Currency Substitution in Selected African Countries[+]

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Abstract

This study investigates the presence of currency substitution in eight African countries- Egypt, Morocco, Nigeria, Ghana, Kenya, South Africa, Tunisia and Zambia- for the period 1976 to 2005 using both regional and US dollar as anchor currencies. We find that currency substitution is prevalent in Ghana and Nigeria when CFA franc is used as an anchor currency. However, when US dollar is used as an anchor currency there is no evidence of currency substitution in Ghana but we still observe the presence of currency substitution in Nigeria. Also we find presence of currency substitution in South Africa but not in Egypt when the US dollar is the anchor currency. For Kenya, Tunisia and Zambia there is no evidence of currency substitution irrespective of the anchor currencies considered. In the case of Morocco, we observe no evidence of currency substitution when the Egyptian pound is used as anchor currency but there is weak evidence of currency substitution when the US dollar is considered.

JEL classification*:* E41; F32; C52
Keywords*:* Currency substitution; money demand

1. Introduction

Currency substitution, in which foreign monies substitute for domestic money in its three traditional roles such as medium of exchange, unit of account and a store of value, makes execution of monetary and fiscal policy extremely difficult (Imrohoroglu, 1994; Calvo and Végh, 1993; Niskanen, 2000;Giovannini and Turtleboom, 1992; Agénor & Khan, 1996; Rodriguez & Turner, 2003). A large number of factors make domestic residents substitute away from the domestic currency namely, the foreign trade transactions, the domestic transactions, the portfolio diversification, and the avoidance of excessive financial losses from inflationary taxation[1] (Brand, 1993). In a country where currency substitution is prevalent interest rate (both real and nominal) changes would be uncertain due to the instability of the money demand.

Researchers examined the existence of currency substitutions and its adverse effects on policy making for both developed and underdeveloped countries[2]. Three distinct methods are used to identify the presence of currency substitution. Thomas (1985) argued that the ratio of real domestic balances to real foreign balances should be negatively related to the domestic nominal interest rate and positively to the foreign nominal interest rate if currency substitution exists in those economies. Other researchers used optimizing framework with both domestic currency and foreign currency as assets to identify currency substitutions (Selçuk, 2003; Agénor & Khan, 1996). The presence of currency substitution has been also tested by examining the

[1]Dontsi (2001) adds a new security motive for African countries especially as fund deposits in European banks remain a safe haven for embezzled public funds and rents from illicit activities for African corrupt ruling clans.

[2] See currency substitution studies by Miles (1978, 1981), Bordo and Choudhri (1982), Imrohoroglu (1994) and He and Sharma (1997) for USA and Canada; Arize (1991), Tavlas & Ozeki (1992) and Sharma et.al., (2005) for Japan and South Korea; Artis et al. (1993), Mizen and Pentecost (1994), and Spencer (1997) for other European countries; Calvo and Végh (1993) for Bolivia, Peru, and Uruguay. Agénor and Khan (1996) found evidence of currency substitution in ten developing countries of Africa (Morocco, Nigeria), Asia (Bangladesh, Indonesia, Malaysia, Philippines, and Pakistan) and Latin America (Mexico, Brazil, and Ecuador). Selçuk (2003) and Buchs (2000) found existence of currency substitution in a number of Eastern European and Middle Eastern countries as well as Russia.

stability of the money demand function as the presence of currency substitution increases the volatility of money demand (Darrat et al., 1996; Sharma et al., 2004).

The latter approach is the one considered in this paper. It is an indirect way of investigating the existence of currency substitution in a country by paying attention to the changes that take place in the money demand for domestic currency. We consider this approach because the data on foreign monies circulating in the economy and foreign deposits of domestic residents are not available for the countries considered here. Moreover, this approach has an advantage because it accounts for both capital mobility and currency substitution. Recently, Prock et al. (2003) investigated the presence of currency substitution in Latin America countries using this approach. They examined the money demand function of Argentina, Brazil and Mexico in a vector error correction model. Their findings indicate that currency substitution is prevalent in all three countries, but it is more pronounced in Brazil and Argentina than in Mexico. Also, Darrat et al. (1996) examined the stability of money demand function for Japan while other researchers used a similar approach to study currency substitution in Asian developing countries (Sharma et al., 2004) and Mexico (Rodriguez and Turner, 2003).

The stability of the money demand function is crucial to conduct an efficient and independent monetary policy. Haug and Lucas (1996) used a co-integration analysis to study the stability of the Canadian long-run money demand. They also estimated the parameters with the fully-modified estimation method using quarterly data from 1953:1 to 1990:4, and observed a stable money demand function for Canada. Lutkepohl et al. (1999) studied the stability and linearity of a German money (M1) demand function. They used smooth transition regression techniques capable of accommodating both smooth and sudden change in regression coefficients over time. Using quarterly data from 1960:1 to 1995:4, they noted that the relationship was linear and stable before 1990 and the monetary unification barely changed this relationship. Ibrahim

(1998) using co-integration technique examined the stability of money demand in Malaysia by considering both M1 and M2 and observed that M1 is unstable in the long run, while M2 is stable in the long-run but unstable in the short-run. Consequently, he concludes that using M2 as a target in monetary policy will be recommended provided that the policy makers figure out the structural break in the money demand. There are only few studies devoted to money demand in African countries.

