# Currency Depreciations and the Trade Balance: The Case of Sub-Sahara Africa

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*Against the backdrop of the impressive economic growth rate of Sub Sahara African (SSA) economies of the last decade, this paper explores the relationship between the trade balance and the real exchange rate for nineteen SSA countries. This is a bilateral approach between a panel of these SSA countries and each of four industrialized countries; the US, Britain, France and Japan. After Unit Root Tests establish the non-stationarity of almost all of these variables used in the study, the paper employs the Johansen-Fisher Panel Cointegration technique, to investigate the existence of a stable long term relationship between bilateral currency depreciations and the trade balance for the panel, and the aforementioned industrial nations individually. The results are generally mixed, with the tentative implication that currency devaluations would be an effective policy tool in reversing the precarious balance of payment situation facing most of these countries.*

## INTRODUCTION

The deceleration of economic growth in Africa between 2003 and 2008 left many experts questioning whether this represented the start of a reversal of the significant gains of the previous decade. After two decades of poor economic performance from 1970 to the early 1990's, several African countries enjoyed almost one full decade of strong economic recovery. There were several indicators of this revival. African equity markets and consumer goods exports, while being smaller than those of any other continent, experienced a significant revival in the last four years. Emerging Market Fund managers were attracted by the relatively low risk vs. significantly above average stock market performance in selected countries such as Botswana, Zambia and Ghana in recent years. At the same time, during the second half of the 1990's, the indefatigable efforts of the South African government and the mass invasion of private South African and Chinese companies into Sub-Saharan Africa, resulted in some of the fastest rates of growth in consumer goods industries anywhere in the developing world. Finally, after shrinking for all of the decade of the 1980's and most of the 1990's, US-Africa trade had climbed to record levels.

The reasons for this reversal of fortune from the previous two decades were reasonably clear: The acceptance of the concept of privatization of public companies; the relaxing of restrictions on imports; the creation of export processing zones; the award of 10-year tax holidays to foreign owned firms; a more robust legal system; the right of repatriation of profits for foreign firms; the liberalization of agricultural marketing boards; and perhaps most important the move to a regime of flexible exchange rates.

For a panel of 21 SSA countries, this study investigates whether devaluations significantly alter the real exchange rate, and then examines the relationship between the real exchange rate and the trade balance.

While economic theory generally accepts the view that a devaluation improves a nation's trade balance there is a considerable difference of opinion as to the process involved. The Elasticities approach suggests that a nominal devaluation by exerting a negative impact on the real exchange value of a nation's currency will improve the global competitiveness of that nation's tradable goods. In the Monetary approach, a devaluation leads to a reduction in real balances, a fall in expenditures and hence to an improvement in the trade balance. The obvious disagreement is on the role accorded relative prices in the adjustment process. [1]

The model that is initially employed is essentially monetarist, with the trade balance dependent on domestic and foreign income levels and the real exchange rate. The domestic and foreign readings on these variables would reflect the "one world" assumption that is so basic to Monetarism. However, the presence of the real exchange rate as a determinant of the trade balance, endows the model with a Keynesian flavor. [2]

This study uses the bilateral exchange rate between each panel member and each of four developed countries [the US, the UK, France and Japan] as well as the SDR exchange rate between the panel and a composite Developed Country variable representing these four countries. The disadvantage of using an aggregate exchange rate such as the SDR for each panel member is that a rise in the bilateral exchange rate against one developed country can be negated by a fall against another country. This would cancel effective rate fluctuations and perhaps lead to an otherwise unwarranted finding of inefficacy of the exchange rate as a potential tool for influencing the trade balance.

Many studies done on the trade balance prior to the last decade used level data, with notable exceptions being Miles (1979) who used first differenced data, and Bahmani and Oskooee and Alse (1994) who used a Unit Root test to ascertain that the data was in fact non-stationary. Unfortunately both used aggregate data. Meanwhile Marwah and Klein (1996) did use level disaggregated data. It is now generally accepted that most macroeconomic variables are non-stationary, carrying the risk that Ordinary Least Squares (OLS) estimates performed on them can unearth potentially spurious relationships.

The next section develops the traditional exchange rate/trade balance model complete with an estimable OLS framework (even though this is not the empirical method used in this paper). This is followed by an initial examination of data used in this study, especially the trade balance, and both the nominal and real exchange rates of the panel countries. After a brief look at panel Unit Root and Cointegration test constructs, the main empirical findings of the paper are presented. This is followed by a concluding section.

**The Traditional Trade Balance Equation Formulation**

A devaluation of the nominal exchange rate will improve the trade balance if two conditions are met. First, that the nominal devaluation results in a lasting real depreciation of the nation's currency. The fear here is not merely that a given devaluation would induce a proportionate offsetting increase in inflation, but also that repeat devaluations could involve the economy in a devaluation-inflation spiral[3].

The second condition is that the nation's foreign trade flows must be sufficiently responsive to changes in the real prices of imports and exports. Several studies have established that for most countries that have devalued, the real depreciation lasts for six or more quarters (see Himarios, 1989). This is a period long enough for a policy package (including a devaluation component) to have a significant impact on the problem.

To pursue this we advance a model to provide the framework for analysis. Following Kruger (1983), the simple Keynesian equation for the trade balance equation may be written as:

**Equation 1**

$$B = B ( Y, R_N / P )$$

where: B is the trade balance
Y is real income

$R_N$ is the nominal exchange rate (here measured as the domestic currency price of the numeraire currency)
P is the domestic price level.

Such a model can be broadened to take account of the Monetarist view of the open economy. Following Branson (1983) the two following assumptions are made. First, that the neoclassical assumption of price and wage flexibility assures full employment. Second, that there is a global market, so that all goods are perfect substitutes. This is the so-called "law of one price" whereby the domestic price and the foreign currency price of each good is equal. Third, that domestic and foreign financial instruments are perfect substitutes; thus domestic and foreign interest rates would be equal except for any expected changes in the exchange rate.

The simple Keynesian trade balance equation can be rewritten as:

**Equation 2**

$$B = B\ (R, Y, Y^*,)$$

where: Y, Y* are the domestic and foreign real income levels
R is the real exchange rate that conforms to the relative version of the Purchasing

Power Parity Theory or:

**Equation 3**

$$R = \frac{R_n P^*}{P}$$

where: P,P* represent the domestic and foreign price levels.

