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The Current Account and Real Exchange Rate Dynamics in African Countries

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Abstract

Persistent international current account imbalances and real exchange rate movements have become a permanent feature of the world economy. This paper, therefore, sets out to investigate the relationship between the real exchange rate and current account dynamics of eleven African countries, using data from 1980 to 2008, based on a stochastic Mundell-Fleming model in which shocks to real exchange rates and current account have been identified as permanent and temporary. Using a bi-variate structural VAR approach, the results are in consonant with the theoretical model, with permanent shocks having permanent and positive effects on both the current account and the real exchange rates. On the other hand, while temporary shocks have insignificant effects on the real exchange rates, they have very different effects on the current accounts of different countries.

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1. Introduction

The determinants of real exchange rates and the current account balances have received extensive coverage in both the theoretical and empirical literatures, however, these variables have largely been treated independently (Lee and Chinn, 1998). For example, the relationship between real exchange rates and the current account has been covered by both the traditional open-economy models (Mundell, 1962; Dornbusch, 1976; and Branson, 1983) and the new open-economy macroeconomics literature (Obstfeld and Rogoff, 1995). Early empirical studies such as Khan and Knight (1983) and Edwards (1989) regarded the real exchange rate as the main determinant of the current account. Other studies linked the US current account imbalances with exchange rate policies include Cline (2003), Edwards (2005) and Leonard and Stockman (2002). More recently Lee and Chinn (2006) examine the relationship between real exchange rates and current account within a VAR framework and find in particular, that temporary shocks (interpreted as monetary innovations) explain current account fluctuations by inducing temporary real exchange rates shifts while permanent (i.e. technology) shocks are predominant in explaining real exchange rates variations. Their empirical analysis does not assign a structural interpretation to the reduced-form correlation between the real exchange rates and the current account, since they are both endogenous to productivity and other shocks. Obstfeld and Rogoff (2005) suggest that any kind of adjustment of existing global current account imbalances requires a sizable real exchange rate shifts. More specifically, the baseline estimate of their three-region model suggests that reducing the US current account deficit by half requires about 20% real depreciation of the dollar against Asian currencies and a depreciation against European currencies.

This paper extends the existing literature in three ways. First, it generalises the model of Clarida and Gali (1994) to include the case of imperfect capital mobility. This extension is important if the approach is to be applicable to developing countries whose capital markets are either thin or is some cases regulated. Second, with this extension, the paper is able to investigate the dynamics between the current account and real exchange rates within a structural VAR model, for eleven developing African countries, whereas previous studies have been concerned only with industrialised countries. Third, since these African economies all adopted structural adjustment programmes in the 1980s of which the liberalisation of the foreign exchange market and adoption of a more flexible exchange rate regime were part of the programme, have resulted in persistent balance of payment crisis, some investigation of the determinants of the current account and real exchange rates and their interaction is long overdue.

The rest of the paper is structured as follows. Section 2 discusses the theoretical framework within which permanent and temporary shocks to the real exchange rates and current accounts are identified. Section 3 outlines the empirical strategy adopted by the paper while Section 4 discusses the data and the estimated results. Section 5 concludes.

2, The Theoretical Framework

The model is based on the four-equation model of Clarida and Gali (1994) extended to allow for the effects of monetary and productivity shocks on the trade balance and real exchange rate, (Lee and Chinn, 1998), and also here to allow for imperfect capital mobility to permit application to developing countries.

The model is given as equations (1) to (4) below, where except for the exchange rate s_t, all variables are defined as relative between domestic and foreign countries, that is, $x_t = x_t^d - x_t^f$, where the superscripts denote the domestic and foreign country values.

