	I(1)
ΔLaid	No	3	-4.792**	F(2,20) = 2.839 [0.076]	I(0)

*Notes: ADF – Augmented Dickey Fuller; DF – Dickey Fuller; **Significant at 1%; *Significant at 5%.*

5.2 Estimation

We first conducted cointegration analysis using the Johansen procedure to determine whether there is a long-run equilibrium relationship between the variables. Due to limited observations, we could not perform cointegration analysis for all the variables at a go. Instead, we carried out the analysis for four variables (real exchange rate included) at a time. After a series of attempts, we chose a combination whose Vector Autoregressive (VAR) analysis produced good

diagnostic test results.[10] The combination we chose is; terms of trade (*ltot*), investment share (*lishare*), and government consumption (*lgcons*) for the real exchange rate for imports (*lrerm*); terms of trade, central bank reserves as a percentage of *GDP* (*lcbresy*), and trade taxes as a percentage of *GDP* (*lttaxy*) for the real exchange rate for exports (*lrerx).* For the internal real exchange rate (*lrera*), we chose terms of trade (*ltot*), the rate of growth of real *GDP* (*gry*), and investment share (*lishare*).

In employing the Johansen procedure to determine the number of cointegrating vectors, we first estimated an unrestricted *VAR* with sufficient lags. In the *VAR* estimation, due to concerns about the degrees of freedom, we started with a lag length of two. All the second lags were then pared down after checking their significance. After reducing the lag length to one, we checked whether the model reduction was accepted before proceeding (see Table 5). In Table 5, the *F-test* for reducing the number of lags from two to one is accepted for all the three real exchange rates. The information criteria, except the *AIC* for the case of the real exchange rate for imports, accept the reduction. The log-likelihood value also supports the reduction for all the three real exchange rates.

Furthermore, after testing for the inclusion of deterministic terms (see Table 1 in Appendix 3), we included the constant as a restricted variable. The dummies entered unrestricted in the *VAR*.[11] We did not include the trend.

[10]We tried other variables in combination but could not get any set of cointegrated variables. Some of the variables we tried are; world real interest rate, deficit as a percentage of *GDP*, trade taxes as a percentage of *GDP* and several proxies of trade policy, aid flows, central bank reserves as a percentage of *GDP* and resource balance. We were particularly surprised by not finding any cointegration that includes aid flows in the model. White and Edstrand (1994) in a different study also failed to establish a cointegration relationship between aid flows and the real exchange rate in Zambia.

[11]See Doornik *et al* (1998) on the role of deterministic terms in cointegration analysis, in which they strongly recommend that impulse dummies should be entered unrestrictedly. The dummy used for *lrerm* was for the period 1988 when it depreciated sharply, while for the *lrerx*, the dummy was for 1990 when it appreciated. The inclusion of the dummies improved the diagnostic test results of the real exchange rate equations and the *VAR* in general.

Table 5: Model Reduction

RER	*Lags*	*T*	*P*	*Log-likelihood*	*SC*	*HQ*	*AIC*	*Test of model reduction*[1]
RER for Imports	1	30	24 OLS	213.84	-11.54	-12.30	-12.66	F(16,52) = 1.59 [0.11]
	2	30	40 OLS	231.91	-10.93	-12.20	-12.79	
RER for Exports	1	30	24 OLS	194.19	-10.23	-10.99	-11.35	F(16,52) = 1.07 [0.41]
	2	30	40 OLS	207.08	-9.27	-10.54	-11.13	
Internal RER	1	30	20 OLS	227.09	-12.87	-13.51	-13.81	F(16,55) = 1.14 [0.34]
	2	30	36 OLS	240.11	-11.93	-13.07	-13.61	

Notes: [1]From two lags to one lag; T- sample size; p – number of coefficients; SC - Schwarz Information Criteria; HQ - Hannan-Quinn Information Criteria; AIC - Akaike Information Criteria.

We also checked for the properties of the residuals, that is, for normality, serial correlation and heteroscedasticity in the preferred *VAR* model. The diagnostic tests are given in Table 6. The table only reports the diagnostic tests for the overall *VAR*, and it shows that the tests are all insignificant. The diagnostic tests for the other equations were all clear, although they are not reported here.

Table 6: Diagnostic Tests

RER	*Equation*	*Test*	*Test Distribution and Statistic*
RER for Imports	VAR	Normality	$\chi^2(8)$ = 4.7575 [0.7831]
		Serial Correlation	F(32,53) = 1.2695 [0.2171]
		Heteroscedasticity[1]	F(80,52) = 0.7821 [0.8406]
		Heteroscedasticity[2]	F(140,25) = 0.3798 [0.9998]
RER for Exports	VAR	Normality	$\chi^2(8)$ = 9.9392 [0.2693]
		Serial Correlation	F(32,49) = 1.1557 [0.3146]
		Heteroscedasticity[1]	F(80,52) = 0.9095 [0.6532]
		Heteroscedasticity[2]	F(140,17) = 0.5905 [0.9702]
Internal RER	VAR	Normality	$\chi^2(8)$ = 10.8870 [0.2082]
		Serial Correlation	F(32,56) = 1.1517 [0.3158]
		Heteroscedasticity[1]	F(80,56) = 0.8533 [0.7473]
		Heteroscedasticity[2]	F(140,33) = 0.5768 [0.9850]

Notes: [1]Using squares; [2]Using squares and cross products.

5.3 Cointegration Results

Table 7 gives the results of the cointegration analysis. For the real exchange rate for imports, both statistics, that is, the l_{trace} and l_{max} statistics show that the null hypothesis for no cointegration is rejected in favour of the alternative that there is one cointegrating vector. However, when adjusted for degrees of freedom, the l_{trace} statistic is exactly equal to the critical value at 5 percent. Thus, at 10 percent, the l_{trace} statistic would show that there is one cointegrating vector. The l_{max} statistic reports no cointegration for the real exchange rate for imports when adjusted for degrees of freedom. Such conflicting results are not uncommon in cointegration analysis. By using both the adjusted and unadjusted l_{trace} statistic at 10 percent, we proceeded with an assumption of one cointegrating vector. Our conclusion is supported by the plot showing the first vector in the cointegration space that appeared close to being stationary (see Figure 2a in Appendix 3).

Table 7: Cointegration Results

RER	*Ho:rank=p*	l_i	l_{max}	*Adj. for df*	*95% CV*	l_{trace}	*Adj. for df*	*95% CV*
RER for Imports	p == 0	-	28.69*	24.98	28.1	60.97**	53.1	53.1
	p <= 1	0.60	22.02*	19.18	22.0	32.29	28.12	34.9
	p <= 2	0.51	7.501	6.533	15.7	10.26	8.938	20.0
	p <= 3	0.22	2.76	2.404	9.2	2.76	2.404	9.2
RER for Exports	p == 0	-	33.28**	29.99*	28.1	51.84	45.15	53.1
	p <= 1	0.66	12.69	11.05	22.0	18.56	16.16	34.9
	p <= 2	0.34	3.872	3.373	15.7	5.866	5.109	20.0
	p <= 3	0.12	1.994	1.737	9.2	1.994	1.737	9.2
Internal RER	p == 0	-	32.35*	28.17*	28.1	69.32**	60.37**	53.1
	p <= 1	0.65	16.92	14.73	22.0	36.97*	32.2	34.9
	p <= 2	0.42	14.93	13	15.7	20.05*	17.46	20.0
	p <= 3	0.38	5.127	4.465	9.2	5.127	4.465	9.2

*Notes: **Significant at 1 percent; *Significant at 5 percent; The column denoted by l_i reports the eigenvalues.*

For the real exchange rate for exports, the l_{max} statistics shows that the null hypothesis of no cointegration is rejected in support of the alternative of one cointegrating vector, even when adjusted for degrees of freedom. However, the l_{trace} statistic shows no cointegration at all. We once again proceeded with the assumption that there is one cointegrating vector using the l_{max} statistic. The plot of the first cointegrating vector is given in Figure 2b in Appendix 3.

For the internal real exchange rate, the l_{trace} and l_{max} statistics show that the null of no cointegration is rejected. However, the l_{trace} also shows that there may be three cointegrating vectors, although when adjusted for degrees of freedom, it shows that there is only one cointegrating vector. We also proceeded with the assumption that there is one cointegrating vector. Figure 2c in Appendix 3 plots the first cointegrating vector.

Assuming we have one cointegrating vector for all three real exchange rate indices, we then investigated whether we could use a single equation rather than a multivariate procedure for estimating an error-correction model for each of the three real exchange rates. The use of a single equation would be appropriate for preserving the degrees of freedom. Two conditions need to be fulfilled; having a single cointegrating vector, and establishing that the variables are weakly exogenous (Harris, 1995).

To test for weak exogeneity, we imposed restrictions on the a vector that the relevant variables were equal to zero, together with a general restriction of a single cointegrating vector. Initially, we tested for each variable individually, and the restriction was accepted for all variables except investment share in the models for the real exchange rate for imports and the internal real exchange rate. However, at the 1 percent level of significance, the restriction was also accepted for investment share (see Table 8). We then imposed a joint restriction that all variables are weakly

exogenous. This restriction was tested within the framework of a single cointegrating vector. The joint restriction could not be rejected for the real exchange rates for imports and exports, while for the internal real exchange rate, it was rejected at 5 percent. However, the restriction could not be rejected at 1 percent (see Table 8).

Table 8: Multivariate Test for Weak Exogeneity

Variable	*RER for Imports*	*RER for Exports*	*Internal RER*
Ltot	$\chi^2(1) = 0.0033$ [0.9539]	$\chi^2(1) = 1.3871$ [0.2389]	$\chi^2(1) = 0.0053$ [0.9421]
Lishare	$\chi^2(1) = 2.3387$ [0.1262]*	--	$\chi^2(1) = 5.6052$ [0.0179]*
Lgcons	$\chi^2(1) = 0.0109$ [0.9168]	--	--
Lcbresy	--	$\chi^2(1) = 0.1420$ [0.7063]	--
Lttaxy	--	$\chi^2(1) = 3.2083$ [0.0733]	--
Gry	--	--	$\chi^2(1) = 2.4752$ [0.1157]
All	$\chi^2(3) = 2.4606$ [0.4825]	$\chi^2(3) = 6.5475$ [0.0878]	$\chi^2(3) = 8.3611$ [0.0391]*

*Notes: *Significant at 5 percent.*

The cointegration results where the joint restrictions of one cointegrating vector and weak exogeneity are imposed are reported in Table 9. The variables are all significant, and the results show that the real exchange rate for imports depreciates if terms of trade improve, or if government consumption increases. However, the real exchange rate for imports appreciates if investment share increases. The real exchange rate for exports also depreciates if terms of trade improve, but it appreciates if central bank reserves and trade taxes increase. The internal real exchange rate depreciates if terms of trade improve, while it appreciates if investment share and the rate of growth of real *GDP* increase.

Table 9: Cointegration Analysis with Restrictions

RER for Imports				
β'				
Lrer	Ltot	Lishare	Lgcons	Constant
1.0000	-0.32059	1.6647	-1.8994	-3.4373
(0.00000)	(0.18576)	(0.37606)	(0.41534)	(0.69094)
α				
Lrer				
-0.39410				
(0.06286)				
RER for Exports				
β'				
Lrer	Ltot	Lcbresy	Lttaxy	Constant
1.0000	-0.70045	0.57004	0.31376	-1.2053
(0.0000)	(0.073806)	(0.17149)	(0.10608)	(0.64649)
α				
Lrer				
-0.78046				
(0.11882)				
Internal RER				
β'				
Lrer	Ltot	Lishare	Gry	Constant
1.0000	-0.46724	0.30948	0.48165	-3.6667
(0.0000)	(0.048825)	(0.085971)	(0.14849)	(0.16898)
α				
Lrer				
-0.77907				
(0.12385)				

Notes: The figures in parentheses are standard errors.

The positive and significant effect of the terms of trade on the real exchange rate indices that we found implies that the substitution effect dominates the income effect. The substitution effect may have been on the supply side, in which case an improvement in the terms of trade may have relaxed the foreign exchange constraints on intermediate inputs in the production of non-tradables. This in turn helped the producers to increase the supply of non-tradable goods, and hence lowering the price of non-tradables. This resulted in the depreciation in the real

exchange rate indices (see also, Elbadawi and Soto, 1997).

Aron (1999) also observed the same positive effect of the terms of trade on the real exchange rate. In Aron's study, evidence is presented to illustrate that the relative prices of two non-tradable sectors, namely services and construction, increased sharply after the first copper price boom, then fell over time after 1974. Furthermore, it may be noted that there were price controls[12] in Zambia, which mainly affected food items. The price controls helped to keep the prices of non-tradables lower than the level they would have been at in a free market. The dominance of the substitution effect over the income effect that we found is not unusual. Elbadawi and Soto (1997) also found that the substitution effect dominated the income effect in Côte d'Ivoire, Ghana and India.

The coefficient on government consumption for the real exchange rate for imports is also positive and significant. In a way, this result comes as a bit of a surprise to us. This is because the result suggests that in the case of Zambia, government consumption has largely been in tradable commodities. Even though we could not obtain detailed data on the composition of government consumption, a general review of some statistics reveals that a large percentage of government consumption consists of wages and salaries, followed by recurrent departmental charges.[13] We consider labour as a non-tradable good in Zambia. However, in the empirical literature, we found that the same results have been obtained from studies on developing countries (see for example, Elbadawi and Soto, 1997; and Edwards, 1989).

[12]From independence, price controls were applied to producer prices of agricultural goods, prices of "essential commodities", and prices of some goods of parastatal companies (Aron, 1999). Some prices were liberalised in 1989, although maize was not liberalised until 1992.

[13]A further disaggregation done by Aron (1999) indicates that of the recurrent expenditure by the government, a significant proportion has been in "constitutional and statutory expenditure", of which defence has been increasing, apart from government debt. The other category of recurrent expenditure, which comprises of mainly salaries, has virtually been sustained at the same percentage.

The coefficient on investment share found for the real exchange rate for imports and the internal real exchange rate is negative and significant. It suggests that gross fixed capital formation has affected more the relative price of non-tradable commodities. It was not possible to get a detailed disaggregation of the data on gross fixed capital formation except that between 40 and 20 percent of it has been in residential and non-residential buildings, and land improvements. The other percentage has been in a category classified as "other". Since most of the investment is in buildings that are constructed using locally produced cement and materials, this might have contributed in increasing the price of non-tradables, and hence appreciating the real exchange rate. Combined with this result that investment share has had the effect of increasing the price of non-tradables, the implication is that the demand side effect of investment has been stronger than the supply side effect of investment.

The coefficient on central bank reserves is negative and significant. It indicates that an increase in central bank reserves appreciates the real exchange rate for exports. This is consistent with theory. Aron *et al* (1997) also found that in the case of South Africa, an increase in reserves appreciates the real exchange rate. The coefficient on trade taxes is negative. It implies that when trade taxes increase, they appreciate the real exchange rate for exports. This is because when trade taxes increase, they increase the domestic prices of imported goods. The increase in prices makes consumers to shift their demand to locally produced substitutes, and hence increasing their prices, leading to an appreciation in the real exchange rate for exports (see Hinkle and Nsengiyumva, 1999*c*).

Lastly, the rate of growth of real *GDP* appreciates the internal real exchange rate. The coefficient is negative and significant. This implies that the rate of technical progress has increased the prices of non-tradable goods over time, and hence

appreciating the real exchange rate.

We then conducted further tests on the cointegration results. We tested whether each of the explanatory variables could be excluded from the equation individually and jointly. The results of the exclusion tests are given in Table 10. They show that all explanatory variables, except the growth rate of real *GDP* in the internal real exchange rate model, cannot be excluded from the cointegrating vectors. Although the multivariate test for exclusion of variables shows that the growth rate of real *GDP* could be excluded from the cointegration vector, we could not drop it given its significance, as indicated by its standard error in Table 9.