It has long been accepted that devaluations take several quarters to exert the greater part of their eventual effect upon the trade balance. Junz and Rhomberg (1973) and others have analyzed the lags in decision, replacement, delivery and production (see Salvatore 2007) that intervene to delay the expected increase and decrease in the volume of exports and imports respectively. [4]

In fact, these delays are often sufficient to give rise to a temporary worsening of the trade balance before there is improvement. This is known as the J-curve phenomenon. To take account of this delayed effect of a devaluation, an Almon distributed lag process is sometimes employed and thus the actual equation estimated may be written as:

**Equation 4**

$$B_i = a_o + a_1\ (L)\ R + a_4 Y + a_5 Y^* + e_i$$

where the variables are previously defined and L represent the unconstrained Almon polynomial distributed lag.

In this empirical study, the sign on the real exchange rate coefficient is important in determining whether a devaluation is successful in improving the trade balance. Assuming that a devaluation effects a real devaluation of a nations' currency, then the Marshall-Lerner condition suggests an improvement in the trade balance.[5] Since R measures the home currency price of a unit of foreign currency, the sign on $a_1$ would have to be positive to suggest that a devaluation has improved the trade balance.

## PRELIMINARY DATA ANALYSIS

This study uses annual data for 24 African nations from 1960 to 2006. The trade balance variable used is the ratio of exports to imports. This is employed to avoid the need to choose a price index to deflate the difference between exports and imports, and also to facilitate the use of a log form model. The real exchange rate used is the nominal exchange rate (measured as the individual panel member's currency per unit of the developed country's currency) multiplied by the ratio of the developed country to the individual panel country's consumer price index. Finally we note that these nominal exchange rates and the price indices, as well as an index of real GDP levels for both panel and developed countries, are obtained from the International Financial Statistics from the IMF.

As the exchange rate and the trade balance are the focal points of this paper, we now take a cursory look at their behavior over the relevant time period. Table 1 shows the ratio of exports to imports, for the earliest and latest year for which it is available, the highest and lowest level, and finally the average over

**TABLE 1**
**RATIO OF EXPORTS TO IMPORTS**

| Country | Beginning of Period | End of Period | Highest Value | Lowest Value | Average Value | Average: Last 10 Years |
|---|---|---|---|---|---|---|
| **BOTSWANA** | 0.82 | 1.74 | 1.74 | 0.32 | 0.92 | 1.29 |
| **BURKINA FASO** | 0.40 | 0.45 | 0.61 | 0.13 | 0.32 | 0.42 |
| **BURUNDI** | 0.60 | 0.14 | 1.21 | 0.14 | 0.56 | 0.34 |
| **CAMEROON** | 1.08 | 1.02 | 1.75 | 0.46 | 1.03 | 1.15 |
| **CENT. AFRICAN REP.** | 0.69 | 0.85 | 1.43 | 0.40 | 0.93 | 1.09 |
| **CONGO, DEM. REP.** | 1.79 | 0.96 | 1.88 | 0.86 | 1.26 | 1.21 |
| **CONGO, REPUBLIC OF** | 0.26 | 2.45 | 3.38 | 0.25 | 1.33 | 2.03 |
| **ETHIOPIA** | 0.88 | 0.21 | 1.12 | 0.17 | 0.55 | 0.29 |
| **GABON** | 1.49 | 3.32 | 3.48 | 1.44 | 2.28 | 2.75 |
| **GAMBIA, THE** | 0.86 | 0.04 | 0.94 | 0.04 | 0.43 | 0.07 |
| **GHANA** | 0.90 | 0.67 | 1.49 | 0.26 | 0.92 | 0.64 |
| **KENYA** | 0.85 | 0.47 | 0.92 | 0.44 | 0.66 | 0.59 |
| **MADAGASCAR** | 0.67 | 0.48 | 1.10 | 0.48 | 0.76 | 0.78 |
| **MALAWI** | 0.77 | 0.45 | 1.17 | 0.45 | 0.70 | 0.67 |
| **MALI** | 0.39 | 0.90 | 1.02 | 0.22 | 0.55 | 0.75 |
| **MAURITIUS** | 0.56 | 0.64 | 1.28 | 0.56 | 0.81 | 0.75 |
| **MOZAMBIQUE** | 0.35 | 0.74 | 0.76 | 0.13 | 0.30 | 0.47 |
| **NIGERIA** | 0.76 | 2.78 | 3.32 | 0.76 | 1.47 | 1.95 |
| **SENEGAL** | 0.66 | 0.48 | 0.94 | 0.45 | 0.66 | 0.59 |
| **SIERRA LEONE** | 1.12 | 0.55 | 1.12 | 0.07 | 0.66 | 0.95 |
| **SOUTH AFRICA** | 1.22 | 0.83 | 2.03 | 0.80 | 1.15 | 0.95 |
| **TANZANIA** | 1.28 | 0.39 | 1.28 | 0.22 | 0.55 | 0.48 |
| **ZAMBIA** | 1.17 | 0.63 | 2.46 | 0.62 | 1.33 | 0.87 |
| **ZIMBABWE** | 1.50 | 0.54 | 1.50 | 0.54 | 0.99 | 0.77 |

** Exports and Imports are based on Billion dollars*

** Note: The ratios are the authors calculations from IFS data*

the entire period as well as the average over the last 10 years. A ratio of 1 indicates that exports equal imports. A value of 2 says that exports are twice imports and 0.5 means that exports are half the value of imports.

Several patterns are easily discernible. First, for two thirds of these countries, the ratio of exports to imports turned less favorable over the period. Second, in six of the 24 countries the ratio declined by more than fifty percent, with the worst case being the Ethiopia where the decline was 76%. Another disturbing observation is that the entire time series for this ratio shows that for more than half of these countries, a significant part of the deterioration occurred within the last 10 years.

Another way of observing this fact is to note that the end of period ratio was just above the lowest value recorded over the sample period for seven countries and was exactly at the lowest value recorded for five countries, Burundi, the Gambia, Madagascar, Malawi and Zimbabwe. At the same time just about every country's highest value is significantly above the beginning year's value, the exceptions being Sierra Leone, Tanzania and Zimbabwe, where the highest recorded value occurred in the first year noted in the table. While only one country began and ended with a ratio of less fifty percent (Burkina Faso), four others had an overall average of less than fifty percent. On the positive side, seven countries, (Cameroon, Congo, Democratic Republic, Congo, republic of, Gabon, Nigeria, South Africa and Zambia) managed on average to maintain a trade surplus overall, with Botswana, the Central African Republic, Ghana and Zimbabwe narrowly failing to do so.