$$y_t^d = \eta(s_t - p_t) - \sigma\big(i_t - E_t(p_{t+1} - P_t)\big) \tag{1}$$

$$p_t = (1 - \theta)E_{t-1}p_t^* + \theta p_t^* \tag{2}$$

$$m_t - p_t = y_t - \lambda i_t \tag{3}$$

$$\tau(s_t - p_t) + \gamma\big(i_t - E_t(s_{t+1} - s_t)\big) = 0 \tag{4}$$

Equation (1) is an open-economy IS curve where relative output demand, $\left(y_t^d\right)$ is positively related to the real exchange rate $(s_t - p_t)$ and negatively related to the real interest rate, $\big(i_t - E_t(p_{t+1} - P_t)\big)$. The price-setting equation is represented by equation (2), which recognizes that price level, p_t moves towards the long-run equilibrium, p_t^* progressively, with the flexibility of the price level governed by θ. If $\theta = 1$, prices are fully flexible and the long-run level is achieved instantly, where as for $\theta < 1$ price adjustment is sluggish. Equation (3) is the LM curve that relates the demand for real balances $(m_t - p_t)$ to the output (y_t) and the nominal interest rate (i_t). Equation (4) is the novel equation in this model and represents the balance of payments, rather than interest rate parity. The first term in (4) represents the trade balance, which depends positively on the real exchange rate, and the second term represents the net capital inflow as a function of the uncovered interest rate differential. The parameter γ denotes the degree of capital mobility, such that as $\gamma \to \infty$ (4) becomes the uncovered

interest rate parity condition. In general, it is assumed that $0 < \gamma < \infty$ so the current account has some role to play in the determination of the exchange rate.

Equations (5) to (7) describe the stochastic processes of output, the money supply and the trade balance:

$$y_t^S = y_{t-1}^S + z_t \tag{5}$$

$$m_t = m_{t-1} + v_t \tag{6}$$

$$b_t = \tau(s_t - p_t) + \rho z_t \tag{7}$$

where z_t is the productivity shock to output (y_t^S); v_t represents monetary shock; and b_t is the trade balance, which depends on the real exchange rate as above, and the productivity shock. A positive supply shock is defined as a shock that results in a permanent increase in the productivity of the domestic economy. The monetary shock, on the other hand, leads to a permanent increase in the money supply, but the assumed inherent neutrality of money wipes out its real effect in the long-run.

In equilibrium when prices are fully flexible and so $\theta = 1$, the equilibrium levels for output, the real exchange rate (defined as $q_t = s_t - p_{t,}$), the interest rate and the price level can be derived from (1) to (4) and given as:

$$y_t^* = y_t^S \tag{8}$$

$$i^* = -\tau D^{-1} y \tag{9}$$

$$q^* = \gamma D^{-1} y \tag{10}$$

$$p^* = m - \varepsilon y \tag{11}$$

where asterisks refer to the long-run equilibrium values, $D = (\sigma\tau + \gamma\eta) > 0$ and $\varepsilon = (1 + \lambda\tau D^{-1}) > 0$.

In the short run when prices are sticky and adjust only slowly to the equilibrium, so $\theta < 1$, the price level, real exchange rate and the output deviate from their long-run equilibrium in the short-run, which gives the following:

$$p_t = p_t^* - (1 - \theta)(v_t - \varepsilon z_t) \tag{12}$$

$$q_t = q_t^* + \mu(1 - \theta)(v_t - \varepsilon z_t) \tag{13}$$

$$y_t = y_t^S + \left[\eta + \sigma\left(1 + \frac{\tau}{\gamma}\right)\right]\mu(1 - \theta)(v_t - \varepsilon z_t) \tag{14}$$

where $\mu = \gamma(1 + \lambda)[(\sigma + \lambda)(\gamma + \tau) + \gamma\eta]^{-1} > 0$.

Equation (15), from (10) and (1), shows the effects of positive monetary and productivity shocks on the real exchange rate, that is

$$q_t = \left(\frac{\gamma}{D}\right)(y + z_t) + \mu(1 - \theta)(v_t - \varepsilon z_t) \qquad (15)$$

and so:

$$\partial q_t / \partial v_t = \mu(1 - \theta) > 0 \qquad (16)$$

$$\partial q_t / \partial z_t = +\gamma/D - \mu(1 - \theta)\varepsilon > < 0 \qquad (17)$$

Therefore, according to (16), the real exchange rate rises (depreciates) following a monetary shock in the short run, but is unchanged in the long run when $\theta = 1$ and money is neutral. Equation (17) shows that a productivity shock can lead to either a real appreciation or depreciation in the short run, but in the long run there is a permanent rise in q, (depreciation) providing $\gamma > 0$, since in the long run the supply shock leads to a lower price level.