Table 10: Multivariate Test for Exclusion of variables

Variable	*RER for Imports*	*RER for Exports*	*Internal RER*
Ltot	$\chi^2(1) = 4.4335$ [0.0352]*	$\chi^2(1) = 18.018$ [0.000]**	$\chi^2(1) = 13.542$ [0.0002] **
Lishare	$\chi^2(1) = 5.9931$ [0.0144]*	--	$\chi^2(1) = 12.897$ [0.0003] **
Lgcons	$\chi^2(1) = 3.9071$ [0.0481]*	--	--
Lcbresy		$\chi^2(1) = 9.6793$ [0.002]**	
Lttaxy		$\chi^2(1) = 9.8285$ [0.002]**	
Gry	--	--	$\chi^2(1) = 1.3814$ [0.2399]
Lrer	$\chi^2(1) = 5.6321$ [0.0176]*	$\chi^2(1) = 19.587$ [0.0000]**	
All	$\chi^2(4) = 18.844$ [0.0008]**	$\chi^2(4) = 28.093$ [0.0000]**	$\chi^2(4) = 9.7307$ [0.0018] **

*Notes: **Significant at 1 percent. *Significant at 5 percent.*

5.4 Error-correction Model: Estimation and Results

We then estimated error-correction models by using single equations. We did this in order to capture short-run determinants of the real exchange rates. The error-correction terms were obtained from the solved static long-run equations reported in Table 11. As expected, the long-run parameter estimates are the same as the ones calculated by the multivariate Johansen technique in Table 9. The output in Table

11 includes the *Wald test,*[14] which rejects the null that all long-run coefficients are zero at the 95 percent level of significance. The *Wald test* supports the multivariate tests we did on exclusion of variables (see Table 10).

Table 11: Solved Static Long-run Equations

RER for Imports

Lrerm =	+3.438	+0.3206 Ltot	-1.665 Lishare	+1.899 Lgcons	+3.907 d1988
(SE)	(1.171)	(0.2561)	(0.5621)	(0.5588)	(1.179)

ECM = Lrerm - 3.4376 - 0.3206*Ltot3 + 1.6646*Lishare - 1.8995*Lgcons - 3.9075*d1988;
WALD Test $\chi^2(4)$ = 38.374 [0.0000]**

RER for Exports

Lrerx =	+1.2053	+0.7005 Ltot	-0.57 Lcbresy	-0.3138 Lttaxy	-0.966 d1990
(SE)	(0.8794)	(0.09214)	(0.2168)	(0.1487)	(0.3327)

ECM = Lrerx - 1.205 - 0.7005*Ltot + 0.5700*Lcbresy + 0.31376*Lttaxy + 0.9664*d1990;
WALD test $\chi^2(4)$ = 289.7 [0.0000]**

Internal RER

Lrera =	+3.667	+0.4672 Ltot	-0.309 Lishare	-0.4817 Gry
(SE)	(0.2764)	(0.2197)	(0.1383)	(0.0727)

ECM = Lrera – 3.66675 - 0.467233*Ltot + 0.309472*Lishare + 0.481655*Gry;
WALD Test $\chi^2(3)$ = 62.096 [0.0000]**

*Notes: lrerm – RER for Imports; Lrerx – RER for Exports; lrera – Internal RER; The figures in Parentheses are standard errors. **Significant at 1 percent.*

In the error-correction models, several stationary variables were included to capture the short-run dynamics. These include all the variables in the cointegration vector differenced once. Other stationary variables included are real money supply, openness, and aid flows, also differenced once, and the official nominal exchange rate differenced twice. General unrestricted models were estimated. In order to develop parsimonious models, we progressively eliminated variables that were insignificant, and we also re-parameterised some variables. In the progressive

[14]The *Wald test* is a test of the null that all long-run coefficients, except the constant, are zero (Harris, 1995).

elimination and re-parameterisation, we were guided by the information criteria and the *t*-statistic (Hendry, 1995; Adam, 1992). The steps we took to arrive at the parsimonious models are given in Table 2 in Appendix 2. The parsimonious models are given in Table 12.

Table 12: Parsimonious Error-correction Models

Dependent Variable: Dlrer[1]	*RER for Imports*	*RER for Exports*	*Internal RER*
Constant	-0.0534 (0.0489)	0.0244 (0.0400)	0.0012 (0.0215)
*ECT*_1	-0.3811 (0.2554)	-0.7891 (0.2420)	-0.7971 (0.1370)
ΔLrer_2		0.2184 (0.1225)	
ΔΔLrer_1	0.2272 (0.1003)		
ΔLgcons	1.1081 (0.3786)		
ΔLgcons_1	0.9042 (0.3557)		
ΔLishare	-0.8970 (0.2708)		
ΔLishare_1	-0.5743 (0.2756)		
ΔLtot		0.5307 (0.1852)	0.3557 (0.0958)
ΔΔLtot_1			0.1827 (0.0721)
ΔLaid_1			0.0874 (0.0374)
ΔGry_2			
ΔLcbresy		-0.4094 (0.1828)	
ΔLcbresy_1		-0.4699 (0.1800)	
ΔΔLoexr		0.4478 (0.1842)	
ΔLopen	0.8185 (0.3531)		
ΔLopen_1	1.0935 (0.3533)		
ΔLrms			0.2648 (0.1013)
Dummy	2.0397 (0.3321)	-0.9770 (0.2141)	
Diagnostics			
R-Squared	0.77	0.80	0.78
Serial Correlation	F(2,17) = 1.846 [0.188]	F(2,18) = 1.354 [0.283]	F(1,22) = 0.090 [0.767]
ARCH 1	F(1,17) = 0.995 [0.332]	F(1,18) = 1.691 [0.210]	F(1,21) = 0.000 [0.990]
Normality	$\chi^2(2)$ = 1.299 [0.522]	$\chi^2(2)$ = 0.102 [0.950]	$\chi^2(2)$ = 4.785 [0.091]
RESET	F(1,18) = 1.876 [0.188]	F(1,19) = 0.005 [0.944]	F(1,22) = 0.628 [0.437]

Notes: [1]Refers to respective real exchanges; ECT – error correction term; The figures in parentheses are standard errors.

The results in Table 12 show the short-run effects on the real exchange rate indices. All the variables, except for the constants, are significant. In the model for the real exchange rate for imports, a change in investment share appreciates the real

exchange rate. This means that the long-run and short-run effects of investment share on the real exchange rate for imports is the same. The variables that depreciate the real exchange rate for imports are the second difference of the real exchange rate (lagged once), the first difference of government consumption (lagged once), and the first difference of openness (also lagged once). Although the openness variable did not enter in any of the real exchange rate models in the cointegration, it shows that in the short-run, an increase in the openness of the Zambian economy tends to depreciate the real exchange rate for imports.

In the model of the real exchange rate for exports, a change in the first difference in central bank reserves (and lagged once) leads to an appreciation in the real exchange rate. The effect of central bank reserves in both the long-run and short-run is the same. A depreciation in the real exchange rate for exports occurs due to a change in the following variables; the first difference of the real exchange rate lagged twice, the first difference of terms of trade, and the second difference of the nominal exchange rate. The substitution effect, once again, dominates the income effect in the terms of term effect, while a devaluation in the nominal exchange rate, as expected, leads to a depreciation in the real exchange rate for exports.

In the model for the internal real exchange rate, the following variables depreciate the real exchange rate in the short-run; the first difference of terms of trade, and the second difference of terms of trade lagged once, the first difference of aid, and the first difference of real money supply. This is as expected. In the short-run, once again, the substitution effect of a change in the terms of trade seems to dominate the income effect. The effect of aid flows has been to depreciate the internal real exchange rate. This can be explained by the fact that aid inflows may have eased the intermediate input constraints on producers, hence contributing to an increase in the supply of non-tradable goods, whose prices in turn fell. An increase in real money supply, as expected, depreciates the real exchange rate. This comes about

due to an increase in aggregate demand, which increases the demand for all goods, including imports. The increase in demand for imports creates a higher demand for foreign exchange, hence depreciating the nominal and real exchange rates.

However, of significance to note in the error-correction models are the coefficients of adjustment, which are -0.38, -0.79, and -0.80 for the real exchange rates for imports and exports, and the internal real exchange rate, respectively. These coefficients indicate that the speeds of adjustment of the real exchange rates for imports and exports in Zambia are quite different, with the speed of adjustment for the real exchange rate for exports being almost twice the size of the one for the real exchange rate for imports. The reason for the difference could be that since imports are necessary to the economy, adjusting after a shock could be quite slow. The speed of adjustment for the internal real exchange rate is as high as the one for the real exchange rate for exports.

The speeds of adjustment for the real exchange rate for exports and the internal real exchange rate are higher than the ones for Chile and Mexico (see Table 13, which gives estimates of speeds of adjustment for seven countries as reported by Elbadawi and Soto, 1997). We may also point out that Feyzioglu (1997) obtained an estimate of -0.11 for the speed of adjustment for Finland. It is notable that a high disparity in the speeds of adjustment exists between countries.

Table 13: Coefficients of Speed of Adjustment

Country	*Estimate of Speed of Adjustment*
Chile	-0.70
Côte d'Ivoire	-0.30
Ghana	-0.91
India	-0.20
Kenya	-0.67
Mali	-0.45
Mexico	-0.70

Source: Elbadawi and Soto (1997).

A manipulation of the error-correction coefficient gives us the adjustment speed in terms of the number of years needed to eliminate a given exogenous shock.[15] According to our calculations, in order to eliminate 99 percent of a shock to the real exchange rate for imports, it would take about nine years, while for the real exchange rate for exports and the internal real exchange rate, it would take about three years.

Having arrived at our final models, we checked how stable the parameters of the models are in the sample period, and also to see whether there were any structural breaks in the model. For this, we plotted the one-step residuals and Chow test statistics. These are given, for each real exchange rate index, in Figures 3 to 5 in Appendix 3. The plots for the one-step residuals show that for all the real exchange rates, the values lie within the error band, indicating no structural break. The plots of the Chow test further support this, showing no statistically significant break.

5.5 Real Exchange Rate Misalignment

As we mentioned in our introductory remarks, one of the reasons for finding the determinants of the real exchange rate is to be able to estimate the degree of misalignment in the real exchange rate. In order to estimate the degree of misalignment in the three real exchange rate measures that we constructed, we used the long-run estimates of the fundamentals to obtain the fitted values of the equilibrium real exchange rates. We then used the Hodrick-Prescott filter to decompose the fitted values into their temporary and permanent movements. The

[15]The formula for the adjustment speed in terms of the number of years is given by; $(1-\beta_0) = (1-|\alpha_0|)^t$, where, t is the number of years, α_0 is the error-correction coefficient, and β_0 is the percentage of a shock to be dissipated (see Aron *et al*, 1997; Elbadawi and Soto, 1997).

equilibrium real exchange rate is then taken to be the permanent movement in the filtered series of the real exchange rate. We calculated the misalignment in the real exchange rate as,

$$\langle 7 \rangle \quad e_{mis} = \frac{RER - ERER}{ERER}$$

where, RER is the actual real exchange rate, and $ERER$ is the equilibrium real exchange rate. The calculated percentages of misalignment for the three real exchange rate measures are given in Table 14, and Figure 6 in Appendix 3 plots the misalignment.

The computed indices of misalignment indicate that the real exchange rates were overvalued and undervalued in a number of episodes. The most notable period is the overvaluation between 1978 and 1984 in the real exchange rate for imports, and between 1982 and 1985 in the real exchange rate for exports. This overvaluation preceded the introduction of the auctioning system for foreign exchange. The auctioning system itself was an effort to deal with the external imbalance that characterised the period. The auctioning was abandoned in 1987. This may have been the cause for the severe depreciation in the parallel market exchange rate between 1987 and 1990. It is very likely that the parallel market premium then was largely dominated by a risk element due to the loss in government credibility in managing the economic crisis. It is likely therefore that the parallel market rate substantially overshot what would have been the market rate. This probably explains the undervaluation in the real exchange rate for imports between 1987 and 1990.

Table 14: Computed Real Exchange Rate Misalignment (Percentage)

	RER for Imports	*RER for Exports*	*Internal RER*
1966	19.13	2.47	11.08
1967	10.04	-15.81	7.09
1968	-14.01	-9.75	4.45
1969	-18.38	14.72	-44.00
1970	-20.58	20.62	-14.02
1971	41.47	-32.43	12.51
1972	24.65	-2.32	8.02
1973	-35.65	-6.83	-21.50
1974	-1.18	70.64	-29.49
1975	32.57	1.49	13.10
1976	63.03	8.77	10.99
1977	39.89	-7.11	16.31
1978	-4.99	-4.23	23.72
1979	-26.01	24.83	-12.74
1980	-28.60	22.65	-10.64
1981	-43.47	6.66	5.23
1982	-48.24	-21.40	21.98
1983	-48.12	-17.19	9.76
1984	-25.57	-17.21	0.41
1985	2.06	-1.40	-5.46
1986	3.29	40.52	-16.38
1987	45.07	-21.72	-16.28
1988	349.34	-12.44	-7.26
1989	108.50	47.27	12.16
1990	21.53	-33.29	-17.83
1991	8.06	-20.25	-6.24
1992	20.40	-8.51	16.38
1993	-26.87	-0.63	8.46
1994	-39.16	7.64	-1.00
1995	-21.70	2.37	-10.05
1996	-9.81	37.31	-3.96

The misalignment in the real exchange rate for exports during the auctioning has been well captured. The sale of foreign exchange that the Bank of Zambia did not have caused frantic bidding, resulting in a fall in the value of the kwacha. The rapid depreciation in the exchange rate is captured by the undervaluation in the real exchange rate after 1985. However, when the Bank of Zambia incurred some losses due to buying foreign exchange at a higher price than they had agreed to sell it at, they resorted to printing more money. The increase in liquidity was inflationary,

that is, it increased the prices of non-tradables, hence appreciating the real exchange rate. This again, is captured by the period of overvaluation from 1987.

In general, and as one would expect, the episodes of overvaluation are predominant. Whether these episodes trace adequately the actual overvaluation in Zambia will of course depend on the reliability of the data used. It is well known that there were substantial price controls for commodities particularly in the period prior to 1989. This may make the official consumer price index suspect. It is also true that tracking the long-run equilibrium is quite tricky, and the method employed here can at best only provide a crude estimate.

6 Summary and Conclusions

This paper set out to find the main determinants of the real exchange rate in Zambia, and to estimate the degree of misalignment in the real exchange rate. The importance of the real exchange rate is well documented in the literature, and was very briefly reviewed in this paper.

First, a brief synopsis of the Zambian economy was provided, followed by a brief review of literature pertaining to the real exchange rate. Then an illustrative model of real exchange rate determination was presented.

Cointegration analysis was employed in identifying and estimating the long-run determinants (the fundamentals) of the three real exchange rates in Zambia, namely the real exchange rates for imports and exports, and the internal real exchange rate. In the long-run, the following fundamentals were found to influence the real exchange rate for imports; terms of trade, investment share, and government consumption, while terms of trade, central bank reserves, and trade taxes were

found to be the long-run determinants of the real exchange rate for exports. For the internal real exchange rate, we found the following long-run determinants; terms of trade, investment share, and the rate of growth of real *GDP*. The next step involved estimation of error-correction models, in order to identify short-run determinants of the real exchange rates. Since one cointegrating vector was found for all real exchange rates, and all explanatory variables were weakly exogenous, we employed a single-equation method in the error-correction models. Apart from the difference of the fundamentals mentioned above, the flow of aid and real money supply were found to impart short-run effects on the internal real exchange rate. The nominal exchange rate and openness were also found to have short-run effects on the real exchange rates for exports and imports, respectively. The coefficients of adjustment were found to be -0.38, -0.79, and -0.80 respectively for the real exchange rates for imports and exports, and for the internal real exchange rate.

The degree of misalignment in the three real exchange rates was then calculated as the difference between the actual real exchange rate and the long-run equilibrium real exchange rate. The latter was obtained from the permanent component of the fitted values of the real exchange rate in the cointegration analysis. The real exchange rates were found to be overvalued in several periods.

A note of caution is needed with regards to the results in this paper. Whereas the method employed has been well refined and can reasonably invite confidence, the data used may not necessarily be good enough. The first obvious weakness in the study is the paucity of the sample. The small sample is a problem common to annual time-series data on African countries. Even smaller samples have been used in other studies on African countries (see for example, Baffes *et al*, 1999; Kadenge, 1998; and Elbadawi and Soto, 1997). The second weakness with regards to the data is on the domestic price level and the nominal exchange rate. With regards to the former, Zambia had price controls, which were particularly widespread prior to

1989. It is not possible to determine the extent to which the controlled prices were relevant to households compared to the parallel market prices. Unfortunately, data on the parallel market for goods is not available.