These are the bare facts to be gleamed from Table 1, but several explanations of this dismal trade performance are relevant at this point. First, over almost five decades, unlike what happened in Latin America and Asia, most of these countries still continued to see primary products as the chief foreign exchange earning sector. For these two other developing continents most countries over this same period moved more aggressively to a mix of light manufacturing with tourism and other services. In Sub-Saharan Africa meanwhile the latter half of the sample period witnessed an even broader mix of consumer imports, ranging from electronics to entertainment that was spurred on by ubiquitous media over-exposure.

One major factor determining the performance of the trade balance was whether the primary export was petroleum, some other extracted mineral or agricultural products. Those countries that depended largely on agricultural output such as Kenya, Ethiopia, Malawi and Tanzania experienced a noticeable worsening of their trade position over the forty year span covered in this study. By contrast the vast increase in global petroleum price over the four decades covered produced a serendipitous improvement for such oil exporting countries as Gabon (1.49 to 3.32), Nigeria (.76 to 2.78), and the Republic of the Congo (.69 to 1.43). Meanwhile for other mineral extractive countries the trade performance depended on global demand and supply for the specific mineral. Zambia (especially in the last 10 years) saw a marked deterioration of its terms of trade as the price of copper, its main foreign exchange earner collapsed on world markets.

In addition countries such as Botswana (.82 to 1.74), Ghana, South Africa and Sierra Leone, all benefited from the significant increase in the world prices of various precious metal and gem stones in the last two decades of the last century. Unfortunately a range of other issues prevented these last three countries from reaping the same benefit as Botswana. The significant decline in both prices and quantities produced of cocoa limited Ghana's potential gains, while the negative impact of three decades of Apartheid hamstrung South Africa. More specifically political turmoil, land distribution issues, outright civil war or some combination of these, exacted a significant toll on the trade balance of the Democratic Republic of the Congo, Burundi, Sierra Leone and Zimbabwe.

The implication of this analysis is that a host of factors other than the real exchange rate have had a significant bearing on the trade balance of these nations.

Table 2 presents 22 cases of significant currency devaluations involving 21 of these countries (Ghana being the only country for which two cases are shown). In every case except one a nominal devaluation effects a depreciation of the real exchange rate by the end of the following year, with that sole exception being the Democratic Republic of the Congo where the hyper inflation of the early 1990's meant that a devaluation of as much as 9185 percent not only failed to induce a depreciation of the real exchange rate

but instead brought about a 60 percent appreciation of the real exchange rate by the end of year 1 which was then followed by a significant depreciation over the next two years (one of only three cases where such a depreciation occurred).

**TABLE 2**
**NOMINAL DEVALUATION, REAL DEVALUATION, AND SLIPPAGE**

| | | (1) | (2) | | | (3) |
|---|---|---|---|---|---|---|
| | | Nominal | Real Devaluation (%)[a] after | | | Total |
| | | Devaluation | t | t+1 | t+2[b] | Slippage |
| Country | Year | (%) | (one year) | (two years) | (three years) | (%) |
| **BOTSWANA** | 1984 | 34.66 | 29.02 | 5.06 | -18.23 | 162.83 |
| **BURKINA FASO** | 1993 | 81.36 | 48.66 | 32.97 | 32.73 | 32.73 |
| **BURUNDI** | 1998 | 24.27 | 22.81 | 20.34 | 29.26 | -28.30 |
| **CAMEROON** | 1993 | 81.36 | 37.75 | 20.59 | 24.19 | 35.92 |
| **CENT. AFRICAN REP.** | 1993 | 81.36 | 49.38 | 19.61 | 23.52 | 52.38 |
| **CONGO, DEM. REP.** | 1993 | 9185.71 | -60.09 | 181.57 | 350.56 | 683.40 |
| **ETHIOPIA** | 1991 | 141.55 | 125.16 | 123.87 | 124.79 | 0.29 |
| **GABON** | 1993 | 81.36 | 36.71 | 18.95 | 26.41 | 28.05 |
| **GAMBIA, THE** | 1985 | 114.54 | 39.58 | 1.85 | -2.04 | 105.16 |
| **GHANA** | 1982 | 991.03 | 405.25 | 176.39 | 486.86 | -20.14 |
| **KENYA** | 1992 | 88.21 | 32.74 | -40.87 | -9.15 | 127.95 |
| **MADAGASCAR** | 1993 | 97.24 | 45.66 | -12.47 | -2.55 | 105.59 |
| **MALAWI** | 1993 | 240.39 | 159.39 | 45.49 | 8.97 | 94.37 |
| **MALI** | 1993 | 81.36 | 51.07 | 27.61 | 27.24 | 46.66 |
| **MOZAMBIQUE** | 1992 | 81.04 | 31.07 | 1.95 | 4.29 | 86.21 |
| **NIGERIA** | 1998 | 347.55 | 336.54 | 320.85 | 304.34 | 9.57 |
| **SENEGAL** | 1993 | 81.36 | 40.66 | 24.79 | 29.39 | 27.73 |
| **SIERRA LEONE** | 1985 | 580.86 | 283.44 | -10.26 | 6.50 | 97.71 |
| **SOUTH AFRICA** | 2000 | 60.22 | 55.86 | 4.30 | -28.66 | 151.30 |
| **TANZANIA** | 1985 | 213.46 | 141.09 | 80.66 | 136.26 | 3.43 |
| **ZAMBIA** | 1991 | 304.32 | 56.78 | -12.69 | -18.22 | 132.09 |
| **ZIMBABWE** | 1990 | 91.57 | 61.89 | 25.10 | 22.11 | 64.27 |

*a. The real devaluations are the authors calculation from the IFS data.*
*b. The slippage is measured as the % change in real devaluation from the first to the third year after the nominal devaluation.*
*c. The Total slippage is measured after removing the effect of any subsequent change in the nominal devaluation.*

A second observation from Table 2 is that the percentage change in the real exchange rate by the end of the year following the nominal devaluation does not accurately mirror the latter (in fact in 11 of the 22 cases the percentage change in the real exchange rate the following year is less than 50 percent of the

nominal devaluation. Further, for 14 of the cases, by the end of the second year after the initial depreciation of the real exchange rate, more than 50 percent of the initial real devaluation had been erased by unfavorable price differentials with trading partners. For six of these 22 cases in fact a real appreciation had set in by the end of the third year.

In only five of the 22 devaluations analyzed can it be said that the nominal devaluation was successful (as measured by the retention of most of the real devaluation (minimum slippage) into the third year; these cases being Burundi, Ethiopia, Ghana (1982), Nigeria and Tanzania. Finally we note that some of the countries with the largest devaluations (the Democratic Republic of the Congo, Sierra Leone and Zambia) sport some of the largest slippages of the real exchange rate. The implication being that even when policy makers muster the courage to take bold action in the face of withering inflation, it does not mean that they will achieve the desired change in the exchange rate to underpin the improvement in the trade balance that they seek.