From (7) and (13), equation (18) shows the effects of positive monetary and productivity shocks on the trade balance

$$b_t = \tau[(\gamma/D)(y + z_t) + \mu(1 - \theta)(v_t - \varepsilon z_t)] + \rho z_t \qquad (18)$$

$$\partial b_t / \partial v_t = \tau\mu(1 - \theta) > 0 \qquad (19)$$

$$\partial b_t / \partial z v_t = \tau[\gamma D^{-1} - \mu(1 - \theta)\varepsilon] + \rho \leq \geq 0 \qquad (20)$$

The trade balance improves in the short run from a monetary shock, as the exchange rate depreciates, but is unchanged in the long run. The effect of a productivity shock on the trade balance is ambiguous in the short run, but is shown to result in a permanent improvement in the long run, regardless of the degree of capital mobility.

3.   The Empirical Strategy

The econometric methodology uses a bi-variate structural VAR model. The theoretical model entails that the variables real exchange rate q_t, is non-stationary in levels but stationary in first difference and current account, b_t is stationary in levels. The first step is to estimate a reduced form VAR represented thus

$$x_t = A(L)u_t \qquad (21)$$

where x_t represents a vector of stationary variables of q_t and b_t while A(L) represents a lag polynomial and u_t is a vector disturbances with an estimated variance-covariance matrix Σ. Therefore, letting $x_t = [\Delta q_t, \ b_t]'$ which denotes a 2×1 vector of the variables with structural

disturbances $\varepsilon_t = [\varepsilon_t^p, \varepsilon_t^T]'$ where ε_t^p denotes country-specific permanent shock and ε_t^T represents country-specific shocks. The structural VAR is represented as

$$x_t = A(L)\varepsilon_t \tag{22}$$

where ε_t denotes the structural shocks, which are serially uncorrelated and have covariance matrix normalised to the identity matrix. The model current be denoted by an MA process

$$\begin{bmatrix} \Delta q_t \\ b_t \end{bmatrix} = \sum_{L=0}^{\infty} B(L) \begin{bmatrix} \varepsilon_{t-L}^p \\ \varepsilon_{t-L}^T \end{bmatrix} \tag{23}$$

with $E(\varepsilon_t) = 0$, and $E(\varepsilon_t \varepsilon_s') = 0$ when $t \neq s$.

As implied by the theoretical model above the temporary shock has no long-run impact on the real exchange rate, which can be represented as

$$\left[\sum_{L=0}^{\infty} B(L) \right]_{(1,2)} = 0 \tag{24}$$

In order to apply restrictions specified in equation (24), the following bi-variate SVAR model is estimated for each of the countries;

$$\begin{bmatrix} \Delta q_t \\ b_t \end{bmatrix} = C(L) \begin{bmatrix} \Delta q_t \\ b_t \end{bmatrix} = \begin{bmatrix} \eta_t^q \\ \eta_t^T \end{bmatrix} \tag{25}$$

representing $\eta_t = \begin{bmatrix} \eta_t^q \\ \eta_t^T \end{bmatrix}$, the MA representation of the model can be written as

$$\begin{bmatrix} \Delta q_t \\ b_t \end{bmatrix} = \sum_{L=0}^{\infty} D(L) \eta_{t-L} \tag{26}$$

where $E(\eta_t) = 0, E(\eta_t \eta_t') = V, E(\eta_t \eta_s') = 0$ when $t \neq s$.

Conventionally, the system in equation (26) could be identified by Choleski factorization of the covariance matrix V. Ordering the system with exchange rate on top implies that exchange rate has no contemporaneous effect on the current account and vice versa. However, as observed by Lee and Chinn (2006) it will be difficult to determine the exact relationship between exchange rate and current account. This is more so, as no model could predict that innovation in exchange rate will not have contemporaneous effects on the current account or vice versa. Therefore, there is need to obtain identification that will be theoretical tenable and the restrictions in equation (24) is consistent with many open-economy macroeconomic models. Equations (24) and (26) are linked as

$$V = B(0)\big(B(0)\big)'$$

Since $\eta_t = B(0)\varepsilon_t$ and $B(L) = D(L)B(0)^{-1}(L = 1,2,3,\dots)$, equation (24) can be written as

$$\left[\sum_{L=0}^{\infty} D(L) B(0)^{-1} \right]_{(1,2)} = 0 \tag{27}$$

Thus equations (26) and (27) would allow us to find the matrix $B(0)$ and uncover the MA representation of system in terms of their permanent and temporary shocks. This identification scheme allows no long-run effect on the exchange rate, irrespective of other properties of the fundamental shocks. Therefore, temporary and permanent shocks current account cannot be necessarily interpreted as shocks to the real exchange rate and current account as under the Choleski factorization, which assumes lower a lower triangle $B(0)$. In this methodology, the estimated innovations η_t, are linear combinations of temporary and permanent shocks since they are off-diagonal elements of matrix $B(0)$ are different from zero.