With regards to the nominal exchange rate, a fixed and non-convertible exchange rate regime prevailed prior to 1993. A parallel market for foreign exchange inevitably developed alongside the official "market". One can thus either use the official nominal exchange rate, or the parallel market rate, or, when possible, a weighted average of the two rates (Hinkle and Nsengiyumva, 1999*a*).[16] The analysis here followed the recommendation by Edwards (1991) and employed the parallel market rate between 1971 and 1993, when the parallel market was pervasive, to calculate the real exchange rate for imports. The assumption is that, at the margin, the parallel market rate counts in decisions on trade. We however used the official exchange rate to calculate the real exchange rate for exports. This is because the main exporter in Zambia, the mining company, was controlled by the government, and therefore naturally put up with the official exchange rate.

One interesting implication emerges from the calculated misalignment. In a situation of a controlled economy like Zambia was, it may be tempting to use the parallel market exchange rate as a rough guide to what would be a market-determined exchange rate. However, as noted above, even the parallel market rate can overshoot, particularly if the behaviour of the government increases the risk of holding the local currency. Such seems to have been the case in Zambia during the period after the botched auctioning system.

The other policy implication can be derived from adjustments to equilibrium from disequilibrium due to short-run changes. The error-correction models show that the rates of change in government consumption, investment share, central bank

[16]The weights can be the percentage of transactions at the official and parallel rates. However, no data exists on the volume of transactions at the parallel market exchange rate.

reserves, the nominal exchange rate, and openness all have a significant effect on the rate of change in the actual real exchange rate. This suggests possibilities for policy actions to correct for misalignment.

Despite the weaknesses pointed out above, this study makes important contributions in several respects. It seems to be the first study of this type on Zambia, and in general, the application of cointegration econometrics on real exchange rate studies is still in its infancy in Africa. Moreover, this is the first study to have estimated the three versions of the real exchange rate. Such an attempt has been avoided for being too daunting (Hinkle and Nsengiyumva, 1999*b*).

Lastly, the findings here concur with the view that the equilibrium real exchange rate is not constant over time, but responds to changes in a range of fundamentals and shocks to the economy (Aron *et al*, 1997). The determinants of the real exchange rate examined here may help in addressing issues of misalignment.

Appendix 1

Definition of variables

Lrerm - the log of the multilateral real exchange rate for imports.[17] It is calculated as follows;

$$\langle i \rangle \quad e = \frac{\sum_{i=1}^{k} a_i E_{it} P_{it}^{*}}{P_j}$$

where, e is the multilateral real exchange rate index, E_{it} is the index of the parallel market exchange rate between country i and Zambia in period t; $i = 1,\ldots,k$ denotes the k partner countries that are used in the construction of the index. The five largest trading partners were considered in constructing the index. The weight corresponding to partner i in the construction of the index is denoted by a_i. P_{it}^{*} is the price index of partner i in period t, and it denotes the price of tradables, which is proxied by the wholesale price index of the trading partners. P_j gives the price index for the home country, and it denotes the price of non-tradables. It is proxied by Zambia's consumer price index. According to Hinkle and Nsengiyumva (1999*a*,*b*), although this measure is called the *external* real exchange rate, for developing countries, it measure can be used to proxy the real exchange rate for imports.

Lrerx - the log of the multilateral real exchange rate for exports, calculated as;

$$\langle ii \rangle \quad e = \frac{\sum_{i=1}^{k} a_i E_{it} (1-b) P_{it}^{*} + P_x b}{P_j}$$

where, e is the bilateral real exchange rate, E_{it} is the index of the nominal exchange rate between country i and Zambia in period t; $i = 1,\ldots,k$ denotes the k partner countries that are used in the construction of the index. The five largest trading partners were considered in constructing the index. The weight corresponding to partner i in the construction of the index is the total trade share, and is denoted by a_i. P_{it}^{*} is the price index of partner i in period t. It denotes the price of tradables,

[17] The multilateral indices were constructed using the trade weights for three years of trade data, that is, for 1975, 1985 and 1995.

and it is proxied by the wholesale price index for the trading partners. P_j gives the price index for the home country, and it denotes the price of non-tradable goods, which is proxied by the consumer price index for Zambia. P_x is the price index of copper prices, b is the weight of copper exports in total exports, and (1-b) is the weight of other exports in total exports (see Hinkle and Nsengiyumva, 1999*b*).

Lrera - the log of the internal real exchange rate, which is calculated as follows;

$$\langle iii \rangle \quad e = RERM_N^{a}.RERX_N^{1-a}$$

where, e is the internal real exchange rate, a is the weight of the share of imports in total trade, (1-a) is the weight of the share of exports in total trade, $RERM_N$ is the internal real exchange rate for imports calculated as the ratio of the import deflator to the domestic absorption deflator, $RERX_N$ is the internal real exchange rate for exports calculated as the ratio of the export deflator to the domestic absorption deflator. This measure of the real exchange rate is calculated from national accounts data (see Hinkle and Nsengiyumva, 1999*b* for details on how to calculate the internal real exchange rate using national accounts data).

Ltot – log of the terms of trade. Due to the fact that published data for terms of trade data is not complete, we computed our own index for terms of trade. In doing this, we took into account the following; (i) Copper constitutes the major export from Zambia, (ii) Manufactured goods and oil constitute the major imports to Zambia. Thus, the index of the terms of trade was computed as follows;

$$\langle iv \rangle \quad tot = \frac{p_X}{P_m}$$

where,
P_x is the index of the real dollar price of copper
$P_m = a_i muv_{USA} + a_j po$; where, P_m is the index of the real price of imports; a_i is the weight of manufactured imports to Zambia, calculated as the ratio of the value of manufactured imports to total imports, muv_{USA} is the index of the unit value of exports of manufactured goods of the USA; a_j is the weight of oil imports to Zambia, calculated as the ratio of the value of oil imports to total imports; and $P0$ is index of the real dollar price of oil.

Lgcons – the log of the ratio of real government consumption to real GDP.

Lishare – the log of the ratio of real gross fixed capital formation to real *GDP*.

Lcbresy – the log of the ratio of real central bank reserves to real *GDP*.

Gry – the growth rate of real *GDP*, as a proxy for technological progress.

Lopen – the log of openness. This is a proxy for the stance of trade policy, defined as the ratio of imports at constant prices to domestic absorption at constant prices.

Lttaxy – the log of the ratio of trade taxes to *GDP*.

Lrms – the log of real money supply.

Loexr – the log of the period average of the official nominal exchange rate.

Laid – the log of the ratio of aid flows to *GDP*. Aid flows include total net receipts of Official Development Assistance (*ODA*), Other Official Flows (*OOF*), and private sector flows (*OECD CD-ROM*, 1999).

Appendix 2

Table 1: Test for Inclusion of Deterministic Terms

Model	*Deterministic Terms*[1,]	*Unrestricted log-likelihood*		
		RER for Imports	*RER for Exports*	*Internal RER*
1**	Constant (R), Dummy (U), No trend	203.66493	191.32018	216.55876
2	Constant (U), Dummy (U), No trend	206.78156	193.26206	219.37903
3	Constant (R), Dummy (U), Trend (R)	nc	nc	nc
4	Constant (R), Dummy (U), Trend (U)	nc	nc	nc
5	Constant (U), Dummy (U), Trend (U)	211.16318	196.14174	220.42135
6	Constant (U), Dummy (U), Trend (R)	nc	193.90729	219.73666
7*	No Constant, No trend, Dummy (U)	203.5187	190.76453	213.66416

Notes: [1]For the Internal RER, there is no dummy; U – unrestricted; R – restricted; nc– no cointegrating vector found.

**This is the model that gave the lowest value of the log-likelihood. However, we did not choose this model because the constant takes care of the units of measurement in the estimation (Hansen and Juselius, 1995). The constant should not be included in a model only if there is a strong reason for not including it.*

***Our preferred model. It gave the second lowest value of the unrestricted log-likelihood test statistic.*

Table 2: Steps Taken to Arrive at Models in Table 12

RER	*Steps*	*F-Test for Model Reduction*	*SIC*[1]
RER for Imports			
	1. General error-correction model		-1.35404
	2 Excluded Δltot, Δltot_1, Δltot_2, Δlaid, Δlaid_1, Δlaid_2, Δlopen_2	F(7,9) = 0.6569 [0.7035]	-1.75412
	3. Excluded Δlgcons_2, Δlishare_2	F(2,16) = 0.7199 [0.5025]	-1.90033
	4. Repalced Δlrer_1 and Δlrer_2 with ΔΔlrer_1	F(1,18) = 0.0261 [0.8735	-2.015
RER for Exports			
	1. General error-correction model		-2.09985
	2. Excluded Δltot_1, Δltot_2, Δloexr_1, Δloexr_2	F(4,11) = 0.2469 [0.9056]	-2.48989
	3. Excluded Δlrer_1, Δlcbresy_2, Δlttaxy, Δlttaxy_2	F(4,15) = 0.7613 [0.5665]	-2.7811
	4. Excluded Δlttaxy_1	F(1,19) = 1.3606 [0.2579]	-2.83095
Internal RER			
	1. General error-correction model		-2.93317
	2. Excluded Δlrms_1, Δlrms_2, Δlrer_1, and Δlrer_2	F(4,10) = 0.1722 [0.9477]	-3.33102
	3. Excluded Δlishare and Δlishare_2	F(2,14) = 0.0262 [0.9741]	-3.5595
	4. Excluded Δgry, Δgry_1, and Δgry_2	F(3,16) = 0.6364 [0.6024]	3.79511
	5. Excluded Δlaid, Δlaid_2	F(2,19) = 0.7066 [0.5058]	-3.95559
	6. Excluded Δlishare_1	F(1,21) = 1.5087 [0.2329]	-4.00233
	7. Replaced Δltot_1 and Δltot_2 with ΔΔltot_1	F(1,22) = 0.3198 [0.5774]	-4.10401

Note: [1]Schwarz Information Criteria.

Appendix 3

Figure 1: Evolution of the Black Market Premium

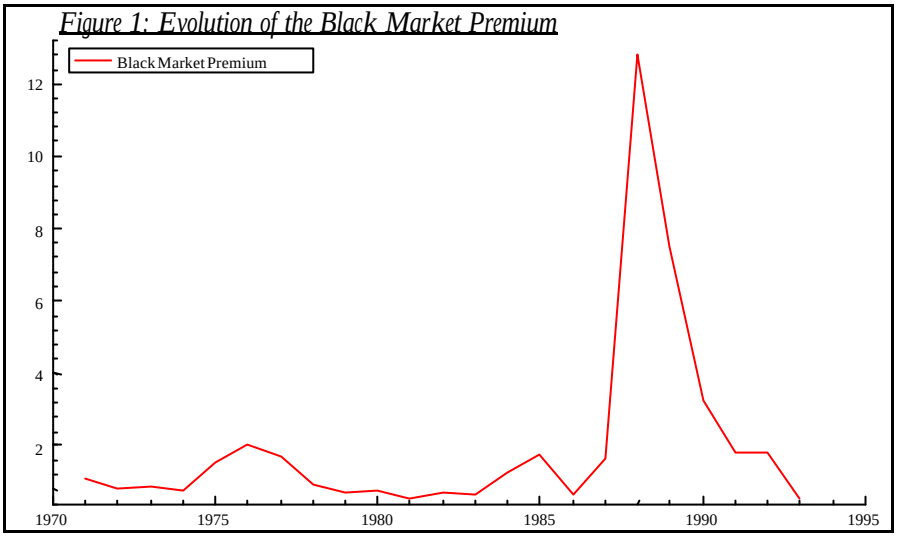


Figure 2a: First Cointegrating Vector – RER for Imports

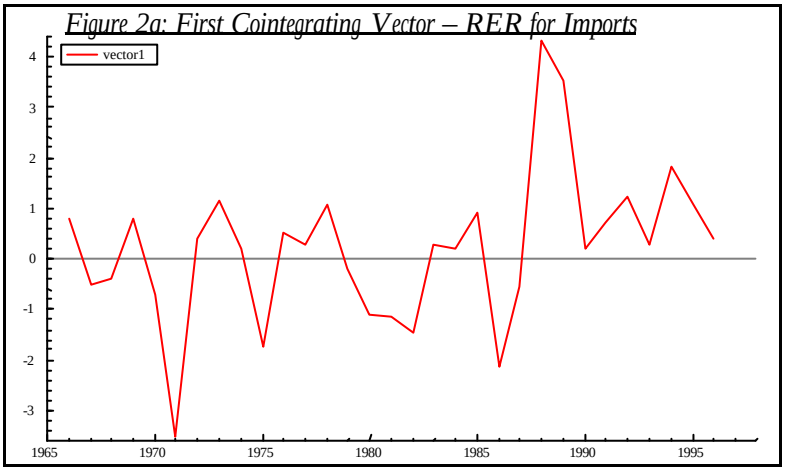


Figure 2b: First Cointegrating Vector – RER for Exports

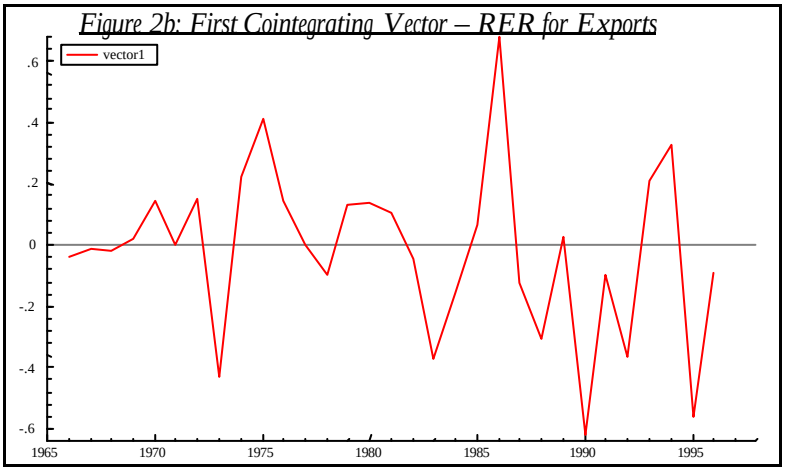


Figure 2c: First Cointegrating Vector – Internal RER

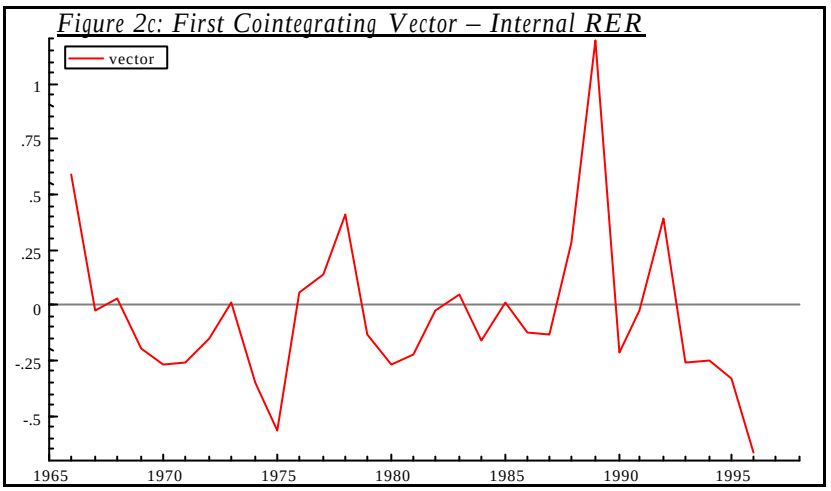


Figure 3: 1-Step Residuals, 1-Step Chow Tests, and Break-point Chow Test – RER for Imports

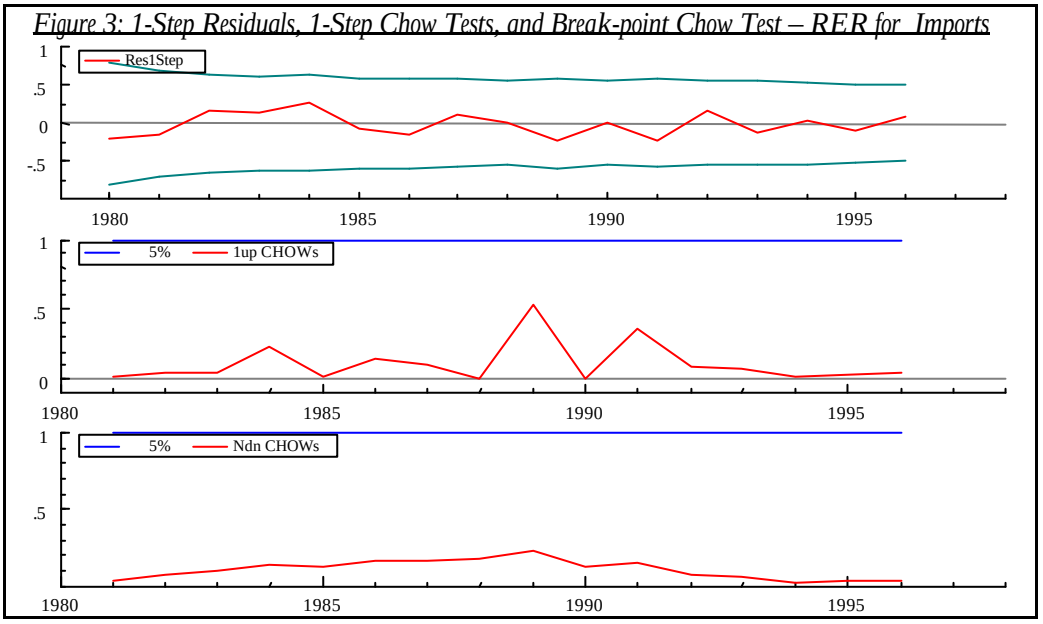


Figure 4: 1-Step Residuals, 1-Step Chow Tests, and Break-point Chow Test – RER for Exports