## PANEL TEST CONSTRUCTS

### Unit Root Test

For a single country series, an autoregressive process specification is set up in the form:

**Equation 5**

$$Y_t = \rho Y_{t-1} + \delta X_t + \varepsilon_t$$

Where $X_t$ represent regressors such as a time trend or a constant, $\delta$ any parameter and $\varepsilon$ is the residual.

The basic test for stationarity consists of evaluating whether $\rho$ takes on the value absolute 1 in which case we can say that the series Y has a unit root and thus is non-stationary. This construct is quickly extended to the Augmented Dickey Fuller test to handle higher order series lag correlation. For multiple cross-sections (such as panel data) Equation 1 may be rewritten as:

**Equation 6**

$$Y_{it} = \rho_i Y_{it-1} + \delta_i X_{it} + \varepsilon_{it}$$

Where there are now i = 1 ……. n series and periods t = 1…..Ti
Once again if $|\rho_i| = 1$ …., then $Y_i$ contains a unit root

### Cointegration Test

Engle and Granger (1987) state that if two variables X and Y are shown to contain a unit root (i.e. are both integrated of order 1, I (1), then upon regressing Y upon X, the regression equation can be rewritten with the residual as the dependent variable, in a form such as:

**Equation 7**

$$\mu_t = Y_t - \beta_0 - \beta_1 X$$

Provided that a unit root test shows that it is stationary, i.e. integrated of order 0, we can state that the variable Y and X are cointegrated thus affirming that there exists a long run relationship between them.

Pedroni (2004, 1999) and Maddala and Wu (1999) in different constructs extend Engle-Granger to panel data situations. For example Pedroni starts out in much the same way as Engle Granger with an equation such as:

**Equation 8**

$$Y_{it} = \alpha_i + \theta_{it} + \beta_1 X_{it} + \ldots\ldots. \beta_{mt} X_{mi,t} + \mu_{it}$$

Where Y and X are integrated of order 1 and where $\alpha_i$ and $\theta$ are individual country and trends effects respectively. As in the Engle-Granger case above, the residuals from this equation are then run in a second regression for each country as:

**Equation 9**

$$\mu_{it} = \rho_i \mu_{it-1} + \sum it$$

The null hypothesis of no cointegration then becomes ($\rho$=1), implying that $\mu_t$ is I (1)

**TABLE 3**
**UNIT ROOT TEST RESULT**

| | Level Test | | First Difference Test | |
|---|---|---|---|---|
| Variable | Statistic | Probability | Statistic | Probability |
| **LTB2** | 2.8622 | 0.9979 | -33.4304 | 0 |
| **LRNX** | 3.13723 | 0.9991 | -19.0545 | 0 |
| **LRGDP** | 1.33629 | 0.9093 | -1.4154 | 0.0785 |
| **LWGDPV** | -8.62232 | 0 | -6.58379 | 0 |
| **LTBUS** | 1.56468 | 0.9412 | -3.42946 | 0.0003 |
| **LTBUK** | 1.23955 | 0.8924 | -1.52669 | 0.0634 |
| **LTBF** | 1.36455 | 0.9138 | -3.3345 | 0.0004 |
| **LTBJ** | 0.67278 | 0.7495 | -1.28259 | 0.0998 |
| **LRBXUS** | 2.35564 | 0.9908 | -21.279 | 0 |
| **LRBUK** | 1.08912 | 0.8619 | -10.521 | 0 |
| **LRBXF** | 1.19533 | 0.884 | -2.421 | 0.0077 |
| **LRBXJ** | 1.4786 | 0.9304 | -2.3901 | 0.0084 |

**TABLE 4**
**OVERALL COINTEGRATION TEST [ P-VALUES]**

| **Null** | **World** | | **U.S.** | | **U.K** | | **France** | | **Japan** | |
|---|---|---|---|---|---|---|---|---|---|---|
| Trace test | | | | | | | | | | |
| r = 0 | 0 | | 0 | | 0 | | 0 | | 0 | |
| r = 1 | 0.0001 | | 0.007 | | 0 | | 0.0001 | | 0 | |
| r = 2 | 0.276 | | 0.5907 | | 0.2612 | | 0.6011 | | 0.0301 | |
| r = 3 | 0.0328 | 2 | 0.505 | 2 | 0.7456 | 2 | 0.2722 | 2 | 0.7858 | 3 |
| Maximum Eigen Value Test | | | | | | | | | | |
| r = 0 | 0 | | 0 | | 0 | | 0 | | 0 | |
| r = 1 | 0.0006 | | 0.0217 | | 0 | | 0.0001 | | 0 | |
| r = 2 | 0.6091 | | 0.6602 | | 0.2166 | | 0.7584 | | 0.0555 | |
| r = 3 | 0.0328 | 2 | 0.505 | 2 | 0.7456 | 2 | 0.2722 | 2 | 0.7858 | 2 |

## EMPIRICAL RESULTS

### Panel Unit Root Test

Table 3 presents the level and the first difference stationarity test for each variable used in this study. The specific form of the test is that by Levin, Lin and Chu (2002), mostly employing the Schwartz Information Criterion automatic lag length where the maximum is set at 2. For all of the variables the null hypothesis in both level and first difference form is the existence of a unit root. For the level test the *p*-values are high with the sole exception of the World GDP, meaning that we cannot reject the null hypothesis. As the reverse is true universally for these variables in the first difference test, it can be definitively concluded that each variable is non-singular possessing one root. All of this evidence points to the possibility of a long run underlying relationship between the trade balance and the exchange rate and real income variables. This in turn clears the way for us to test for cointegration to further investigate the existence of, and to explore the nature of any such relationship.

### Panel Cointegration Test

Table 4 presents the cointegration results that make use of the Johansen-Fisher construct displaying the Trace test followed by the Maximum Eigen Value test. These were derived from a Johansen-Fisher construct, which itself follow closely from the Pedroni formulation laid out above. In all cases a cointegration test is carried out on the panel's trade balance, the exchange rate and the domestic and foreign income levels. In column 2 the cointegrating relationship is with the developed country composite, and in each of the next four columns, it is run bilaterally with the US, UK, France and Japan. Next to each such column the number of the cointegrating relations is shown based upon the *p*-values for the null hypotheses of the number of cointegrating equations shown in column 1.

In the test of our panel with the developed country composite variable, Table 4 (both versions of the test are in agreement) reveals that there are two cointegrating relations with this composite variable. It shows that there are also two cointegrating relations when the bilateral trade balance and exchange rate are combined with the domestic and foreign income levels for the US, UK, and France. Meanwhile the Trace and Eigen Value tests do agree likewise that there are multiple cointegrating relations for Japan, thought they do not agree on exact number.