4. Data and the Estimated Results

The data-set consists of real effective exchange rates and ratio of current account to real GDP covering the period 1980 to 2008 sourced from the IMF International Financial Statistics and the World Bank Development Indicators Database. Countries for which real effective exchange rates are not available, real exchange rates were constructed from the nominal exchange rates using $q_t = s_t + p_t^* - p_t$, where s_t is the nominal exchange rate and all variables are in logs.

In order to identify the level of integration, the series were subjected to battery of unit root tests; the augmented Dickey-Fuller, the Philips-Perron and Kwiatkowski-Phillips-Schmidt-Shin tests. The results are reported in Table 1. For most countries, the results indicate that the series are I(1) in levels and I(0) in first differences. However, in Botswana, Kenya and Tunisia the ratio of the current account to GDP is found to be I(0) in levels, therefore Johansen (1988) cointegration tests were also carried out to determine the possible existence of cointegration. The cointegration results failed to reject the null of no cointegration (also reported in Table 1) and thus validated the use of the structural VAR approach. A structural VAR, based on the identification discussed in Section 3 was estimated for each of the countries covered by this study. As VAR models are sensitive to the lag

length, we started with the highest possible lag length and found that two lags are adequate to whiten the residuals[3].

Figure 1 reports the impulse responses for the current account balance (relative to GDP) and real exchange rates to both permanent and temporary shocks. The responses of the current account to permanent and temporary shocks are reported in the first two columns and those of the real exchange rates are in the last two columns. Permanent shocks are considered to be productivity shocks and temporary shocks are monetary shocks, consistent with the model set up in Section 2.

The responses of the current account to the permanent shock are positive and persistent up to the 10th quarter in almost all the countries in the sample, although the magnitude varies. For example, current account responses to the permanent shocks in Botswana and Ghana are higher and more persistent than those of Algeria, Egypt and Ghana. The results seem to suggest that an improvement in technology has a stronger effect on the tradable sector and hence results in an improved the current account. Lee and Chin (2006) have reported similar results for the advanced economies.

The current accounts of the sample countries, however, have responded differently to the temporary shock. Temporary shocks are interpreted as monetary shocks, which according to the theoretical model are expected to result in current account improvement in the short-run, but not in long run when money is assumed to be neutral. From the results reported in Figure 1, the responses can be grouped into three classes. The first group are those countries where the responses of the current account to temporary shocks have been insignificant. These countries include Algeria, Botswana, Ghana, Nigeria, Tanzania and Uganda. The second group are those countries where the responses were initially positive, but after some periods revert back to zero. The countries in this group are Kenya, South African, Tunisia and Zambia and are the ones that are consistent with the theoretical prediction of the model. The third group, consist of just one country, Egypt, where the response is persistently positive up to the 20th quarter. These results suggest that the monetary transmission mechanism is weak in the first group, such that the current balance is largely independent of monetary disturbances and hence determined primarily by real factors. On the other hand, for Egypt the results suggest that the monetary effects may be stronger than suggested by the model.

Similar to the current account responses to the permanent shocks, the real exchange rates responses to the permanent shocks are also positive and persistent for several quarters in

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[3] Refer to Chari, et al. (2008) for detailed discussion on lag length in VAR models.

virtually all the countries, as predicted by the theoretical model. However, where permanent shocks produced real depreciation in the immediate period after the shock and in some cases in the short-run as well, in the long-run improved productivity produced a long-run real exchange rate appreciation in all the countries considered. Similar results were reported by Lee and Chinn (1998) and perhaps reflect the fact that in the longer term output rises tend to dominate price falls, and thus the real exchange rate appreciates. The persistence of the real appreciation differs across the countries: Egypt, Ghana, Kenya, South Africa and Tanzania, for example, recorded a more steady long-run appreciation than the rest of the sample countries.