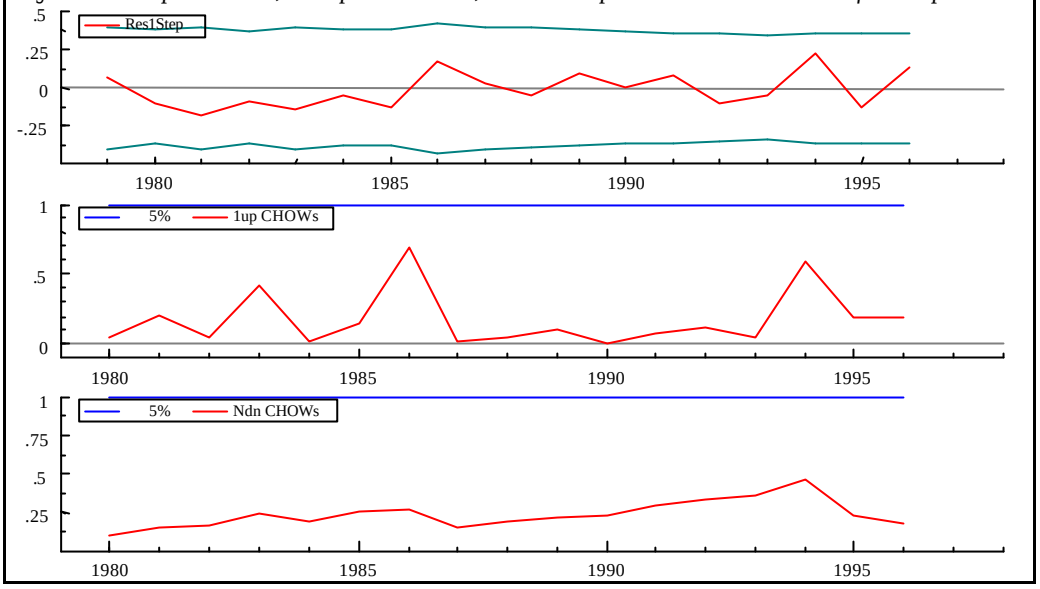


Figure 5: 1-Step Residuals, 1-Step Chow Tests, and Break-point Chow Test – Internal RER

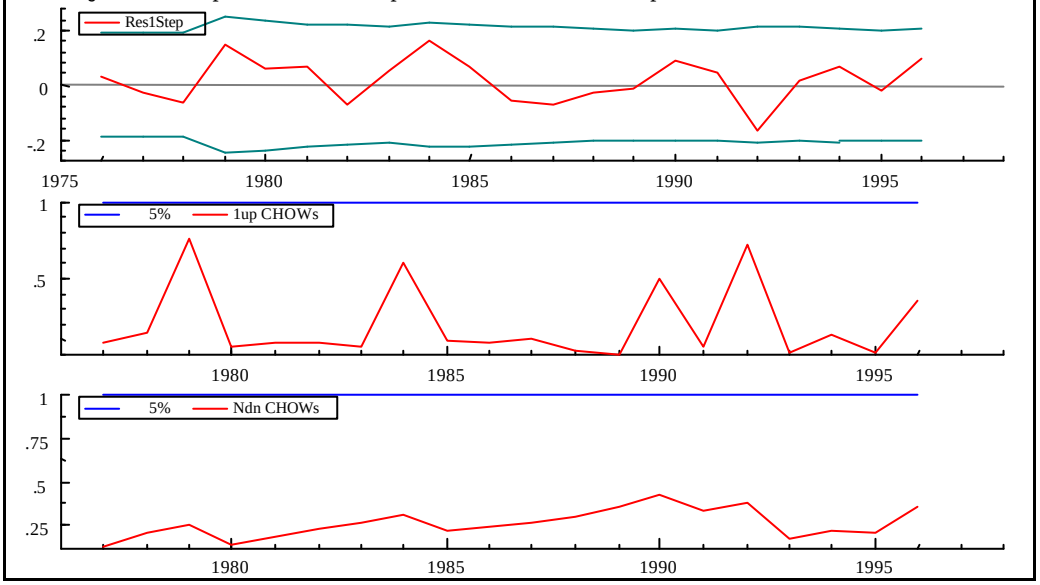
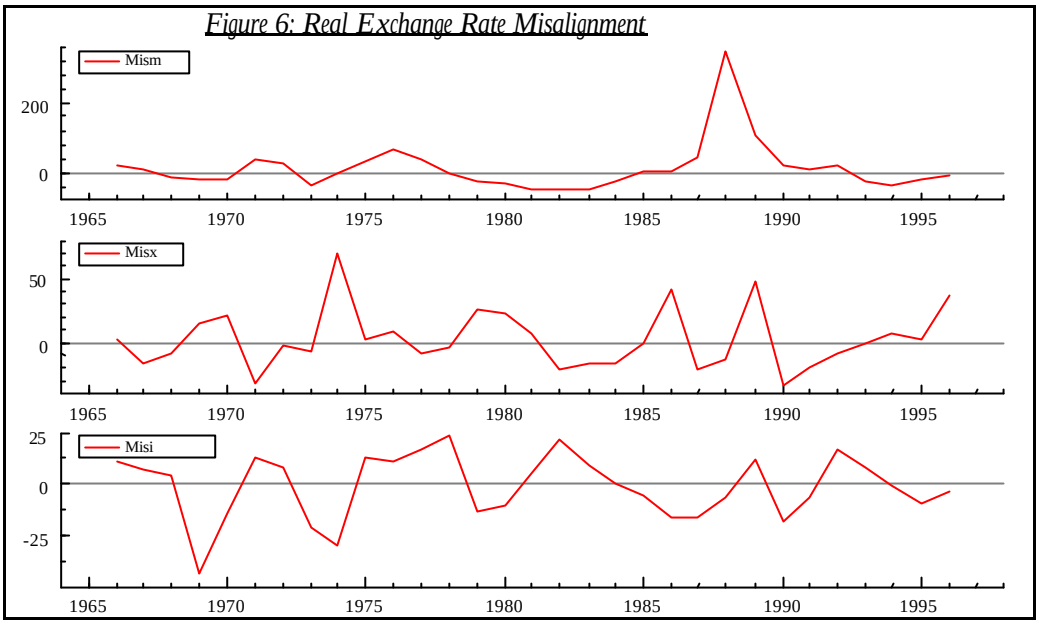


Figure 6: Real Exchange Rate Misalignment



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Is East Africa an Optimum Currency Area?

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Abstract

The paper investigates whether the East African Community, comprising of Kenya, Tanzania, and Uganda, constitutes an optimum currency area or not. The East African Community has been revived, and one of the long-term objectives of the Community is to have a common currency. The paper employs the Generalised Purchasing Power Parity method, and various criteria suggested by the theory of Optimum Currency Areas to investigate the optimality of the Community as a currency area. While the various indices that we calculated based on the theory of Optimum Currency Areas gave mixed verdicts, the Generalised Purchasing Power Parity (*G-PPP*) method supports the formation of a currency union in the region. Using the *G-PPP* method, we were able to establish cointegration between the real exchange rates in East Africa for the period 1981 to 1998, and even for the period 1990 to 1998. This finding suggests that the three countries tend to be affected by similar shocks.

Keywords: Optimum Currency Area, Cointegration, Purchasing Power Parity, East Africa, Kenya, Tanzania, Uganda.

JEL-Codes: C32; F15; O55.

1 Introduction

The Treaty to revive the East African Community (*EAC*) was signed in 1999.[1] The Community comprises of three countries; Kenya, Tanzania and Uganda. Among the long-term objectives of the Community is to establish a monetary union. Article 94 of the Treaty states that the partner states will "co-operate in monetary and financial matters and maintain the convertibility of their currencies as a basis for the establishment of a monetary union" (*EAC, n.d.).*[2] Further, Article 97 states that "there shall be a unit of account of the Community to be known as the East African Currency Unit (*EACU)*". The natural question is; is the formation of a monetary union for the three countries a good idea? In particular, do the three countries of East Africa constitute an optimum currency area?

In this paper, we attempt to use the theory of optimum currency areas (*OCAs*) to assess the suitability of the East African countries of Kenya, Tanzania, and Uganda of forming a monetary union. The empirical method used is the Generalised Purchasing Power Parity (*G-PPP*) developed by Enders and Hurn (1994). This method is supplemented by several indices that are used as criteria for the optimality of a currency area.

An important observation needs to be made at the outset. This is that the traditional theory of optimum currency areas defines the ideal *economic* conditions for introducing a single currency into a region. In reality, economic conditions may not be the only decisive reasons for the formation of a monetary union. Other factors, for example, historical, cultural and political, may also play a part in influencing the decision. Although we acknowledge the importance of other factors, our main focus will remain on the economic suitability of forming a

[1]By July 7th 2000, the Treaty had been ratified by each parliament in the three countries. The *EAC* was officially inaugurated on January 15th 2001.

[2]*n.d.* means the document quoted is not dated.

monetary union in the region. Despite the signing of the Treaty, the debate on the matter still goes on, and whether indeed a monetary union will be formed remains moot. Given the economic backwardness of these three countries, the economic significance of a monetary union is likely to be quite important in the debate.

The rest of the paper is organised as follows. The second section discusses the theory of optimum currency areas and reviews selected empirical studies. The third section gives a background to the *EAC* by firstly examining the characteristics of the three economies. Secondly, the old *EAC* is discussed, before the final sub-section discusses the revived *EAC*. The fourth section is an empirical part, which examines whether East Africa constitutes an optimum currency area. The fifth and final section concludes the paper.

2 The Theory of Optimum Currency Areas and a Selective Review of Empirical Literature

Mundell's seminal article in 1961 set out the theoretical foundation that gave the framework for the debate about optimum currency areas.[3] Other researchers, for example, McKinnon (1963) and Kenen (1969), explored the issue of optimum currency areas following Mundell's work.

Over the years, due to developments in macroeconomic theory, the theory of optimum currency areas has been extended and modified.[4] However, in spite of the refinements, the basic literature on optimum currency areas still addresses two issues, namely, the advantages and disadvantages of adopting a common currency,

[3]Mundell is regarded as the father of the theory of optimum currency areas (see Bayoumi and Eichengreen, 1998). His work in this area, and indeed in exchange rate economics earned him a Nobel Prize in economics in 1999.

[4]See for example Tavlas (1993) and De Grauwe (1997).

and the characteristics that are desirable for countries to consider monetary integration (Tavlas, 1993; Tjirongo, 1995). We discuss these two issues in turn.

The advantages and disadvantages of joining a currency union may arise at the micro or macro level. The advantages of a common currency accrue mostly at the microeconomic level. A common currency leads to gains in economic efficiency emanating from two sources. The first one is that a common currency can eliminate the transactions costs that are incurred when converting currencies. Secondly, a common currency can help to eliminate risk from uncertainty in the movements of the exchange rates (De Grauwe, 1997). A further advantage of a common currency is that it provides potential for reinforcing the discipline and credibility of monetary policy (Dupasquier and Jacob, 1997).

The disadvantages of a common currency are the loss of independence over monetary and exchange rate policy. When a country relinquishes the exchange rate as an instrument, it loses a mechanism for protecting itself from economic shocks. However, the costs are less severe if the shocks affect all the members of the currency union similarly (symmetric), as a common policy response would be appropriate. But if the shocks affect the members differently (asymmetric) due to, for example, different industrial structures, then a common policy might not be appropriate, in which case the inability to use the exchange rate to make the needed adjustments could result in greater volatility in output and employment. The disadvantages of a common monetary and exchange rate policy are, however, reduced if prices and wages are flexible, and also, if labour is sufficiently mobile (De Grauwe, 1997; Dupasquier and Jacob, 1997). The flexibility of prices and wages, and the mobility of labour allow adjustment to a shock to occur more promptly.

The other issue considered in the theory of optimum currency areas regards the characteristics that are relevant for choosing likely candidates for a currency union. The literature identifies the following factors as key in deciding whether to join a currency union or not; factor mobility, openness, degree of product diversification, flexibility of prices and wages, similarity in industrial structures, high covariation in economic activities, similar economic policy preferences, and political factors (see Mundell, 1961; McKinnon, 1963; Kenen, 1969; Ishiyama, 1975; Jonung and Sjöholm, 1998; and Tavlas, 1993). We discuss each of these factors in turn.

Factor mobility

If the degree of factor mobility between the potential members is high, then they would be better candidates for a currency union. This is because the mobility of factors provides a substitute for exchange rate flexibility in undertaking adjustment when a disturbance occurs (Mundell, 1961).

Openness

An optimum currency area between a group of countries means that individual countries maintain an irrevocably fixed exchange rate between each other. Therefore, an individual country within the union cannot unilaterally devalue her currency. In fact, with the introduction of a single currency within a currency area, individual countries completely surrender their right to unilaterally alter the exchange rate. For an individual country therefore, the nominal exchange rate becomes redundant as a policy instrument.

McKinnon (1963) maintained that the more open an economy is, the less effective is the nominal exchange rate as a policy instrument for adjustment. Thus, if an economy is more open, it makes it easier for it to enter into a currency union arrangement in that the nominal exchange rate is already redundant as a policy instrument. Frankel and Rose (1996) also noted that a small open economy will

find it gainful to enter into a currency union with her trading partners who are equally open. This is because it reduces transaction costs and exchange rate risk that would be suffered if a flexible exchange rate were to be maintained against each other. Also, such a currency union would provide a credible nominal anchor for monetary policy in the individual countries. They further argue that to the extent that such open economies are integrated in terms of capital flows, labour mobility, or similar economic behaviour, the need to maintain the exchange rate as a policy instrument in individual countries becomes less.

Degree of product diversification

If an economy is more diversified in the goods it produces, it can forgo the need to frequently change its nominal exchange rate in case of an external shock. This is because an economy producing a wider variety of products would also export a wider variety. In that case, if a fall in the demand occurred for some of its products, the effect of such a shock would not create a large fall in employment. However, if an economy is less diversified, a shock that can affect one sector would necessarily have a bigger total effect on the economy. Moreover, in a more diversified economy, if independent shocks affected each of the products, the law of averages would ensure that the economy remained stable. Thus, a more diversified economy is more suitable for a currency union than a less diversified one (Kenen, 1969). This is more so if sufficient occupational mobility exists to re-absorb labour and capital that is made idle by the shocks.

Flexibility of prices and wages

If prices and wages are flexible between and among the regions, the need of using the exchange rate for adjustment is diminished. This is because the transition toward adjustment between regions is not likely to be associated with unemployment in one region and inflation in another.

Similarity in industrial structures

Countries that have similar industrial structures are better candidates for a currency area because they are affected in a similar way by sector specific shocks. As such, it negates the need for undertaking a unilateral adjustment in the exchange rate in response to terms of trade shocks (Bayoumi and Ostry, 1995; Jonung and Sjöholm, 1998).

High covariation in economic activities

Countries may have different industrial structures but if they exhibit a high covariation in their economic activities, they will still be candidates for a currency union because it means that they are likely to experience similar economic shocks. This reduces the significance of exchange rate policy autonomy for making necessary adjustments (Bayoumi and Ostry, 1995; Jonung and Sjöholm, 1998).

Similar inflation rates

If countries have different inflation rates, it indicates that there are differences in the way they conduct their economic policies, and also that there are differences in the structure of the economies. Thus, if countries are to be good candidates for a currency union, the patterns of inflation should be similar as this can make the convergence in inflation rates easier once they belong to a currency area (Jonung and Sjöholm, 1998).