**TABLE 5**
**CROSS-SECTION COINTEGRATION TEST [P-VALUE]**
**TRACE TEST**

| Country | Null | World | | U.S. | | U.K | | France | | Japan | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BOTSWANA** | r = 0 | 0.0228 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.3763 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.5091 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.3173 | 1 | n.a. | | n.a. | | n.a. | | n.a. | |
| **BURKINA FASO** | r = 0 | 0.3249 | | 0.4334 | | 0.0041 | | 0.064 | | 0.0015 | |
| | r = 1 | 0.7108 | | 0.7934 | | 0.2057 | | 0.7152 | | 0.0802 | |
| | r = 2 | 0.5798 | | 0.7256 | | 0.9735 | | 0.6981 | | 0.3246 | |
| | r = 3 | 0.2087 | 0 | 0.3925 | 0 | 0.7437 | 1 | 0.4055 | 0 | 0.6393 | 1 |
| **BURUNDI** | r = 0 | 0.6809 | | 0.0435 | | 0.0279 | | 0.0662 | | 0 | |
| | r = 1 | 0.7792 | | 0.4587 | | 0.146 | | 0.5419 | | 0.09 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | r = 2 | 0.8274 | | 0.958 | | 0.3868 | | 0.9512 | | 0.7462 | |
| | r = 3 | 0.2222 | 0 | 0.467 | 1 | 0.045 | 1 | 0.6245 | 0 | 0.8865 | 1 |
| **CAMEROON** | r = 0 | 0.3148 | | 0.0012 | | 0 | | 0.0011 | | 0.0089 | |
| | r = 1 | 0.5323 | | 0.1124 | | 0.0007 | | 0.0228 | | 0.1291 | |
| | r = 2 | 0.8778 | | 0.2163 | | 0.0201 | | 0.0408 | | 0.1552 | |
| | r = 3 | 0.5164 | 0 | 0.8004 | 1 | 0.5729 | 3 | 0.63 | 3 | 0.5437 | 1 |
| **CENT. AFRICAN** | r = 0 | 0.0006 | | 0 | | 0.0067 | | 0 | | n.a. | |
| **REPUBLIC** | r = 1 | 0.0569 | | 0.0448 | | 0.3152 | | 0.0015 | | n.a. | |
| | r = 2 | 0.7221 | | 0.2357 | | 0.3363 | | 0.6298 | | n.a. | |
| | r = 3 | 0.5068 | 1 | 0.2155 | 2 | 0.3817 | 1 | 0.8893 | 2 | n.a. | |
| **CONGO, DEM.** | r = 0 | n.a. | | 0.0062 | | 0.0013 | | 0.0027 | | 0.0056 | |
| **REPUBLIC** | r = 1 | n.a. | | 0.0861 | | 0.1123 | | 0.0158 | | 0.023 | |
| | r = 2 | n.a. | | 0.395 | | 0.268 | | 0.0595 | | 0.0367 | |
| | r = 3 | n.a. | | 0.4253 | 2 | 0.4204 | 1 | 0.0969 | 2 | 0.117 | 3 |
| **ETHIOPIA** | r = 0 | 0.0026 | | 0.8659 | | 0.0024 | | 0.0006 | | 0.0735 | |
| | r = 1 | 0.2346 | | 0.8639 | | 0.2313 | | 0.1495 | | 0.2776 | |
| | r = 2 | 0.4732 | | 0.8303 | | 0.3427 | | 0.9051 | | 0.8801 | |
| | r = 3 | 0.3957 | 1 | 0.7292 | 0 | 0.1826 | 1 | 0.3484 | 1 | 0.9994 | 0 |
| **KENYA** | r = 0 | 0.1994 | | 0.0068 | | 0.003 | | 0.4883 | | 0.0004 | |
| | r = 1 | 0.7248 | | 0.1903 | | 0.0812 | | 0.6878 | | 0.0255 | |
| | r = 2 | 0.5778 | | 0.5791 | | 0.3699 | | 0.8596 | | 0.1495 | |
| | r = 3 | 0.5331 | 0 | 0.9271 | 1 | 0.976 | 1 | 0.6051 | 0 | 0.6125 | 2 |
| **MADAGASCAR** | r = 0 | 0.3783 | | 0.1117 | | 0.006 | | 0.0485 | | 0.0099 | |
| | r = 1 | 0.5403 | | 0.4573 | | 0.2234 | | 0.2623 | | 0.2111 | |
| | r = 2 | 0.3469 | | 0.5468 | | 0.4581 | | 0.2804 | | 0.3428 | |
| | r = 3 | 0.0856 | 0 | 0.1351 | 0 | 0.7402 | 1 | 0.5457 | 1 | 0.391 | 1 |
| **MALAWI** | r = 0 | 0.0374 | | 0.0012 | | 0.1225 | | 0.0018 | | 0.013 | |
| | r = 1 | 0.2406 | | 0.4733 | | 0.5045 | | 0.1791 | | 0.1146 | |
| | r = 2 | 0.165 | | 0.4578 | | 0.7806 | | 0.4945 | | 0.6291 | |
| | r = 3 | 0.021 | 1 | 0.4975 | 1 | 0.8723 | 0 | 0.0664 | 1 | 0.5638 | 1 |
| **MAURITIUS** | r = 0 | 0.002 | | 0.0022 | | 0.004 | | 0.0066 | | 0.0058 | |
| | r = 1 | 0.0263 | | 0.059 | | 0.3594 | | 0.0493 | | 0.028 | |
| | r = 2 | 0.0786 | | 0.0951 | | 0.8121 | | 0.5313 | | 0.3224 | |
| | r = 3 | 0.0498 | 2 | 0.0792 | 1 | 0.2936 | 1 | 0.1129 | 2 | 0.3003 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **MOZAMBIQUE** | r = 0 | 0.0004 | | 0.0008 | | 0.1845 | | 0.015 | | 0 | |
| | r = 1 | 0.0109 | | 0.2587 | | 0.2128 | | 0.3254 | | 0 | |
| | r = 2 | 0.2142 | | 0.4089 | | 0.3105 | | 0.3043 | | 0.0193 | |
| | r = 3 | 0.9085 | 2 | 0.5544 | 1 | 0.1429 | 0 | 0.3987 | 1 | 0.1412 | 3 |
| **NIGERIA** | r = 0 | 0.0004 | | 0.004 | | 0.0002 | | 0.0016 | | 0 | |
| | r = 1 | 0.0541 | | 0.0624 | | 0.0782 | | 0.0777 | | 0.0019 | |
| | r = 2 | 0.3264 | | 0.6001 | | 0.2567 | | 0.3075 | | 0.2405 | |
| | r = 3 | 0.1895 | 1 | 0.3429 | 1 | 0.5464 | 1 | 0.7122 | 1 | 0.6413 | 2 |
| **SENEGAL** | r = 0 | 0.74 | | 0.4769 | | 0.0002 | | 0.0031 | | 0.0007 | |
| | r = 1 | 0.9122 | | 0.5333 | | 0.0031 | | 0.286 | | 0.0063 | |
| | r = 2 | 0.7132 | | 0.4961 | | 0.0542 | | 0.9028 | | 0.0713 | |
| | r = 3 | 0.1368 | 0 | 0.3065 | 0 | 0.7859 | 2 | 0.7175 | 1 | 0.6015 | 2 |
| **SIERRA LEONE** | r = 0 | 0.2508 | | 0.0011 | | 0.0373 | | 0.0001 | | n.a. | |
| | r = 1 | 0.5978 | | 0.0697 | | 0.6826 | | 0.2083 | | n.a. | |
| | r = 2 | 0.6226 | | 0.9925 | | 0.9514 | | 0.9886 | | n.a. | |
| | r = 3 | 0.3418 | 0 | 0.9282 | 1 | 0.9599 | 1 | 0.8451 | 1 | n.a. | |
| **SOUTH AFRICA** | r = 0 | 0.0375 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.164 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.1448 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.0601 | 1 | n.a. | | n.a. | | n.a. | | n.a. | |
| **TANZANIA** | r = 0 | 0 | | 0.0002 | | 0 | | 0.0001 | | 0.002 | |
| | r = 1 | 0.0022 | | 0.0373 | | 0 | | 0.026 | | 0.2506 | |
| | r = 2 | 0.2764 | | 0.1617 | | 0.2311 | | 0.1418 | | 0.3926 | |
| | r = 3 | 0.4354 | 2 | 0.5852 | 2 | 0.6687 | 2 | 0.0332 | 2 | 0.335 | 1 |
| **ZAMBIA** | r = 0 | 0.0001 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.0001 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.0066 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.1929 | 3 | n.a. | | n.a. | | n.a. | | n.a. | |
| **ZIMBABWE** | r = 0 | 0.0556 | | 0.0035 | | 0.0011 | | 0.0042 | | 0.01 | |
| | r = 1 | 0.5993 | | 0.1545 | | 0.0852 | | 0.0961 | | 0.1236 | |
| | r = 2 | 0.9937 | | 0.1219 | | 0.4576 | | 0.6131 | | 0.2034 | |
| | r = 3 | 0.9894 | 0 | 0.1077 | 1 | 0.4516 | 1 | 0.1866 | 1 | 0.6583 | 1 |