The responses of the real exchange rates to the temporary shocks are generally insignificant in all the countries, except in South Africa where positive monetary shocks produced a produced a real exchange depreciation for about one year and thereafter they became insignificant. This is the prediction of the model when there are price rigidities in the short run. It is important to note that South Africa has the most developed financial system on the continent and therefore, the insignificant effects of monetary shocks on the real exchange rates of the other countries could be attributed, at least in part, to the less developed financial system prevalent in those countries.

To assess contributions of temporary and permanent shocks to the current account and real exchange rates of these countries, a historical decomposition was computed based on the estimated VAR. The results are reported in Figure 2. Permanent shocks played a more important role in the current account dynamics than the temporary shocks in almost all the countries. However, temporary shocks have significant effects on the current accounts of some countries during certain periods, for example, temporary shocks played an important role in Kenyan current account in the 1980s and for most of the sample period for Tunisia. Unlike in the case of the current accounts, both temporary and permanent shocks are significantly important to the real exchange rate fluctuations in all the countries in the sample. There relative importance, however, varies from country to country as well as over different time periods. For example in Algeria, during the 1980s, the period during which the country was operating a fixed exchange rate regime, temporary shocks had a larger influence that the permanent shocks. But during the floating period of the late 1990s and 2000s, permanent shocks contributed more to the real exchange rate fluctuations than the temporary

shocks. A similar pattern can be observed in the Nigerian results during the country's pegged regimes of the 1990s and the floating regime of the 1990s and 2000s[4].

5.   Conclusion

This paper has investigated the dynamics between real exchange rates and current accounts in eleven African countries, motivated by a stochastic open economy macroeconomic model. The results indicate that permanent shocks have persistent positive effects on the current account in all the countries considered. This is consistent with the theoretical model as well as results obtained by Lee and Chinn (2006) for the G7 countries. However, the current accounts of the sample countries have responded differently to temporary shocks, while the real exchange rates have responded insignificantly to the temporary shocks in all the countries. The computed historical decompositions, based on the estimated VARs, also indicate that permanent shocks have more influence on the current account balances than the temporary shocks, although temporary shocks have played a significant role in the real exchange rate dynamics, particularly during the floating periods of some countries, such as Algeria and Nigeria.


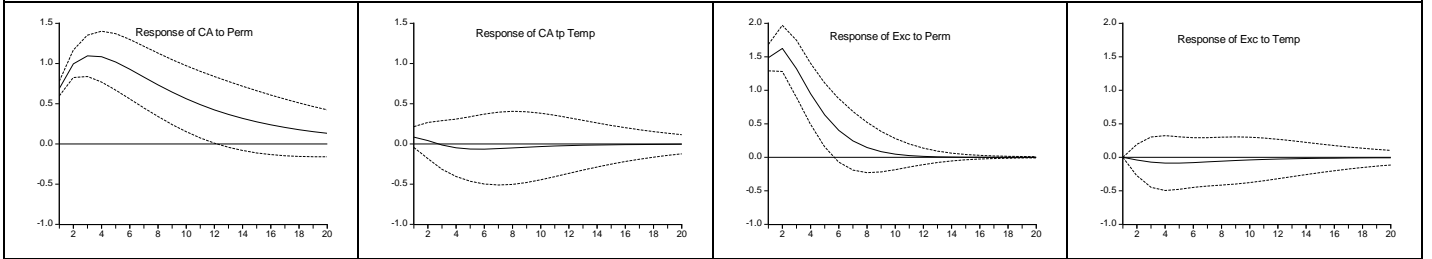[4] For discussion on the African exchange rate regimes, refer to Ahmad et al (2011).