Political factors

In the formation of a currency area, political factors are important. That is to say, a strong political will by the leaders in government is needed, and also, there has to be strong public support (Jonung and Sjöholm, 1998). Without political will and public support, the commitment to the currency union would be lacking, which in turn can lead to the demise of the union. Political will among leaders is important because belonging to a currency union must involve agreeing to, for example, co-

ordination of policies with members. This may not be popular to the public, but in order to convince the public, the leaders have to be committed and determined, so that they can convey the benefits to be had from the currency union.

An empirical study by Cohen (1993) has supported the importance of political factors. In his study of six currency unions, Cohen found that political factors dominated economic criteria in successful currency areas. The dissolution of the East African Currency Board in 1966 is an example of lack of political will to sacrifice domestic policy needs for the sake of the currency union. However, we now turn to empirical studies on the economic optimality of currency areas.

A number of empirical studies have been done to assess the optimality of potential or actual currency areas. These include, among others, Enders and Hurn (1994), Jonung and Sjöholm (1998), Tjirongo (1995), Bergman (1999), De Grauwe and Vanhaverbeke (1993), Horvárth and Grabowski (1997), Jenkins and Thomas (1997), and Frankel and Rose (1996). We briefly review some of these studies.

Jonung and Sjöholm (1998) studied whether Finland and Sweden should form a monetary union with each other, and with the rest of Europe. In their evaluation, they calculated indices on the degree of wage flexibility and product diversification, the degree of factor mobility, the similarity of production structures, the covariation in economic activities, the similarity of economic policies, and political and other factors. They concluded that Finland and Sweden could constitute an optimum currency area, while they are not "obvious" candidates for membership in a European monetary union.

Another study that used the theory of optimum currency areas as a framework is the one by Tjirongo (1995). His study not only evaluated Namibia's suitability of

being a member of the Common Monetary Area (*CMA*),[5] but it also examined the costs and benefits of its membership and the instruments that could be used to address asymmetric shocks. The criteria that were used in the study are factor mobility, openness of the economy and the degree of diversification. Tjirongo (1995) concluded that given the relative size of the Namibian economy versus South Africa, the degree of openness to foreign trade and the high degree of capital mobility, the use of the nominal exchange rate as an instrument of economic policy would have limited effects. Regarding the benefits and costs of Namibia's membership to the *CMA*, his conclusion was that membership to the *CMA* could bring about positive net benefits due to the long-term benefits of price stability, and also, it helps to enhance the reputation of economic policy management. These could in turn promote macroeconomic stability. It was thus beneficial for Namibia to remain within the *CMA*.

Bergman (1999) also used the theory of optimum currency areas to examine whether the countries which formed the Scandinavian Currency Union (*SCU*), namely Denmark, Norway and Sweden, constituted an optimum currency area. First of all, he investigated the macroeconomic series of the three countries during the time of the union by employing statistical tests. He further estimated a structural *VAR* model to examine the symmetry of country-specific structural shocks in each of the three countries. For purposes of comparison, a model was estimated for Belgium, which belonged to the gold standard and was a member of the Latin Union. He found that country-specific structural shocks in the *SCU* members were not highly symmetric during the union period. He further found that the differences between the pattern of structural shocks in Belgium and those in the *SCU* member countries were not clear-cut. Given these findings, he concluded that the three Scandinavian countries did not form an optimum currency union.

[5]The *CMA* consists of South Africa, Namibia, Lesotho, and Swaziland (Tjirongo, 1995).

3 The Background

In this section, we present a brief synopsis of the economies of Kenya, Tanzania and Uganda. The purpose is to provide the reader with background information on the three countries constituting the *EAC*. We provide basic macroeconomic indicators, and also, some historical and political facts.

3.1 Brief Economic Background of Kenya, Tanzania and Uganda[6]

Table 1 provides selected macroeconomic indicators on the three countries, and Table A1 in the appendix gives the sectoral contribution to *GDP*. All the three countries attained their independence in the early 1960s. Although all the countries are currently pursuing market-oriented economic policies, this was not the case a couple of years after attaining independence. In particular, Tanzania, under the leadership of the late Mwalimu Julius Nyerere, pursued a socialist-oriented development strategy, where previously privately owned companies were nationalised after the Arusha Declaration in 1967. Nyerere voluntarily handed over power to Ali Hassan Mwinyi in 1985, and the slow reform towards a market economy ensued. Mwinyi completed his tenure in 1995 and a new administration under Benjamin Mkapa took over with even more commitment to economic reforms. Uganda, on the other hand, went through a brief period of flirtation with socialism under Obote, and then was under a brutal and totally chaotic dictatorship of Idi Amin. Amin was toppled in 1979 with the help of Tanzania. Uganda was then under the leadership of Professor Lule and then a couple of other leaders before Obote took over again. Thereafter, Museveni started a protracted guerrilla

[6]This sub-section draws on, among others, various publications by the Economist Intelligence Unit.

Table 1: Macroeconomic Indicators

	1990	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*
KENYA								
GDP at market prices (constant 1995 US$bn)	8.37	8.49	8.42	8.45	8.67	9.05	9.43	9.63
GDP per capita, *PPP* (current international $)	1090	1100	1100	1090	1110	1160	1190	1190
Gross domestic fixed investment (% of *GDP*)	20.74	19.29	17.13	16.94	18.87	21.37	19.79	18.24
Resource balance (% of *GDP*)	-5.22	-1.27	0.10	4.78	3.14	-5.91	-4.10	-7.74
Total debt service (% of *GNP*)	9.71	9.42	8.80	11.74	12.97	10.29	9.35	6.46
Official exchange rate (*LCU* per US$)	22.92	27.51	32.22	58.00	56.05	51.43	57.12	58.73
Inflation, consumer prices (annual %)	15.59	19.82	29.55	45.80	29.01	0.79	8.82	12.02
Agriculture, value added (% of *GDP*)	29.14	27.02	26.79	31.52	33.32	31.11	29.47	28.83
Manufacturing, value added (% of *GDP*)	11.79	12.24	11.20	10.01	10.70	9.87	10.17	10.07
Labor force in agriculture (% of total)	79.52	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Population, total (million)	23.55	24.30	25.05	25.78	26.51	27.22	27.92	28.61
TANZANIA								
GDP at market prices (constant 1995 US$bn)	4.17	4.35	3.97	4.45	4.51	4.63	4.82	5.01
GDP per capita, *PPP* (current international $)	540	580	510	570	570	520	550	580
Gross domestic fixed investment (% of *GDP*)	22.27	25.90	26.54	25.81	24.63	21.69	17.86	*na*
Resource balance (% of *GDP*)	-22.3	-26.8	-28.4	-28.9	-26.9	-21.9	-14.7	*na*
Total debt service (% of *GNP*)	4.46	4.76	5.04	4.85	4.51	4.40	4.13	2.18
Official exchange rate (*LCU* per US$)	195	219	298	405	510	575	580	612
Inflation, consumer prices (annual %)	35.83	28.70	21.85	25.28	33.09	29.80	19.66	16.09
Agriculture, value added (% of *GDP*)	48.00	47.19	48.06	48.06	46.33	46.21	47.63	47.35
Manufacturing, value added (% of *GDP*)	8.92	9.10	8.53	7.80	7.44	7.27	7.28	*na*
Labor force in agriculture (% of total)	84.40	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Population, total (million)	25.47	26.28	27.10	27.94	28.79	29.65	30.49	31.32
UGANDA								
GDP at market prices (constant 1995 US$bn)	4.10	4.33	4.48	4.85	5.16	5.75	6.28	6.62
GDP per capita, *PPP* (current international $)	770	810	850	910	960	1060	1140	1160
Gross domestic fixed investment (% of *GDP*)	12.70	15.17	15.91	15.21	14.56	15.43	16.63	15.51
Resource balance (% of *GDP*)	-12.1	-14.5	-15.5	-14.1	-10.4	-9.1	-11.3	-7.7
Total debt service (% of *GNP*)	3.49	4.54	4.11	4.94	3.82	2.40	2.46	2.91
Official exchange rate (*LCU* per US$)	429	734	1134	1195	979	969	1046	1083
Inflation, consumer prices (annual %)	33.12	28.07	52.44	6.08	9.73	8.55	7.15	7.03
Agriculture, value added (% of *GDP*)	56.58	52.84	51.14	51.56	50.00	49.45	45.50	43.80
Manufacturing, value added (% of *GDP*)	5.67	5.82	6.17	5.97	6.52	6.80	7.76	8.17
Labor force in agriculture (% of total)	84.53	*na*	*na*	*na*	*na*	*na*	*na*	*na*
Population, total (million)	16.33	16.89	17.46	18.03	18.60	19.17	19.74	20.32

Note: na - not available; bn – billion; mn – million; LCU – local currency unit.
Source: World Development (1999), World Development Indicators CD-ROM.

war that ended with him taking power in 1986. Under the leadership of Museveni, Uganda has been at the forefront in economic reforms. As for Kenya, a more

market-oriented economy has been maintained all along, both under the presidency of Jomo Kenyatta and later under Daniel arap Moi.

The sectoral contribution of *GDP* indicates that agriculture contributes a larger share of Uganda's *GDP*, followed by Tanzania. The average contribution of manufacturing to *GDP* between 1990 and 1996 is highest in Kenya, followed by Tanzania. In the tertiary sector, Kenya dominates the group (see Table A1 in the appendix). In terms of commodities exported and imported, all the countries export primary commodities, with coffee being one of the main export crops. Other primary export commodities include tea and cotton. The goods imported include machinery and transport equipment, consumer goods, crude oil and petroleum products. Tables A2 and A3 in the appendix show the main trading partners of the East African countries in 1994 and 1996, and the extent of intra-regional trade between 1990 and 1996, respectively.

All the countries have pursued structural adjustment reforms with the help of the *IMF* and the World Bank. In Kenya, the programme of liberalisation and reforms has included the removal of import licensing and price controls, removal of exchange controls, fiscal and monetary restraint, and reduction in the public sector. In Tanzania, the programme of reforms was announced in mid 1986, and it has involved the following measures, implemented over the years; trade liberalisation, privatisation, civil reforms, price decontrols, and exchange adjustments. In Uganda, the reforms started in 1987, and they have included public sector reforms, market and price reforms, exchange rate reforms, and trade liberalisation (Bigsten and Kayizzi-Mugerwa, 1999).

3.2 The Rise and Fall of the "Old" East African Community

The Treaty that established the Community was signed in June 1967 by the heads of state of the three partner countries. Although the *EAC* was formalised in 1967, the conditions for its establishment were developed during the colonial era. As early as 1917, a customs union was established between Kenya and Uganda. Ten years later, Tanganyika became part of the customs union. In the union, the three countries jointly administered customs, excise and income tax, and other services such as, medical and industrial research, education, transport and communication, and agriculture. Besides the services that were jointly run, a monetary union and a high degree of fiscal integration existed. Labour was also fairly mobile within the region.

A common legislative body and administrative organisation for East Africa was established in 1948. It was called the East Africa High Commission (*EAHC*). The Commission was made up of the three governors of the three territories, and its policy decisions were effected through its Secretariat in Nairobi. There was also a Central Legislative Assembly (*CLA*), which considered and enacted legislation relating to aspects of the common services.

In 1961, Tanganyika attained her independence, and later, Kenya and Uganda gained their independence too. With the attainment of independence, a number of changes were effected in the machinery of co-operation. The High Commission was transformed into the East African Common Services Organisation (*EASCO*), which consisted of chief executives of the three governments. The *CLA* was enlarged, and also, the authority operated through various committees composed of three ministers from each country. The operations of the common market, however, continued without any formal enactment, until 1967 when the Treaty was signed. The Treaty founded the East African Community, and as an integral part of

it, a common market. The Treaty also established the East African Council, which consisted of the three presidents and five councils, each assigned to the following areas; common market, communications, economics and planning, finance and research, and social affairs. The aims of the Community were stated as;

> to strengthen and regulate the industrial, commercial and other relations of the Partner States to the end that there shall be accelerated, harmonious and balanced development and sustained expansion of economic activities the benefits whereof shall equitably shared (Hazlewood, 1975:71).

Besides a common market and services, the East African countries also belonged to a monetary union, whose conditions were set up during the colonial period. In 1919, the East African Currency Board was established, and a single currency was in use until 1966. The Currency Board, among other things, was responsible for issuing and redeeming local currency for sterling. The East African countries belonged to the Sterling Exchange System, whereby the external reserves were held in sterling securities. There was a high degree of monetary integration, such that there were no restrictions on the movement of capital between the countries.

However, by 1967, separate central banks were created in each of the countries. This was done because the countries felt that a monetary union limited their discretion in relation to monetary policy (Robson, 1968). Although separate central banks had been created in the Treaty that established the *EAC*, the three states agreed to harmonise their monetary policies "to the extent required for the proper functioning of the Common Market and the fulfilment of the aims of the Community" (Hazlewood, 1975:81). As one of the requirements for harmonising their monetary policies, the three governors of the central banks were required to meet regularly. The three countries now had separate currencies, but although this was the case, the currencies were identical as they could be used in other states for

transactions, and the notes could be exchanged freely. Transfers between the three states could also be done without difficulties.

Some problems emerged in the monetary union soon after the Treaty was signed. The first problem was the nationalisation of banks in Tanzania in 1967, in the wake of the Arusha Declaration, and the ensuing exchange controls that were imposed against Kenya and Uganda to restrict capital flight. Also, the free circulation and redemption of Tanzanian notes were suspended in the other states. The exchange controls put a temporary break in the union, and it lasted from February to June. In November, following the devaluation of the Sterling, the countries agreed to maintain the par values of their currencies, and the link to the Sterling was severed.

A major disruption in the union occurred in 1970. There was a heavy outflow of capital from Uganda after a nationalisation policy was announced. Exchange controls against Kenya and Tanzania were imposed, and the export and import of the Ugandan currency was banned. The exchange controls triggered retaliatory measures by the others states. The restrictions were directed at capital, and not goods and services. When the exchange controls were in place, the countries pursued divergent policies regarding pegging for their currencies. This created suspensions in transactions for a couple of days, until it was agreed that all currencies were to be pegged to the dollar. The three currencies were pegged to the dollar until the *EAC* collapsed in 1977. The *EAC* was officially dissolved in 1983.

There are several reasons that may explain the collapse of the *EAC*. Firstly, there was a feeling that the benefits of the common market were accruing more to Kenya than to Tanzania and Uganda. The differences in the benefits arose due to the differences in the level of industrialisation of the three countries (Musonda *et al*, 1997). This disparity in the level of industrialisation was rooted in colonial times,

where Kenya was taken to be a permanent colony of Britain, and hence invited more investment, while Uganda and Tanganyika were more of temporary colonies.

The fact that Kenya's industrial sector was more developed than in the other member states meant that the relatively less developed countries were buying more goods from Kenya than the amount Kenya was buying from them. A trade imbalance in favour of Kenya thus ensued, with Tanzania and Uganda remaining deficit countries in East African trade (see Musonda *et al*, 1997; and Rothchild, 1974).

The other factor that contributed to the collapse of the *EAC* and perhaps the most important one, is the ideological differences between the three countries. Mugomba (1978) argues that the ideological distance between the partner states exacerbated the tensions that were already there in the *EAC.* While Tanzania pursued a socialist-oriented path of development and was slowly drifting its attention southwards in its bid to help with the liberation movement together with other frontline states, Kenya, on the other hand, was committed to the capitalist path of development, becoming increasingly isolated in a region that was predominantly socialist. Uganda, however, had witnessed several ideological shifts. In the late 1960s, Uganda had closer ideological affinity to Tanzania. Presidents Obote, Nyerere and Kaunda (of Zambia) teamed up in what was called the Mulungushi Club[7] to spearhead the liberation of the Southern African countries of Mozambique, Zimbabwe, Angola, Namibia, and South Africa, from colonial rule and racial supremacists. Zambia, Tanzania and Uganda were then pursuing some

[7]The Mulungushi Club was later turned into a group of frontline states that included Tanzania, Zambia, and Botswana, and later joined by Mozambique, Angola, Zimbabwe and Namibia. The frontline states' objectives were to co-ordinate military, diplomatic and economic support to the liberation movements. The group dissolved when apartheid collapsed in South Africa but as an outcrop, the Southern African Development Co-operation Conference, *SADCC* (later renamed, Southern African Development Co-ordination, *SADC),* emerged as an organisation co-ordinating economic co-operation and integration among the former frontline states, including South Africa and a few other countries.

form of African Socialism (Humanism in Zambia, Ujamaa in Tanzania, and Common man's charter in Uganda). Western countries had refused to support the liberation movements militarily, thus the communists countries filled in the void. The Mulungushi Club countries had no problem hosting Soviet and Chinese-trained guerrilla armies for liberation movements. In this score, Kenya was isolated from Tanzania and Uganda.