** Note: These are parts of the results from the panel cointegration results reported in Table 5*

**TABLE 6**
**CROSS-SECTION COINTEGRATION TEST [P-VALUE]**
**Maximum Eigen Value Test**

| Country | Null | World | | U.S. | | U.K | | France | | Japan | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **BOTSWANA** | r = 0 | 0.0197 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.4426 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.5375 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.3173 | 1 | n.a. | | n.a. | | n.a. | | n.a. | |
| **BURKINA FASO** | r = 0 | 0.249 | | 0.3085 | | 0.006 | | 0.019 | | 0.0073 | |
| | r = 1 | 0.8293 | | 0.8285 | | 0.0516 | | 0.7466 | | 0.1292 | |
| | r = 2 | 0.6905 | | 0.7402 | | 0.9627 | | 0.7053 | | 0.2828 | |
| | r = 3 | 0.2087 | 0 | 0.3925 | 0 | 0.7437 | 1 | 0.4055 | 1 | 0.6393 | 1 |
| **BURUNDI** | r = 0 | 0.6896 | | 0.0326 | | 0.1032 | | 0.0416 | | 0 | |
| | r = 1 | 0.7266 | | 0.208 | | 0.1878 | | 0.2875 | | 0.0312 | |
| | r = 2 | 0.9222 | | 0.967 | | 0.7723 | | 0.9421 | | 0.6207 | |
| | r = 3 | 0.2222 | 0 | 0.467 | 1 | 0.045 | 1 | 0.6245 | 1 | 0.8865 | 2 |
| **CAMEROON** | r = 0 | 0.3953 | | 0.0034 | | 0.0079 | | 0.0239 | | 0.034 | |
| | r = 1 | 0.3522 | | 0.2456 | | 0.0102 | | 0.1932 | | 0.4669 | |
| | r = 2 | 0.8718 | | 0.1615 | | 0.0135 | | 0.0279 | | 0.1355 | |
| | r = 3 | 0.5164 | 0 | 0.8004 | 1 | 0.5729 | 3 | 0.63 | 2 | 0.5437 | 1 |
| **CENT. AFRICAN** | r = 0 | 0.004 | | 0 | | 0.0054 | | 0 | | n.a. | |
| **REPUBLICS** | r = 1 | 0.0225 | | 0.081 | | 0.5104 | | 0.0003 | | n.a. | |
| | r = 2 | 0.6993 | | 0.2787 | | 0.3248 | | 0.5454 | | n.a. | |
| | r = 3 | 0.5068 | 2 | 0.2155 | 1 | 0.3817 | 1 | 0.8893 | 2 | n.a. | |
| **CONGO, DEM.** | r = 0 | n.a. | | 0.0341 | | 0.0038 | | 0.0854 | | 0.1527 | |
| **REPUBLIC** | r = 1 | n.a. | | 0.0971 | | 0.2016 | | 0.0983 | | 0.2928 | |
| | r = 2 | n.a. | | 0.3734 | | 0.2454 | | 0.1022 | | 0.1173 | |
| | r = 3 | n.a. | | 0.4253 | 1 | 0.4204 | 1 | 0.0969 | 0 | 0.117 | 0 |
| **ETHIOPIA** | r = 0 | 0.0028 | | 0.8785 | | 0.0026 | | 0.0009 | | 0.1621 | |
| | r = 1 | 0.2678 | | 0.8501 | | 0.3605 | | 0.0464 | | 0.1032 | |
| | r = 2 | 0.465 | | 0.7823 | | 0.4347 | | 0.9397 | | 0.6213 | |
| | r = 3 | 0.3957 | 1 | 0.7292 | 0 | 0.1826 | 1 | 0.3484 | 2 | 0.9994 | 0 |
| **KENYA** | r = 0 | 0.1077 | | 0.0129 | | 0.0159 | | 0.5031 | | 0.0076 | |
| | r = 1 | 0.8465 | | 0.1602 | | 0.098 | | 0.5628 | | 0.0861 | |
| | r = 2 | 0.5362 | | 0.4916 | | 0.2903 | | 0.8343 | | 0.1119 | |
| | r = 3 | 0.5331 | 0 | 0.9271 | 1 | 0.976 | 1 | 0.6051 | 0 | 0.6125 | 1 |
| **MADAGASCAR** | r = 0 | 0.4942 | | 0.1209 | | 0.0085 | | 0.0948 | | 0.0176 | |
| | r = 1 | 0.8203 | | 0.5246 | | 0.2613 | | 0.4828 | | 0.3886 | |
| | r = 2 | 0.5816 | | 0.7375 | | 0.3829 | | 0.2367 | | 0.4688 | |
| | r = 3 | 0.0856 | 0 | 0.1351 | 0 | 0.7402 | 1 | 0.5457 | 0 | 0.391 | 1 |
| **MALAWI** | r = 0 | 0.0773 | | 0.0003 | | 0.1154 | | 0.0027 | | 0.064 | |
| | r = 1 | 0.6198 | | 0.627 | | 0.4005 | | 0.1819 | | 0.0689 | |
| | r = 2 | 0.5487 | | 0.4196 | | 0.712 | | 0.8193 | | 0.7126 | |
| | r = 3 | 0.021 | 1 | 0.4975 | 1 | 0.8723 | 0 | 0.0664 | 1 | 0.5638 | 0 |
| **MAURITIUS** | r = 0 | 0.0381 | | 0.016 | | 0.0022 | | 0.0691 | | 0.131 | |
| | r = 1 | 0.1301 | | 0.2503 | | 0.2247 | | 0.0325 | | 0.0347 | |
| | r = 2 | 0.1922 | | 0.181 | | 0.8733 | | 0.7557 | | 0.5257 | |
| | r = 3 | 0.0498 | 1 | 0.0792 | 1 | 0.2936 | 1 | 0.1129 | 0 | 0.3003 | 0 |
| **MOZAMBIQUE** | r = 0 | 0.0171 | | 0.0005 | | 0.5441 | | 0.0147 | | 0.0001 | |