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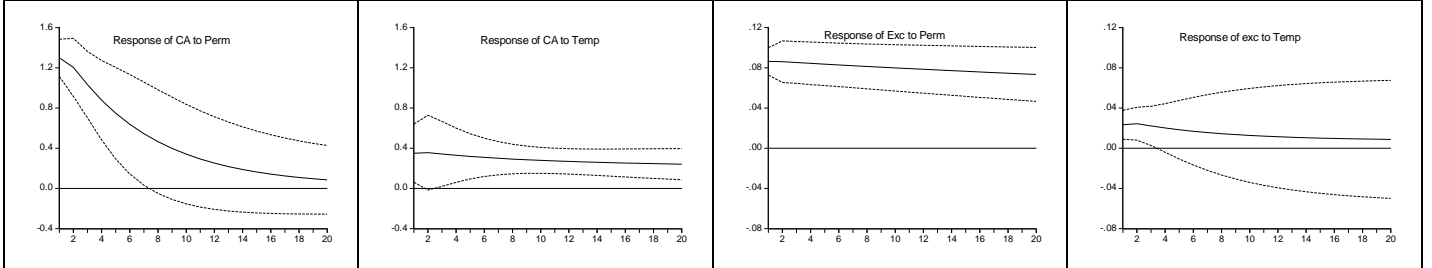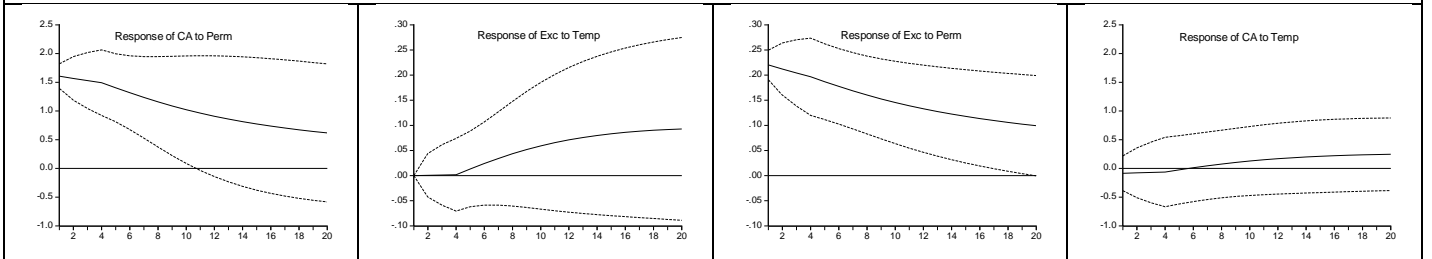