In the same connection, Tanzania and Zambia invited the Communist Chinese Republic to build a railway line to connect the two countries in a bid to reduce Zambia's dependence on colonial Rhodesia and apartheid South Africa. This did not augur well with Kenya both because of the involvement of Communist China, but also because the Tanzania-Zambia railway line was independent of the *EAC*-run East African Railway.

In 1971, Idi Amin overthrew the government of Obote in Uganda and established a military dictatorship. This did not go well with Nyerere, both because of the affinity that he had developed with Obote (Obote took refuge in Tanzania), and because of the utterly chaotic and brutal nature of Idi Amin's dictatorship. Tanzania hosted military groups opposed to Idi Amin (that included a group headed by Yoweri Museveni) and refused to recognise Idi Amin's leadership. This meant that the summit meetings of the three leaders of East Africa could not be held at the time when ideological and economic disparities were crippling the *EAC*. Inevitably, the *EAC* collapsed in 1977.

3.3 The Revival of the East African Community

When the *EAC* collapsed, the heads of state of the partner countries signed a Mediation Agreement to divide the assets and liabilities of the defunct co-

operation. However, a provision in the agreement enabled the partners to revive their co-operation some time in the future. Following a number of meetings, the leaders signed an agreement to establish the Permanent Tripartite Commission for East African Co-operation, in November 1993. The operations of the *EAC*, however, did not commence until the Secretariat was launched in March 1996, at its headquarters in Arusha, Tanzania. Meanwhile, the agreement that revived the *EAC* came under parliamentary and public debate before it could be updated and signed as a Treaty. It was finally updated to a Treaty, and was signed in November 1999.

The *EAC* has several institutions to ensure that the objectives that are set out are achieved. These institutions are; the Summit, the Council, the Co-ordination Committee, the Sectoral Committees, the *EAC* Court, the *EAC* Assembly, and the Secretariat. The Summit consists of the three heads of state of the partner countries, and their role is to give direction to the development and achievement of the objectives of the co-operation. The Council is composed of ministers from the member states, and it has important executive and administrative powers. The Co-ordination Committee consists of permanent secretaries responsible for regional co-operation, and their main duty is to co-ordinate the activities of the various sectoral committees. The Co-ordination Committee recommends the Sectoral Committees' composition and functions. The *EAC* Court is a judicial body that ensures that the law is adhered to in the interpretation and application of the Treaty. The Summit appoints the judges of the Court. The *EAC* Assembly consists of twenty-seven elected members (nine from each partner state), and three ex-officio members, namely, the Chairman of the Council, the Secretary General, and the Legal Counsel of the Community. Finally, the Secretariat, which is the principal executing organ of the *EAC*, is headed by the Secretary General of the Community.

The objectives of the *EAC* are stated in Article 4 of the Treaty. Essentially, it aims at promoting and developing programmes that will strengthen and deepen co-operation among its partner states, with a goal of promoting "a people-centred economic, political, social and cultural development on the basis of balance, equity and mutual benefit of the three states" (*EAC, n.d*). In order to achieve its stated objectives, the *EAC* hopes to establish a common market and customs union. The *EAC* further envisages co-operation in other areas too, such as, fiscal and monetary policies, transport and communication, immigration, security, energy, promotion of investment in the region, trade and industry, agriculture and animal husbandry, tourism and wildlife conservation, environment and natural resources, social and cultural activities, legal and judicial, political, health, labour and employment, education and training, and development of information systems.

Since its inception, the new *EAC* has achieved a number of its objectives. Some of these include;

- The introduction of an East African passport. This is in line with its objective of easing the movement of people within the Community.
- Full convertibility of the three currencies, and agreement to liberalise capital accounts.
- Holding of pre- and post-budget consultations by Finance Ministers, synchronisation of the budget day, and development of a macroeconomic framework for the region in order to guide the three states towards economic convergence. This is in line with its objective of strengthening and consolidating co-operation.
- Signing of memoranda of understanding on defence and foreign policy, in line with it objective of maintaining peace and security within the region.
- Reduction in border delays, harmonisation of customs documentation, and execution of a tripartite agreement on avoidance of double taxation. These are all aimed at achieving a single market.

- Establishment of bodies for facilitating the setting up of an East African Stock Exchange and promoting cross border trade and investment. These are aimed at establishing a conducive environment for trade and investment.
- Establishment of an *EAC* digital transmission telecommunication, completion of study on common oil and gas pipelines, and introduction of *COMESA* standards on motor vehicles. These are in line with the objective of developing an integrated transport and communication network.

There is some optimism about the revived *EAC*. This is because, first of all, the three countries are pursuing similar programmes to restructure their economies. Unlike in the old pact when the economic policies of the three countries were divergent, in the new one, they are all pursuing market-oriented economic policies. Connected to this is the fact the private sector is now being involved in the running of businesses and in participating in regional organisations. The private sector and civil society are being involved by participating in regional activities through regional bodies that have been set up. For example, the East African Business Council has been set up to promote cross border trade and investment, and to lobby for business-friendly policies in the member states. In the old *EAC*, the public corporations proved to be inefficient and were mismanaged. The involvement of the private sector in the new *EAC* will help to improve the performance of the various bodies. The Tanzanian Minister put it that in the new *EAC*,

> "there is no joint East African ownership of assets … the private sector is the motor for development … our job is to promote cross border trade and investment" (Kikwete, 1998).

Another aspect of economic policy that is bringing the three countries closer together is the synchronisation of the budget day. All the three countries present

their budgets on July 1st. This is in line with one of their objectives of harmonising fiscal and monetary policies.

The second reason for optimism is in the political arena. There are indications that there is a lot of political will among the leaders, to the extent that a future political union is envisaged, as Kikwete (1999:3) notes,

> Ultimately, the future co-operation in East Africa aspires to accomplish the long-standing dream of creating a political federation ... There is greater harmony now at the ideological and political level and greater mutual understanding.

The commitment of the three governments to economic integration in general can be seen by their participation in a conference that was organised by the Financial Times, and the visits to the western capitals undertaken by the co-operation ministers to drum up support for financial assistance, and for general information. There is also the feeling that a united East Africa can help to resolve tribal and political conflicts in the Great Lakes region (Mkapa, 1999).[8]

The third reason is that the region is receiving some incentives from donors. For example, the European Union has given financial support to improve the road network, and also to improve the running of the Secretariat. It has also pledged some money to cushion the effects of the loss in revenue due to the proposed zero tariff (*Daily News*, 1998; *Financial Times*, 1999).

The last factor that may help in the success of the union is the use of common languages. In all the countries, Kiswahili and English are widely used. The use of similar languages enables ease of communication.

[8]For example, Burundi and Rwanda have indicated an interest in joining the Community (*BBC News*, 1999). The two tiny countries have unresolved ethnic problems, which may be better handled in a larger setting of a regional community.

The objective of forming a currency union among the East African countries may sound lofty, but apart from the political will and historical and cultural ties, the economic optimality of such a union may surely count as an important factor. In the next section, we delve on the empirical aspects of the optimality of East Africa as a currency area.

4 Empirical Analysis

The main focus of the empirical analysis is the estimation of the *G-PPP* model. This is carried out in sub-section 4.2. However, preliminary indicators of the optimality of the East African Community as a currency area are reported first in sub-section 4.1.

4.1 Optimum Currency Area Criteria

Section 2 has provided a discussion on the factors that are important in assessing whether a group of countries or a region could form a currency union. We now provide empirical evidence on some of these factors as they pertain to the *EAC*.

Degree of product diversification

This refers to the extent to which the industrial structure is diversified in terms of production of goods. A more diversified industrial structure would enable countries in the currency union to absorb some shocks affecting a particular sector. We constructed a Herfindahl Index for the three East African countries (see Jonung and Sjöholm, 1998). The Herfindahl Index is given by

$$\langle 1 \rangle \quad Product\ Diversification_i = 100 * \sum_{j=1}^{n} s_j^2$$

where, s_j is the fraction occupied by sector j in manufacturing value added in country *i.* A higher value indicates a smaller degree of product diversification. The value of the index can vary from 0 to 100. The data we used is from *UNIDO*'s International Yearbook of Industrial Statistics. The data is on manufacturing industries classified at three-digit level of *ISIC*. Table 2 shows the computed Herfindahl indices for the degree of product diversification in the three East African countries for the years for which data was available.

Table 2: Degree of Product Diversification, 1989-1997

	1989	1990	1991	1994	1995	1996	1997
Kenya	*na*	11.4	11.9	13.9	16.6	*na*	*na*
Tanzania	*na*	11.1	20.1	*na*	*na*	*na*	*na*
Uganda	22.2	*na*	*na*	13.0	12.4	13.5	13.5

Note: na - not available.
Source: Calculated from UNIDO, International Yearbook of Industrial Statistics, various issues.

Table 2 shows that in 1989 and 1991, the industrial structure in Uganda and Tanzania respectively, was not very diversified. On average, the two countries had a value of about 21, compared to only 11 for Kenya in 1990 and 1991. Thus Kenya was more diversified than the other two partner countries. Tanzania moved from having a value similar to Kenya in 1990 to being less diversified in 1991. A closer look at the composition of the industrial structure showed that it could be explained by the increase in value added of a few industries, namely, paper and products, rubber products, and transport equipment, mainly motor vehicles, this being due to the liberalisation of passenger transport. The drop in value added in textiles also explains the reduction in diversification.

In 1994 and 1995, Kenya's degree of diversification fell from what it was in 1991. The value stood at 16.6 in 1995. Uganda, however, improved its degree of diversification from its 1989 value. In 1997, its value was 13.5. Given that the data for Kenya and Tanzania is not available for later years, we cannot make a conclusive remark regarding the degree of diversification and its implications for the suitability of the three countries to form a currency union.

Degree of Openness

In order to evaluate the degree of openness, we calculated two measures; namely, the share of intra-regional trade in each of the countries' *GDP*, and also, the share of total trade in *GDP*. These measures are given in Tables 3 and 4 respectively. Table 3 shows that the extent of intra-regional trade among the East African countries is low (see also Table A3 in the appendix). This suggests that the degree of openness with each other is small, and thus the basis for a currency union is challenged.

The figures in Table 3 are calculated from official trade statistics, and as such, they do not include statistics on unofficial cross-border trade among the East African countries. Data on the extent of unofficial cross-border trade is not consistently available. However, some surveys that were done in the 1994/95 and 1995/96 periods for Kenya and Uganda, and for Tanzania respectively, indicated that in the 1994/95 period, unofficial cross-border trade between Kenya and Uganda was about 49 percent of official trade. Between Tanzania and Kenya, cross-border trade as a percentage of official trade in the 1995/96 period was about 12 percent, while between Tanzania and Uganda, it was 45 percent (see Ackello-Ogutu, 1997; and Ackello-Ogutu and Echessah, 1998). When we included the figures on unofficial cross-border trade to the official figures to calculate the degree of openness, unofficial trade had only a marginal effect on the degree of openness, to the order of 0.3 percent and 0.1 percent to the calculated indices for Tanzania's total trade

Table 3: Intra-regional Trade as a Share of GDP (%), 1991-1996

		1991	1992	1993	1994	1995	1996
KENYA							
Exports to:	Tanzania	0.4	0.6	1.6	1.6	1.5	1.8
	Uganda	0.6	0.9	1.9	2	1.9	2.2
Imports from:	Tanzania	0.1	0.1	0.1	0.1	0.1	0.2
	Uganda	0	0.1	0.1	0.1	0.1	0.1
Total Trade with:							
	Tanzania	0.5	0.7	1.7	1.7	1.7	1.9
	Uganda	0.6	1	2	2.1	2	2.3
TANZANIA							
Exports to:	Kenya	0.1	0.2	0.2	0.2	0.2	0.2
	Uganda	0.1	0.1	0.1	0.2	0.2	0.2
Imports from:	Kenya	0.8	1	2.1	3.1	3	2.9
	Uganda	0	0	0	0	0	0
Total Trade with:							
	Kenya	0.9	1.1	2.2	3.3	3.2	3.2
	Uganda	0.1	0.1	0.1	0.2	0.2	0.2
UGANDA							
Exports to:	Kenya	0	0.1	0.2	0.2	0.1	0.2
	Tanzania	0	0	0	0	0	0
Imports from:	Kenya	1.7	2.6	4.2	3.8	3.1	3.6
	Tanzania	0.2	0.2	0.2	0.2	0.2	0.2
Total Trade with:							
	Kenya	1.7	2.8	4.4	3.9	3.2	3.8
	Tanzania	0.2	0.2	0.2	0.2	0.2	0.2

Source: Calculated from Direction of Trade Statistics, IMF.

with Kenya and Uganda, respectively. For the degree of openness between Kenya and Uganda, when we included unofficial cross-border trade, the openness index increased by 2 percent.

Thus, the degree of openness between the three countries is still low even with the inclusion of unofficial cross-border trade for the years for which data is available. However, cross-border trade is still important to the East African countries. Among the constraints facing informal traders are poor infrastructure, lengthy procedures in receiving licenses, harassment by government officers, corruption at

borders, limited credit facilities and high tax rates (Ackello-Ogutu, 1997). It is hoped that with the support that the Community is receiving from donors for improving the infrastructure and the procedures that are being put in place to establish a single market, the volume of trade will improve.

Table 4 shows the extent of openness with respect to the rest of the world. It shows that Kenya is a more open economy of the three, followed by Tanzania. Uganda is the least open economy. In general, the indices of openness indicated in Tables 3 and 4 do not favour the formation of a currency union in East Africa.

Table 4: Trade as a Share of GDP (%)

	KENYA			TANZANIA		UGANDA		
	1975-80	1980-90	1990-97	1988-90	1990-96	1975-80	1980-90	1990-97
Exports/GDP	29.98	24.86	31.61	12.54	15.10	13.62	11.17	10.78
Imports/GDP	34.54	29.29	33.64	31.14	39.37	15.13	17.92	24.31
Total Trade/GDP	64.51	54.14	65.25	43.68	54.47	28.75	29.09	35.08

Source: World Bank, World Development Indicators CD-ROM, 1999.

Cyclical covariation in economic activity

In order to assess whether the three countries' economic activities move together, we examined the behaviour of four macroeconomic variables. The variables are; growth of output and money, and the nominal and real interest rates. Table 5 gives some descriptive statistics of the variables, that is, the correlation of the variables, the mean, and the standard deviation of each of the variables.

Starting with the growth of output and money, the correlation among the three countries is very low and insignificant. The most significant correlation coefficient

Table 5: Correlation Matrix

	Output Growth, 1982-1998					*Money Growth, 1977-1998*				
	Kenya	Tanzania	Uganda	Mean	SD	Kenya	Tanzania	Uganda	Mean	SD
Kenya	1.00			0.32	6.92	1.00			18.89	11.59
Tanzania	0.11	1.00		3.49	18.31	0.12	1.00		26.69	11.40
Uganda	-0.18	-0.11	1.00	7.21	15.26	-0.16	0.13	1.00	61.48	46.66
	Nominal Interest Rate, 1981-1990					*Real Interest Rate, 1981-1990*				
	Kenya	Tanzania	Uganda	Mean	SD	Kenya	Tanzania	Uganda	Mean	SD
Kenya	1.00			14.20	1.80	1.00			77.4	17.83
Tanzania	0.54**	1.00		18.04	8.11	0.86***	1.00		279.6	142.12
Uganda	0.61**	0.89***	1.00	24.29	10.75	0.86***	0.95***	1.00	5710	5952.0

*Note: Significant at; *** 1%, ** 5%, *10%; SD stands for Standard Deviation.*
Source: Calculated from IFS Data, IMF-CD ROM, 1999.

is in the nominal and real interest rates. The correlation coefficients for interest rates suggest a very high correlation among the countries, with the correlation coefficients for all the countries being significant at 1 percent. Overall, the low correlations of output and money growth suggests that the three countries' economic activities do not move together, suggesting that they are not suitable to form a currency union.

Similarity of the industry structure

The other factor used for examining the suitability of countries to form a currency union is the similarity in industry structure. We used the contribution of industries to value added to analyse the extent of similarities in the industrial structures of the three countries. The percentage contributions are given in Table 6. The percentage contributions show that food products and beverages dominate Kenya's industrial value added, which together contribute about two-fifth of valued added. This is followed by other chemicals and fabricated metal products.