| | r = 1 | 0.0177 | | 0.3488 | | 0.358 | | 0.5648 | | 0.0003 | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | r = 2 | 0.1571 | | 0.359 | | 0.4339 | | 0.2869 | | 0.0503 | |
| | r = 3 | 0.9085 | 2 | 0.5544 | 1 | 0.1429 | 0 | 0.3987 | 1 | 0.1412 | 2 |
| **NIGERIA** | r = 0 | 0.0025 | | 0.0302 | | 0.0006 | | 0.0081 | | 0 | |
| | r = 1 | 0.0701 | | 0.0359 | | 0.1399 | | 0.1148 | | 0.0019 | |
| | r = 2 | 0.4082 | | 0.6251 | | 0.2147 | | 0.2449 | | 0.1921 | |
| | r = 3 | 0.1895 | 1 | 0.3429 | 2 | 0.5464 | 1 | 0.7122 | 1 | 0.6413 | 2 |
| **SENEGAL** | r = 0 | 0.5745 | | 0.6646 | | 0.0313 | | 0.0024 | | 0.0693 | |
| | r = 1 | 0.9657 | | 0.6745 | | 0.0196 | | 0.1218 | | 0.0408 | |
| | r = 2 | 0.8956 | | 0.5286 | | 0.0356 | | 0.872 | | 0.0459 | |
| | r = 3 | 0.1368 | 0 | 0.3065 | 0 | 0.7859 | 3 | 0.7175 | 1 | 0.6015 | 2 |
| **SIERRA LEONE** | r = 0 | 0.2377 | | 0.0061 | | 0.0098 | | 0 | | n.a. | |
| | r = 1 | 0.652 | | 0.0084 | | 0.4418 | | 0.045 | | n.a. | |
| | r = 2 | 0.6502 | | 0.9868 | | 0.9247 | | 0.9815 | | n.a. | |
| | r = 3 | 0.3418 | 0 | 0.9282 | 2 | 0.9599 | 1 | 0.8451 | 2 | n.a. | |
| **SOUTH AFRICA** | r = 0 | 0.127 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.4833 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.3096 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.0601 | 0 | n.a. | | n.a. | | n.a. | | n.a. | |
| **TANZANIA** | r = 0 | 0.0015 | | 0.0019 | | 0 | | 0.0016 | | 0.0015 | |
| | r = 1 | 0.002 | | 0.0972 | | 0 | | 0.0744 | | 0.4115 | |
| | r = 2 | 0.2508 | | 0.1264 | | 0.1806 | | 0.4001 | | 0.5963 | |
| | r = 3 | 0.4354 | 2 | 0.5852 | 1 | 0.6687 | 2 | 0.0332 | 1 | 0.335 | 1 |
| **ZAMBIA** | r = 0 | 0.0001 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 1 | 0.0001 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 2 | 0.0072 | | n.a. | | n.a. | | n.a. | | n.a. | |
| | r = 3 | 0.1929 | 3 | n.a. | | n.a. | | n.a. | | n.a. | |
| **ZIMBABWE** | r = 0 | 0.0255 | | 0.0077 | | 0.0047 | | 0.0187 | | 0.0416 | |
| | r = 1 | 0.258 | | 0.5101 | | 0.0796 | | 0.0604 | | 0.358 | |
| | r = 2 | 0.9885 | | 0.1977 | | 0.4311 | | 0.7478 | | 0.15 | |
| | r = 3 | 0.9894 | 1 | 0.1077 | 1 | 0.4516 | 1 | 0.1866 | 1 | 0.6583 | 1 |

** Note: These are parts of the results from the panel cointegration results reported in Table 6*

Having established multiple cointegrating relations for the trade balance and the three variables for the panel we now turn to an examination of the Johansen-Fisher cross section for the individual countries that produced these results. Tables 5 and 6 provide a summary of the results of the Trace and MEV cointegration tests for the individual countries in the panel, with the composite variable and these developed countries individually. For some of the countries in the study the bilateral trade balance with each individual developed country was not available causing us to drop those countries from the bilateral part of Tables 5 and 6. The results overall indicate at least one cointegating relationship in more than half of the cases and in particular shows multiple relations being established fairly consistently in the case of Cameroon and Tanzania. As we had anticipated, a quick comparison of these results with outcomes of the case of selected devaluations in Table 2, fails to establish any necessary association between the slippage of the real exchange rate two years after the devaluation, and the likelihood of an underlying relationship between the trade balance and the real exchange rate. This was because Table 2 was merely showing the degree to which one episode of significant nominal devaluation was translating into a sustained real depreciation.