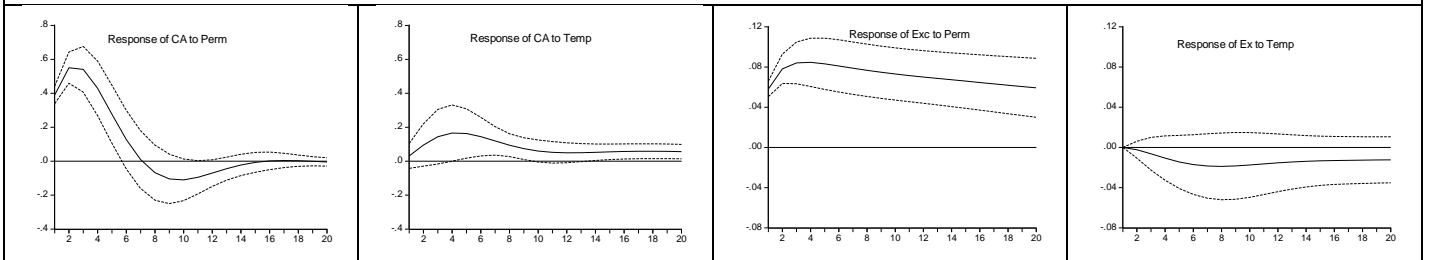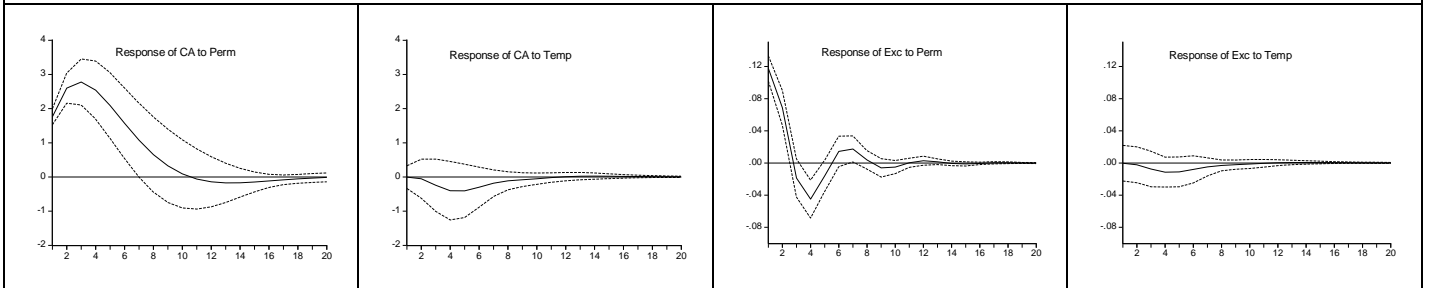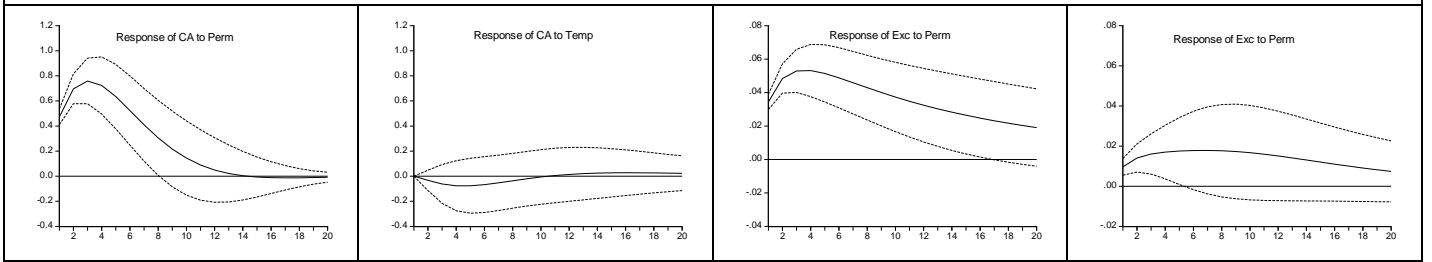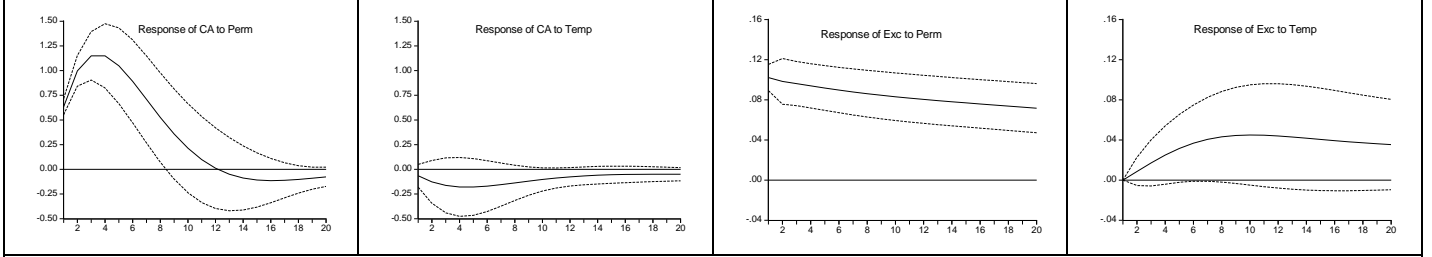
Figure 1