In Tanzania, paper and products, food products, beverages, other non-metallic products, and transport sector dominate industrial value added. The contribution of the first three sectors to value added is more than 50 percent. In Uganda, food products, beverages, tobacco and textiles dominate the industrial structure. Although Uganda's industrial structure is similar to that of Kenya in that food products and beverages are the top two industries, however, in Uganda, their contribution to value added is much larger, accounting for approximately 55 percent.

Table 6: Percentage Contribution of Industrial Sectors to Value Added[a]

	KENYA	TANZANIA	UGANDA
Food products	28.77	20.43	42.83
Beverages	10.21	12.19	11.86
Tobacco	1.38	8.47	8.93
Textiles	5.83	-22.66	8.00
Wearing apparel, except footwear	1.70	0.43	1.34
Leather and fur products	0.49	0.46	0.17
Footwear, except rubber or plastic	0.89	0.08	1.34
Wood products, except furniture	1.78	1.06	0.09
Furniture and fixtures, excluding metal	1.22	1.44	4.03
Paper and products	4.38	22.65	0.94
Printing and publishing	3.00	3.19	1.39
Industrial chemicals	1.86	3.38	0.25
Other chemicals	7.13	4.25	5.78
Petroleum refineries	0.81	3.69	0.00
Misc. petroleum and coal products	0.00	0.00	0.00
Rubber products	3.57	4.57	0.22
Plastic products	2.84	-0.18	0.00
Pottery, china, earthenware	0.08	0.01	0.02
Glass and products	0.49	0.77	0.00
Other non-metallic mineral products	4.54	10.42	2.49
Iron and steel	0.24	0.58	3.02
Non-ferrous metals	0.00	4.38	0.03
Fabricated metal products	6.89	3.53	4.66
Non-electrical machinery	0.57	1.20	0.73
Electrical machinery	5.19	4.82	1.81
Transport equipment	4.21	9.97	0.07
Professional and scientific equipment	1.94	0.09	0.00
Other manufacturing industries	0.00	0.79	0.00
	100	100	100

Note: [a]*The figures for Kenya and Tanzania are for 1991, while those for Uganda are for 1989.*
Source: *Calculated from UNIDO, International Yearbook of Industrial Statistics, various issues.*

The percentage contributions of the various sectors to industrial value added show that the three countries' industrial structures are similar in that food products and beverages account for a large share of the countries' value added. While food products account for the largest share of value added in Kenya and Uganda, it is the second largest sector in Tanzania. This reflects the dominance of the agricultural sectors in all the three countries (see Table A1 in the appendix).

Given that the three countries' economies are dominated by the agriculture sector, we further examined the structure of the agriculture sector. Owing to lack of data on value added in the agriculture sector, we made use of macroeconomic data, given in Table 7.

Table 7 gives data on the structure of agricultural exports. Between 1992 and 1996, the percentage contribution of agricultural exports to total exports in Kenya, Tanzania and Uganda averaged 47, 59, and 70 respectively. The crops that contributed the highest percentage to total exports are tea and coffee for Kenya, coffee and cotton for Tanzania and coffee and tea for Uganda.

Table 7 shows that by and large, the three countries' agricultural sectors are similar. Besides contributing the largest share to *GDP*, the agriculture sector is the largest export income earner, with the contribution of tea and coffee, and other agricultural products dominating their export earnings. The similarity of the agriculture sector in the three countries implies that if a shock in the price of one of the crops occurred in the world market, the three countries would be affected in the same way.

Table 7: Contribution of Agriculture Sector to GDP and Exports, 1992-1996

	1992	*1993*	*1994*	*1995*	*1996*	*Average, 1992-96* *Value*	*Percent*
Kenya							
Agriculture value added / *GDP* (%)	27	32	33	31	29		30.4
Total exports (million US$), *of which:*	1013	1102.9	1484	1875	1969	1488.7	
Coffee	128	176.5	233.3	282	286.7	221.3	14.9
Tea	294.7	298.6	301.1	330.6	396.3	324.26	21.8
Horticulture	70.3	67.8	83.7	119.2	136.7	95.54	6.4
Processed fruits & vegetables.	46	44.7	44	94.4	87.1	63.24	4.2
Subtotal, agricultural exports	539	587.6	662.1	826.2	906.8	704.34	47.3
Tanzania							
Agriculture value added / *GDP* (%)	48	48	46	46	48		47.2
Total exports (millions US$), *of which:*	397	367.2	519.3	661.2	768	542.54	
Coffee	59.5	87.6	115.4	142.6	136.1	108.24	20.0
Cotton	97.6	65.3	105.1	120.2	125.3	102.7	18.9
Sisal	1.3	2.1	5.1	6.3	5.3	4.02	0.7
Tea	22.4	23.1	39.5	23.4	22.5	26.18	4.8
Tobacco	27.2	15.9	20.6	27.1	49.2	28	5.2
Cashew nuts	23.5	22.4	51.2	64	97.8	51.78	9.5
Subtotal, agricultural exports	231.5	216.4	336.9	383.6	436.2	320.92	59.2
Uganda							
Agriculture value added / *GDP* (%)	51	52	50	49	45		49.4
Total exports (million US$), *of which:*	157	253.8	595.3	590.3	670.8	453.44	
Coffee	99.1	172.3	456.6	404.4	365.6	299.6	66.1
Cotton	5.3	4.3	3.3	13.2	15	8.22	1.8
Tea	6.5	8.9	11.8	12.5	13.5	10.64	2.3
Subtotal, agricultural exports	110.9	185.5	471.7	430.1	394.1	318.46	70.2

Source: IMF (1998), Kenya: Selected Issues and Statistical Appendix, IMF (1998), Uganda: Selected Issues and Statistical Appendix; IMF (1998), Tanzania: Statistical Appendix, World Bank (1999), World Development Indicators CD-ROM.

The fact that the three East African countries may face symmetric shocks is further supported by the correlation of their real commodity export price indices.[9] Figure 1 plots quarterly data of the commodity prices for the period between 1957(q1) and

[9]The indices for each country were calculated as a geometric weighted average of the commodities it exported, excluding manufactures. That is, $R_j = \prod_i P_i^{w_i}$ where, R_j is the index for country j, P_i is the dollar international commodity price for commodity i, W_i is the weighting item, which is the value of commodity i in the total value of all commodities, n.

1997(q4). It shows that the three countries' price indices have moved very closely together.

Figure 1: Evolution of Real Commodity Export Prices, 1957(q1)-1997(q4)

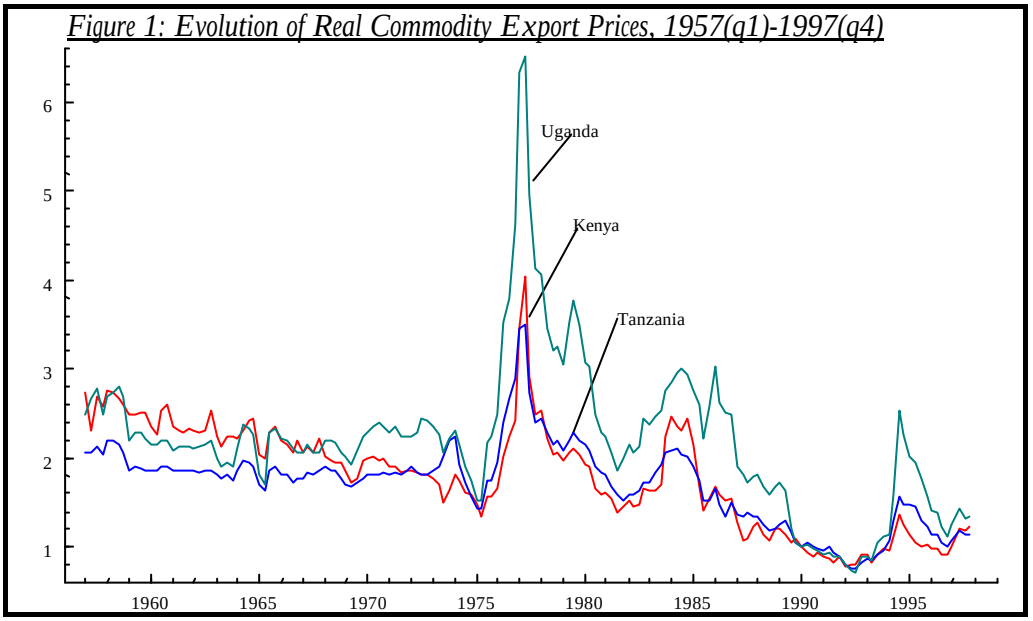


Table 8 gives the correlation matrix and the *t*-statistics for the correlations. The correlation coefficients are all significant at one percent. However, the movement of prices is more closely correlated between Tanzania and Uganda, followed by the correlation between Tanzania and Kenya. The close movement of the commodity prices implies that the three countries are affected by shocks in a similar way, and thus would be form a currency union.

Table 8: Correlation Matrix of Commodity Export Prices, 1957-97

	Kenya	Tanzania	Uganda
Kenya	1.0000		
Tanzania	0.8817 (23.7842***)	1.0000	
Uganda	0.7585 (17.2204***)	0.9217 (28.9301***)	1.0000

*Note: The figures in parentheses are t-statistics; ***denotes significant at 1%.*

Similarity in inflation

Table 9 shows that between 1981 and 1991, the average rates of inflation in the three countries were different. Uganda had the highest average rate of inflation, followed by Tanzania. Kenya had the lowest average rate of inflation. However, between 1991 and 1997, Uganda's average rate of inflation was the lowest, followed by Kenya and then Tanzania. The average rates of inflation between 1991 and 1997 in the three countries appear to be similar compared to the period between 1981 and 1991.

Table 9: Inflation – Average Percentage, 1981-97

Country	1981-1997	1981-1991	1991-1997
Kenya	15.58	12.63	20.83
Tanzania	28.28	30.46	24.92
Uganda	67.84	96.56	17.01

Source: Calculated from World Development Indicators CD-ROM, World Bank (1999).

The similarity in the average rates of inflation in the three countries reflects some similarities in the way they have been conducting their economic policies. The aspects of economic policies that are similar are that all the three countries are undertaking *IMF*/World Bank-supported adjustment reforms. The reforms entail among other things, liberalising the goods and foreign exchange markets, fiscal discipline, trade liberalisation, privatisation of previously state-owned companies, and other wide-ranging reforms. These economic policies can help to make the inflation rates converge, and hence making it easier for them to form a currency union.

4.2 Shock Absorption: Generalised Purchasing Power Parity Approach

The Generalised Purchasing Power Parity (*G-PPP*) approach for assessing the suitability of forming a currency union was developed by Enders and Hurn (1994). The approach works as follows. Empirically, it has been established that real exchange rates are non-stationary. It is postulated that real exchange rates are influenced by some macroeconomic variables. These are known as fundamental variables and may include income, terms of trade, government consumption and so on.[10] It has been found that most macroeconomic variables are non-stationary. Thus, it is not surprising that *PPP*-defined real exchange rates exhibit non-stationarity.

If two countries qualify for creation of a currency union, then they must experience symmetrical shocks to their macroeconomic variables. The fundamentals in the two countries must thus, on average, move together. Therefore, *G-PPP* postulates that the real exchange rates between the two countries comprising the domain of a currency area should be cointegrated (Enders, 1995).

G-PPP is also relevant in a multi-country setting. In such a setting, a currency area is such that the fundamentals that drive the real exchange rates will exhibit common stochastic trends. Thus the real exchange rates in the currency area will share common trends. Within the currency area therefore, there should be at least one linear combination of the various bilateral real exchange rates that is stationary. In other words, the real exchange rates will be cointegrated.

[10]See Paper II for an attempt to find the main determinants of the real exchange rate in Zambia.

Enders and Hurn (1994) summarise the basic tenets of *G-PPP* as follows;

> 1. The real fundamental macroeconomic variables determining real exchange rates (i.e., the forcing variables) tend to be non-stationary, so that, in general, the real rates themselves will be non-stationary.
> 2. Within a currency area, the real fundamentals themselves will share common trends. In an appropriately defined currency area, the forcing variables will be sufficiently interrelated for the real exchange rates to share a reduced number of common trends. Given that a vector of bilateral real rates share common trends, there exists (at least one) linear combination of the real rates which is stationary; thus the real rates will be cointegrated (p.180).

The *G-PPP* test thus involves establishing whether there is cointegration in the following equation;

$$\langle 2 \rangle \quad r_{12t} = b_0 + b_{13} r_{13t} + b_{14} r_{14t} + \ldots + b_{1m} r_{1mt} + e_t$$

where,

r_{1it} are the bilateral real exchange rates between country *1* (the base country), and country *i* in period *t*,

b_0 is an intercept term,

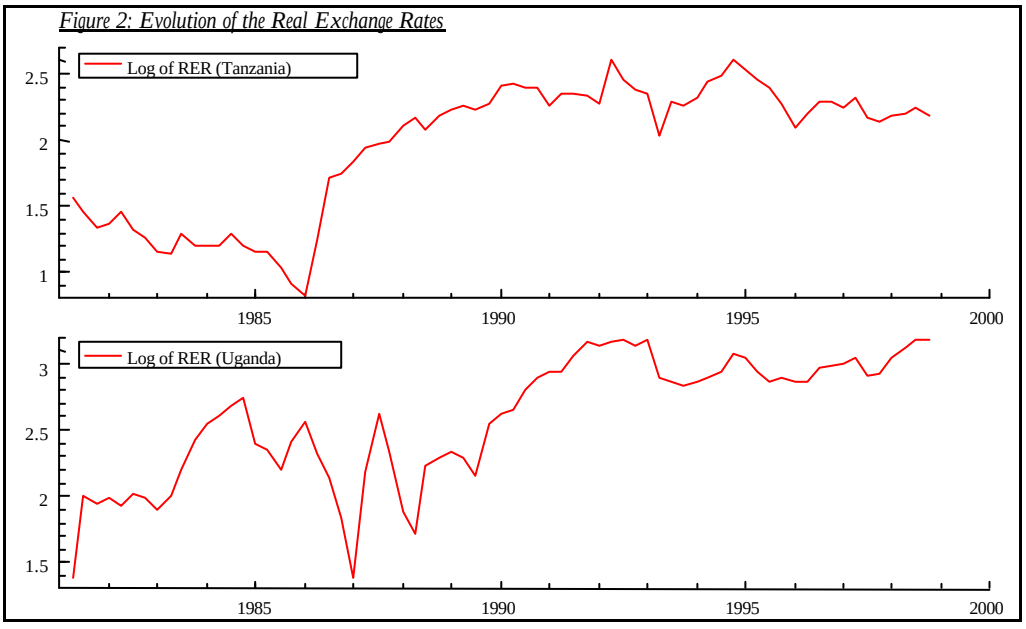
b_{1i} are the parameters of the cointegrating vector, and

e_t is a stationary stochastic disturbance term.

Enders and Hurn (1994) applied their theory of *G-PPP* to countries in the Pacific Rim, and India. We now employ this approach to determine the optimality of the *EAC*. We used quarterly data on price indices and nominal exchange rates for Kenya, Uganda and Tanzania, covering the period from 1981(q2) to 1998(q4). The data was obtained from the *IFS CD-ROM*, and was used to construct the bilateral real exchange rates as follows;

$$\langle 3 \rangle \quad r_{1_{it}} = S_{1_{it}} \frac{P_{it}^{*}}{P_{it}}$$

where, r_{1it} is the bilateral real exchange rate index between country 1 (the base country) and country *i*. We used Kenya as the base country because, of the three countries, it trades more with the other East African countries than either Tanzania or Uganda (see Table A3 in the appendix). S_{1it} is the nominal exchange rate between the base country and country *i* at time *t*, and P_{it}^{*} is the base country's price index. Here, we used the consumer price index for Kenya, and P_{it} is the domestic price level for country *i*, proxied by the consumer price index for each country *i*. The resulting real exchange rates (for Uganda and Tanzania) are graphed in Figure 2. By visual inspection of the graph, we can see that neither variable is stationary.



Formal tests for unit roots was conducted using the Augmented Dickey Fuller (*ADF*) test and the results are reported in Table 10. The real exchange rate for

Uganda for the sample 1990 to 1998 is barely stationary. We will however still include this variable in the cointegration test (see Harris, 1995, for justification of occasional inclusion of a stationary variable in a vector of non-stationary variables for the purpose of conducting cointegration).