A more interesting exercise would be to see whether there is any link between the establishment of cointegration and an individual country's experience under inflation. Table 7 sorts these countries by ascending order of the annualized rate of inflation over the study period, includes the average annual rate over the last 10 years, and reports the number of cases of no observed cointegration from Table 5 and 6[6].

The results are mixed but suggestive of an association. Burkina Faso, Senegal and Burundi, three of the countries in the lower half of Table 6 with the lowest rates of inflation each report as many as four or five cases of no cointegration (the sum of the Trace and MEV Tests) of no cointegration. On the other hand it is significant that four of the countries in the upper half of Table 6 with some of the higher rates of inflation (Nigeria, Tanzania and Zimbabwe) report one or no case of no cointegration.

**TABLE 7**
**INFLATION RATES AND CASES OF NO COINTEGRATION FOR PANEL**

| Country | 1960 to 2006 | Last 10 year Available | Total case of No Cointegration |
|---|---|---|---|
| **MALI** | 3.13 | 2.08 | |
| **CENT. AFRICAN REP.** | 3.45 | 1.64 | 0 |
| **CONGO, REPUBLIC** | 4.64 | 7.75 | |
| **BURKINA FASO** | 4.95 | 2.36 | 5 |
| **GABON** | 5.62 | 0.95 | |
| **SENEGAL** | 5.88 | 1.45 | 5 |
| **ETHIOPIA** | 6.46 | 3.46 | 4 |
| **CAMEROON** | 7.02 | 2.51 | |
| **MAURITIUS** | 8.21 | 5.91 | 2 |
| **SOUTH AFRICA** | 8.71 | 5.62 | |
| **GAMBIA, THE** | 8.81 | 5.72 | |
| **BURUNDI** | 9.91 | 11.41 | 4 |
| **BOTSWANA** | 10.41 | 8.26 | |
| **KENYA** | 10.48 | 8.77 | 4 |
| **MADAGASCAR** | 12.56 | 9.74 | 5 |
| **NIGERIA** | 17.52 | 14.01 | 0 |
| **TANZANIA** | 17.79 | 7.08 | 5 |
| **ZIMBABWE** | 20.23 | 47.56 | 1 |
| **MALAWI** | 22.27 | 20.11 | 4 |
| **SIERRA LEONE** | 28.06 | 13.95 | 2 |
| **MOZAMBIQUE** | 28.20 | 13.20 | 2 |
| **GHANA** | 31.71 | 19.32 | |
| **ZAMBIA** | 58.33 | 24.61 | |
| **CONGO, DEM. REP. OF** | 850.69 | 194.50 | 2 |

* *Note: These are the authors calculations using IFS data.*
*The number of case of no cointegration reported in the sum of the Trace and Eigen Value tests shown in Table 6*
*The inflation variable is the annual rate of inflation.*

More ominously Zambia, (one of those countries without the bilateral trade balance data) which after Democratic Republic of the Congo carries the second highest rate of inflation, is the only country sporting 3 cointegrating relationships with the developed country composite (both tests agree on this). Some contradictory evidence can be gleaned from the fact that Mauritius with two, Kenya with four, and Madagascar with 5 cointegrating relations, have average rates of inflation of 8.21, 10.48 and 12.56 percent respectively over the 45 year period. It is beyond the scope of this paper but a worthwhile follow up study should be to investigate more thoroughly the precise role that inflation plays (beyond utilizing the domestic and foreign price level in calculating the real exchange rate) in determining the success or failure of policies that manipulate the nominal exchange rate to determine the trade balance.

## CONCLUSION

This paper examines the relationship between the real exchange rate and the trade balance by employing several investigative methods. The subject of this study is the relationship of a panel of 21 Sub-Saharan Africa countries with the rest of the world and also individually with four developed countries, the US, UK, France and Japan. An initial examination of the trade balance of the panel countries reveals a general deterioration over the forty five year study period with an especially sharp drop over the final ten years from 1995 to 2005. The paper advances several structural changes that perhaps in addition to real exchange rate changes might have accounted for the worsening trade balance. We next examined selected episodes of nominal devaluation and discovered that not only had each translated into smaller real depreciations but that after a further two years, almost all of this depreciation had disappeared.

An empirical evaluation of these variables quickly confirms that just about everyone possesses a unit root, providing the grounds for an investigation of the possible existence of a long term relationship between these variables. Finally the cointegration test using the Fisher-Johnson method shows that there are multiple cointegration relationships between the panel and the rest of the world, and also bilaterally with each of the developed countries individually. When we look at the individual country cross section analysis, there is evidence of cointegrating relationships for most countries and even some slight evidence of a greater likelihood that countries with a higher pattern of inflation tending to exhibit such cointegration.

The clear conclusion is that manipulating the nominal exchange rate and having this successfully change the real exchange rate can improve a nation's trade balance based on the experience of these countries. However the brief ad hoc examination of these nations' inability to turn these into real currency depreciations appears to be an additional reason why their trade balance has been worsening so significantly of late.

## ENDNOTES

1. It should be mentioned that while the channels of transmission appear to be diametrically opposed, several theoretical and empirical studies have indicated that these processes are closely integrated; see, for example, Frenkel, J.A.T., Gylfacon and J.F. Helliwell, "A Synthesis of Monetary and Keynesian Approaches to Short Run Balance of Payments Theory." Economic Journal, September 1908.
2. The Keynesian approach to analyzing the effects of a devaluation does go beyond the relative price switching effects. It encompasses the deleterious impact of excessive domestic spending and income increases on the trade balance.
3. Using correlation analysis, Himarios (1989) has shown that for both the Bretton Woods and the post Bretton Woods period, changes in nominal exchange rate did appear to be correlated with changes in real exchange rates, thus contradicting one of the principal conclusions of the strict Purchasing Power Parity Theory.
4. See Salvatore (1987) for a discussion of the issues attendant to these lags and an analysis of the manner in which they produce a J-curve.
5. The Marshall-Lerner condition states that the trade balance will improve following a devaluation if the sum of the elasticity of demand for exports and the elasticity of demand for imports (facing a gives country) exceeds unity. Given this condition, we are accepting the considerable weight of evidence that in practice the sum of these demand elasticities exceeds one.
6. The number reported in Table 6 is the number of times an individual country had a finding of no cointegration with either the developed country variable or each of the four developed countries. The actual number reported is the sum for the Trace and Maximum Eigen Value Tests.

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