Algeria
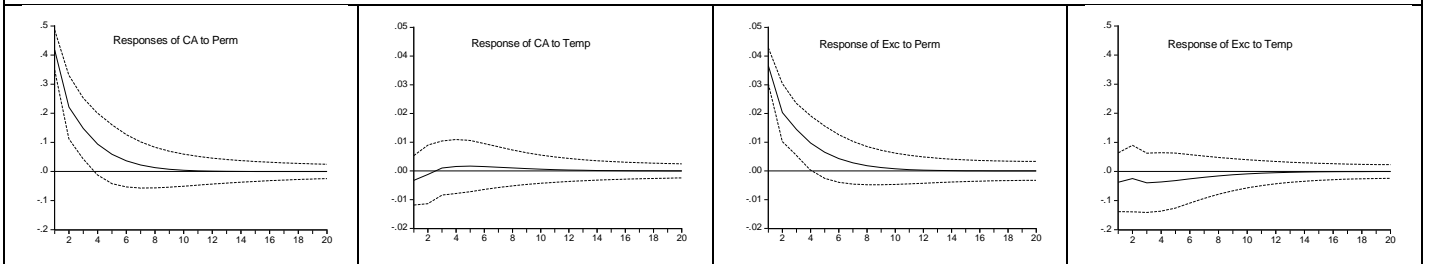
Botswana

Egypt

Ghana

Kenya

Nigeria

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Figure 1 Cont'd

South Africa

Tanzania

Tunisia

Uganda

Zambia

14

Figure 2

Figure 2 Cont'd

S/Africa: Current Account
Historical Decomposition

S/Africa: Exchange Rates
Historical Decomposition

Tanzania: Current Account
Historical Decomposition

Tanzania: Exchange Rates
Historical Decomposition

Tunisia: Current Account
Historical Decomposition

Tunisia: Exchange Rates
Historical Decomposition

Uganda: Current Account
Historical Decomposition

Uganda: Exchange Rates
Historical Decomposition

Zambia: Current Account
Historical Decomposition

Zambia: Exchange Rates
Historical Decomposition

Table 1									
Unit Root and Johansen Cointegration Tests									
No.	**Country**	**Variables**	**ADF**		**PP**		**KPSS**		**Johansen Cointegration Tests$^{\pm}$**	
			Level	**1st Diff**	**Level**	**1st Diff**	**Level**	**1st Diff**	**Trace**	**Maximum Eigenvalues**
1.	Algeria	Lreer	-1.29	-2.91**	-0.64	-4.88**	1.10	0.12$^{\#}$	3.05	2.64
		rcgdp	-0.21	-3.27**	-1.24	-4.96**	0.91	0.07$^{\#}$		
2.	Botswana	Lreer	-1.15	-10.17**	-1.14	-10.25**	1.23	0.07$^{\#}$	10.24	9.67
		rcgdp	-4.31**	-4.39**	-1.90	-5.97**	0.68	0.12$^{\#}$		
3.	Egypt	Lreer	0.99	-5.42**	-0.93	-11.07**	1.12	0.10$^{\#}$	11.27	9.90
		rcgdp	-1.96	-10.58**	-2.08	-10.58**	0.54	0.06$^{\#}$		
4.	Ghana	Lreer	-1.47	-10.66**	-1.47	-10.66**	0.86	0.11$^{\#}$	5.92	5.53
		rcgdp	-0.73	-10.71**	-0.72	-10.74**	0.86	0.16$^{\#}$		
5.	Kenya	Lreer	-2.06	-7.09**	-1.93	-6.97**	1.18	0.34$^{\#}$	13.89	10.47
		rcgdp	-3.04**	-6.49**	-3.13**	-4.83**	0.56	0.16$^{\#}$		
6	Nigeria	Lreer	-1.90	-4.65**	-1.64	-6.85**	0.64	0.13$^{\#}$	7.77	6.01
		rcgdp	-1.71	-4.91**	-2.32	-5.21**	0.63	0.12$^{\#}$		
7.	South Africa	Lreer	-2.07	-6.67**	-1.79	-6.78**	0.89	0.07$^{\#}$	10.40	10.28
		rcgdp	-2.02	-5.06**	-2.02	-5.06**	0.53	0.06$^{\#}$		
8.	Tanzania	Lreer	-2.52	-10.45**	-2.48	-10.52**	1.19	0.41$^{\#}$	14.22	13.26
		rcgdp	-1.71	-3.05**	-2.81	-5.40**	0.33	0.06$^{\#}$		
9.	Tunisia	Lreer	-1.63	-4.03**	-1.55	-5.94**	0.97	0.15$^{\#}$	14.69	13.14
		rcgdp	-3.29**	-3.48**	-1.83	-5.77**	0.57	0.11$^{\#}$		
10.	Uganda	Lreer	-1.77	-4.65**	-3.40**	-4.88**	1.02	0.33$^{\#}$	3.77	2.83
		rcgdp	-2.82	-3.67**	-2.59	-8.35**	0.34$^{\#}$	0.05$^{\#}$		
11.	Zambia	Lreer	-2.91**	-6.12**	-2.23	-4.89**	0.39	0.09$^{\#}$	7.13	4.49
		rcgdp	-2.24	-3.54**	-1.95	-5.35**	0.17	0.08$^{\#}$		

** and $^{\#}$ signify rejection of the null at 5% level of significance.

$^{\pm}$The tests have failed to reject the null of no cointegration at 5% significance level in all the countries. The critical values for Trace and Maximum Eigenvalues are 15.49 and 14.26, respectively.