Table 10: Unit Root Tests for the Full Sample and Sub-Samples

Sample	*Variable*	*Trend*	*Lags*	*ADF*	*LM Test for Serial Correlation*	*Order of Integration*
Full sample: 1981-1998						
	Ltrer	No	0	-1.126	F(5, 63) = 0.3454 [0.8833]	I(1)
	ΔLtrer	No	0	-7.492**	F(5, 62) = 0.4484 [0.8129]	I(0)
	Lurer	No	3	-1.399	F(5, 57) = 1.3908 [0.2415]	I(1)
	ΔLurer	No	2	-7.299**	F(5, 58) = 1.3277 [0.2653]	I(0)
1981-1990						
	Ltrer	Yes	1	-2.321	F(3,30) = 0.778 [0.5156]	I(1)
	ΔLtrer	No	0	-4.277**	F(3,32) = 1.004 [0.4037]	I(0)
	Lurer	No	1	-2.599	F(3,31) = 1.470 [0.2419]	I(1)
	ΔLurer	No	1	-5.753**	F(3,30) = 1.312 [0.2889]	I(0)
1990-1998						
	Ltrer	No	0	-2.814	F(3,30) = 0.474 [0.7030]	I(1)
	ΔLtrer	No	3	-3.912**	F(3,24) = 1.304 [0.2961]	I(0)
	Lurer	No	1	-3.111*	F(3,28) = 0.142 [0.9337]	I(0)

Note: Ltrer – log of the real exchange for Tanzania; Lurer – log of the real exchange rate for Uganda; D- difference operator.

Next, we conducted cointegration analysis. This was conducted over the entire sample of the data (1981 to 1998). We also conducted cointegration over the periods 1981 to 1990, and 1990 to 1998 separately. The former period represents the time that the three East African countries had divergent policy regimes. Tanzania was on a very slow and reluctant reform track, from a highly regulated economy with a predominance of government-run businesses to a more market-oriented and privately run economy. In 1985, Nyerere, the socialist president, handed over power to Mwinyi, a pragmatic and reform-minded president, whose

reform pace was however, very slow and marred with mounting corruption.[11] In 1995, Benjamin Mkapa won the presidential election and continued with reforms initiated by Mwinyi with more vigour. Uganda was ushering in a post-Idi Amin era in 1980, and went through a period of prolonged civil war that brought a pragmatic and reform-minded government of Museveni to power in 1986. Uganda, under Museveni, embarked on an earnest economic reform programme. Kenya was all along a more market-oriented economy of all the East African countries, but it became increasingly corrupt and despotic under the ageing presidency of Daniel arap Moi. In early 1990, Moi succumbed to pressure and allowed a multiparty system. Economic shocks and mismanagement also forced the Kenyan government to embark on a structural adjustment program. By 1990, all three countries were becoming more and more similar in their macroeconomic regimes. The period from 1990 to 1998 can thus be analysed separately and contrasted to the 1981 to 1990 period. This will shed light on whether, as expected, the three countries are moving towards more convergent macroeconomic policies.

In the VAR estimation of the full sample, 8 lags were used, while 3 lags and 4 lags were used for the 1981-1990 and 1990-1998 periods, respectively. Both the information criteria and the need to have satisfactory diagnostic test results guided the choice of the number of lags.

The cointegration results for the full sample are reported in Table 11. It seems that one cointegration vector exists between the real exchange rates, suggesting that in the long-run, the real exchange rates move together. This result suggests that the

[11]Towards the end of his tenure in office, Mwinyi's government had become too weak and corrupt. As a result of this, the Nordic countries, except Denmark, suspended aid to Tanzania. The pace of reforms and the credibility of the government to donors was restored by the presidency of Mkapa, who took office in 1995 (Bigsten *et al*, 1999).

real variables that affect the real exchange rates in East Africa are inter-related. Using this criterion therefore, one can conclude that the region constitutes an optimum currency area.

Table 11: Cointegration Results: Full Sample

Ho:rank=p	λ_i	λ_{max}	*Adj. for df.*	*95% CV*	λ_{trace}	*Adj. for df.*	*95% CV*
p == 0	-	20.86**	16.15*	15.7	21.47*	16.62	20.0
p <= 1	0.286	0.6136	0.475	9.2	0.6136	0.475	9.2
p <= 2	0.010						

Note: The column denoted by λ_i reports the eigenvalues.

Table 12 reports the coefficients of the cointegrating vector, b', together with the adjustment coefficients, a. Of particular interest are the coefficients of the speed of adjustment, which suggest that the real exchange rate for Uganda has a faster speed of adjusting to equilibrium than that of Tanzania. This is as should be expected. As noted above, Uganda started its economic liberalisation policies in 1986, while Tanzania started the same effort about the same time but with a slow pace and notable reluctance. The devaluation of the Tanzanian Shilling, for example, was for a long time a politically controversial issue, and was only undertaken haltingly and in piecemeal.

Table 12: Cointegration; Parameter Estimates: Full Sample

Full sample			
b'			
Ltrer		Lurer	Constant
1.0000		-1.9878	3.5852
a			
Ltrer	0.04203		
Lurer	0.18058		

No cointegration was found between the real exchange rates in the period 1981-1990 (see Table 13). This is not surprising. Between 1980 and 1986, Uganda was not only tasting a new lease of life after the chaotic regime of Idi Amin, but had to endure a period of political uncertainty[12] prior to Museveni's take over. Kenya, on the other hand, maintained its stability and continuity throughout the 1980's. Tanzania entered the decade with an economy bedevilled by serious problems, partly as a result of her efforts to repel and later topple Idi Amin, but also due to a highly regulated economy with substantially entrenched government ownership. Under Julius Nyerere, Tanzania refused economic reforms suggested by the Bretton Woods institutions. In 1986, a deal with these institutions was finally reached but the pace of reforms was slow. So, for a larger part of the 1980's, the three countries had different macroeconomic policies. The reforms that started after the mid 1980s in both Uganda and Tanzania, while leading to a converging policy, had different paces.

Table 13: Cointegration Results: 1981-1990

Ho:rank=p	λ_i	λ_{max}	*Adj. for df.*	*95% CV*	λ_{trace}	*Adj. for df.*	*95% CV*
P == 0	-	9.701	8.038	15.7	10.84	8.983	20.0
P <= 1	0.242	1.141	0.9452	9.2	1.141	0.9452	9.2
P <= 2	0.032						

In the period between 1990 to 1998, cointegration was established between the real exchange rates (see Table 14). It is notable that on entering the 1990s, all the three

[12]Notable is the quick succession of power from Prof. Lule to Binaisa, from Binaisa to Muwanga, from Muwanga to Obote, from Obote to Tito Okello and finally, after a protracted guerrilla war, Museveni took over in January 1986. All this happened in a span of six years, from 1980 to 1986 (Museveni, 1997).

governments in East Africa had been implementing structural adjustment programmes for some time, and one may conclude that a convergence in macroeconomic policies was taking place.

Table 14: Cointegration Results: 1990-1998

Ho:rank=p	λ_i	λ_{max}	*Adj. for df.*	*95% CV*	λ_{trace}	*Adj. for df.*	*95% CV*
p == 0	-	18.02*	14.02	15.7	20.43*	15.89	20.0
p <= 1	0.394	2.409	1.874	9.2	2.409	1.874	9.2
p <= 2	0.065						

It is also notable that while cointegration was also established for the full sample of 1981 to 1998, the coefficients of the speeds of adjustment for the full sample are lower than for the 1990-1998 sample (see Table 12 and 15). It seems therefore that more market-oriented macroeconomic policies were dominating East Africa in the 1990s, and hence the faster speeds of adjustment to equilibrium in the real exchange rates.

Table 15: Cointegration; Parameter Estimates: 1990-1998

Full sample			
β'			
Ltrer		Lurer	Constant
1.0000		0.48344	-3.7833
α			
Ltrer	-0.51164		
Lurer	-0.36214		

In this sub-section, it has been shown that there was cointegration between the real exchange rates in East Africa for the period 1981-1998 and 1990-1998. Of the two periods, the speed of adjustment to equilibrium is higher in the 1990-1998 period. No cointegration could be established between the real exchange rates for the

period 1981-1990. The conclusion is that as per the *G-PPP* theory, the East African countries constitute an optimum currency area; they seem to suffer the same type of shocks. This is probably so because the three countries are predominantly agricultural, and heavily rely on the export of cash crops and importation of oil and manufactured goods. The convergence in macroeconomic policies enhanced by the implementation of similar macroeconomic adjustment programmes seems to account for the optimality of the currency area in the region, and this is more so in the 1990s than in the period 1981 to 1990.

It is of course true that the three economies are still changing. New sectors are assuming prominence; for example, mineral exploitation and tourism in Tanzania are two sectors that are poised to overtake other major cash crops as the main foreign exchange earners. The future may still have some surprises in store. The results reported here are thus tentative.

5 Conclusion

The revival of the *EAC* seems promising. The ideological differences that contributed to the failure of the "old *EAC*" seem to have vanished. All three countries are actively pursuing market-oriented economic policies under the tutelage of the Bretton Woods institutions and the donor community. The ambition of the *EAC* includes formation of a monetary union. This paper examined whether the three countries constitute an optimum currency area. Standard indices were used, together with the *G-PPP* approach, for the purpose. The results in this paper are not necessarily conclusive. However, one major feature of these countries is the heavy reliance on agriculture. The export of agricultural crops constitutes the main source of export earnings. It is likely therefore that these countries tend to experience similar external shocks. This seems to be confirmed

by the *G-PPP* approach, which shows that the real exchange rates of these countries are cointegrated.

Whereas in the past, these countries might have enjoyed different growth rates and suffered different levels of inflation, the tendency seems to be one of convergence. This is mainly because of the *IMF*/World Bank sponsored structural adjustment programmes. The future is therefore more promising for the monetary union.

In the final analysis, the formation of a monetary union relies on the political will and cultural ties of the countries concerned. There seems to be political enthusiasm for more economic union in East Africa. Indeed, more countries are showing interest in joining the *EAC.* Should political stability endure in the three countries, the prospects for more integration are good. Culturally, the people of East Africa share two languages of Kiswahili and English. These factors may prove decisive in the formation of a monetary union despite the verdict from an optimum currency area study like this one.

Appendix

Table A1: Sectoral Contribution to GDP (%), 1988-1997

	KENYA					TANZANIA					UGANDA				
	1988	1990	1992	1994	1997	1988	1990	1992	1994	1996	1988	1990	1992	1994	1997
Agriculture	31.46	29.14	26.79	33.32	28.83	53.07	48.00	48.06	46.33	47.63	56.71	56.58	51.14	50.00	43.80
Industry	19.17	19.14	19.07	17.25	15.53	19.98	21.54	21.03	21.25	21.15	10.19	11.06	13.21	13.82	17.33
Manufacturing	11.62	11.79	11.20	10.69	10.06	8.14	8.92	8.53	7.44	7.28	5.78	5.67	6.17	6.52	8.17
Services	49.37	51.72	54.14	49.43	55.65	26.95	30.45	30.91	32.42	31.22	33.10	32.36	35.66	36.18	38.88

Source: World Bank, World Development Indicators CD-ROM, 1999.

Table A2: Trading Partners, 1994 and 1996

	KENYA		TANZANIA		UGANDA	
	1994	1996	1994	1996	1994	1996
EXPORTS	United Kingdom, Germany, Uganda, Tanzania, United States, Netherlands, Pakistan, France, Somalia, Italy	United Kingdom, Uganda, Germany, Tanzania, Netherlands, United States, Pakistan, Egypt, Somalia, France	India, Germany, Japan, United Kingdom, Rwanda, Netherlands, Portugal, United Arab Emirates, Belgium-Luxembourg, United States	India, Germany, Japan, Malaysia, Rwanda, United Kingdom, Netherlands, United Arab Emirates, Taiwan, Portugal	Spain, France, Germany, United States, Italy, United Kingdom, Poland, Chile, Portugal, Belgium-Luxembourg	Spain, France, Germany, Belgium-Luxembourg, Italy, Hungary, United Kingdom, Canada, Portugal, Switzerland
IMPORTS	United Kingdom, United Arab Emirates, South Africa, Japan, United States, Germany, India, Italy, France, Belgium-Luxembourg	United Kingdom, South Africa, United Arab Emirates, India, Japan, Germany, France, Italy, Netherlands, United States	United States, Kenya, Saudi Arabia, Japan, Germany, India, China, Italy, South Africa, United States	South Africa, Kenya, United Kingdom, Saudi Arabia, India, Japan, China, United Arab Emirates, Thailand, United States	Kenya, United Kingdom, Japan, India, United States, Germany, Italy, Hong Kong, France, Netherlands	Kenya, United Kingdom, India, Japan, Germany, France, South Africa, Hong Kong, Italy, United States

Source: IMF, Direction of Trade, various issues.

Table A3: Intra-Regional Trade (percentage of total trade in US$ mn), 1990-1996

	1990	1991	1992	1993	1994	1995	1996
KENYA							
Exports to: Tanzania	2.13	3.07	3.29	6.96	6.90	7.29	7.79
Uganda	18.43	4.16	5.38	8.61	8.52	8.99	9.63
Imports from: Tanzania	.47	.45	.53	.47	.46	.41	.48
Uganda	-	.06	.29	.35	.33	.27	.31
TANZANIA							
Exports to: Kenya	2.89	2.05	1.92	1.78	1.73	1.72	1.71
Uganda	.96	1.17	1.20	1.33	1.35	1.25	1.32
Imports from: Kenya	1.75	2.48	3.25	6.88	8.11	9.97	12.63
Uganda	.09	.07	.07	.07	.07	.13	.14
UGANDA							
Exports to: Kenya	-	.5	2.82	2.79	1.42	1.52	1.61
Tanzania	.68	.5	.70	.56	.24	.43	.36
Imports from: Kenya	35.91	12.69	19.79	27.79	17.36	17.58	29.36
Tanzania	.68	1.24	1.25	1.31	.92	.86	1.49

Note: Calculated from the IMF's Direction of Trade.

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Essays on Purchasing Power Parity, Real Exchange Rate, and Optimum Currency Areas

ERRATA

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Page and Line	Correction
Paper I	
17, equation 10	$\langle 10 \rangle \quad MRER_{jt} = \frac{\sum_{i=1}^{k} \alpha_i E_{it} P_{it}^{*}}{P_{jt}}$
Paper II	
23, 14-15	Fundamentals in equation 7, along with terms of trade (χ) and trade policy (η), as in equation in 8.
25, 12	Insert this sentence after "real exchange rate": However, the demand for imports and consequently for foreign exchange will increase, leading to a depreciation in the real exchange rate.
29-30, 24	we follow the convention and use the wholesale price index for the trading partners as a proxy for the price of tradable goods,
32, 15-16	The information criteria, except the *AIC* for the case of the real exchange rate for imports, accept the reduction.
43, 13	the first difference of the real exchange rate lagged twice,
43, 19	the first difference of terms of trade, and the second difference of terms of trade lagged once,
52, 19	where, e is the multilateral real exchange rate,
63, Reference	Gelband, E. and Nagayasu, J., (1999), "Determinants of Angola's Parallel Market Real Exchange Rate", *IMF* Working Paper, *WP/99/90*, July.
56, Table 2	See below:

Table 2: Steps Taken to Arrive at Models in Table 12

RER	*Steps*	*F-Test for Model Reduction*	*SIC*[1]
RER for Imports			
	1. General error-correction model		-1.35404
	2 Excluded Δltot, Δltot_1, Δltot_2, Δlaid, Δlaid_1, Δlaid_2, Δlopen_2	F(7,9) = 0.6569 [0.7035]	-1.75412
	3. Excluded Δlgcons_2, Δlishare_2	F(2,16) = 0.7199 [0.5025]	-1.90033
	4. Replaced Δlrer_1 and Δlrer_2 with ΔΔlrer_1	F(1,18) = 0.0261 [0.8735	-2.015
RER for Exports			
	1. General error-correction model		-2.09985
	2. Excluded Δltot_1, Δltot_2, Δloexr_1, Δloexr_2	F(4,11) = 0.2469 [0.9056]	-2.48989
	3. Excluded Δlrer_1, Δlcbresy_2, Δlttaxy, Δlttaxy_2	F(4,15) = 0.7613 [0.5665]	-2.7811
	4. Excluded Δlttaxy_1	F(1,19) = 1.3606 [0.2579]	-2.83095

Note: [1]Schwarz Information Criteria.