Generally researchers examine whether currency substitution exists between domestic currency and US dollar, British Pound, or Japanese Yen. However, countries with weaker trade ties to these rich countries along with underdeveloped foreign currency market might lead agents to substitute other regional currency that might make their money demand unstable. As African countries are moving towards a more market based monetary regimes, a crucial part of this framework is to understand the behavior of their money demand functions. But, only few studies have been devoted to investigate the money demand in African countries. Moreover, all these studies investigated the stability of money demand by using currency substitution between US dollar and domestic currency. In this paper, we investigate the existence of currency substitution in eight African countries: Ghana, Kenya, Tunisia, Zambia, South Africa, Morocco, Nigeria and Egypt by examining the stability of the money demand function in these countries using quarterly data from 1976:1 to 2005:4. Towards this goal both the US dollar and regional currencies are used as anchor currencies.

The extent of currency substitution could be determined with precision if one could get data on the quantity of foreign money with the public, the quantity of foreign money deposits in the domestic banking system and the amount of foreign currency deposits made abroad by domestic residents. However, the data on quantity of foreign money in circulation is not available even in developed countries. So applied researchers commonly use proxies like

expected change in depreciation of exchange rate to circumvent the data problem (see Prock et al., 2003; Elkhafif, 2003).

Our results indicate that there is no evidence of currency substitution in Kenya, Tunisia, and Zambia for both US dollar and regional currencies. However, for Ghana we observe that people substitute for CFA franc for their currency but not U.S. dollar. This means that if we take into account only the US dollar to examine the currency substitution we would have missed the presence of currency substitution in Ghana. We also note that Nigerians substitute both US dollar and CFA franc for their currency. This is quite possible since the rate of inflation in Nigeria is about 25%, so in order to protect the value of their liquidity Nigerians opted for substituting for foreign currencies. In Egypt and South Africa, we observe no evidence of currency substitution with respect to the US dollar. Morocco yields currency substitution when the US dollar serves as anchor but it is insignificant. On the other hand, when the Egyptian pound is used as anchor currency, Morocco yields no evidence of currency substitution.

This paper is structured as follows. In section 2 we specify the model. Data descriptions are presented in section 3, while the results and the policy implications are discussed in section 4. At the end some concluding remarks are made.

2. Monetary policies in Africa

African countries have adopted different monetary policies depending on whether or not a country was colonized by France or Great Britain. Honohan and O'Connell (1997) have identified 5 types of monetary regimes adopted by countries across Africa since the 1960s. First, we have a rule-based regime. The currency board system is defined as a set of rules preventing the exercise of discretion in most dimensions of central bank activity (see Honohan and O'Connell, 1997). For instance, in most of the British colonies (Ghana, Kenya, Nigeria, Zambia,

among others) this system prevailed throughout the 1960s. On the other hand, in the French colonies (Benin, Côte d'Ivoire, Senegal, Central African Republic, Burkina Faso, among others) a rule-based system with much more control from France was implemented. It simply pegged local currencies to the French national currency (the French Franc). As a result, monetary policies of these countries were almost entirely conducted by proxy by France throughout the 1960s to the 1990s. Recently, these countries are conducting somewhat more independent monetary policies.

The second form of monetary regime is the automatic monetary financing system. In this system, authorities make extensive use of deficit financing by issuing high-powered money to accommodate any macroeconomic shock. Fiscal deficits for instance are essentially financed through inflation tax. Countries like Liberia, Sierra Leone, Somalia and Zambia (in the 1980s, 1990s); Angola (in the 1990s) and Democratic Republic of Congo (from the 1970s to the 1990s) fit in this category. In other words, the quest for a controlled inflation is not a key objective of monetary decision-makers in these countries. As a result, these countries have experienced persistent inflation, or even hyperinflation.

Third, there is the controlled economy regime or rationing regime. In these regimes, goods and exchange rates are rationed meaning that prices and quantities cannot fluctuate to clear markets. Authorities keep a tight control over the money supply. All shocks are accommodated through the establishment of rations. Thus, monetary policy in these economies is almost entirely passive or inactive. Ghana, Tanzania and Uganda among others implemented such regime in the 1970s; while other countries like Angola and Mozambique among others used it for a longer period throughout the 1970s and 1980s.

Fourth, there is the monetary arrangement with credit ceiling. In this regime, commercial banks are limited in their ability to create money by the monetary authorities. Many African

countries have introduced this form of monetary arrangement starting in the 1980s (see for instance Killick and Mwega, 1990). Ethiopia, Malawi and Nigeria have had a monetary policy driven by credit ceiling from the 1970s to the 1980s. Others like Kenya, Zambia and Ghana among others have used this regime in the 1970s and 1980s, respectively.

Finally, we have market-clearing regimes. In these regimes, most of the decisions made by monetary authorities find their rationales through the forces of markets. They enjoy much more independence vis-à-vis the government and in the implementation of their policies. The government itself barely relies on expansionary monetary policies to offset the fiscal deficit. There is no preset credit ceiling as in the previous monetary arrangement: markets' conditions dictate the creation of money by banks. This form of regime is not currently widely observed in Africa. However, as more and more African governments are becoming fiscally responsible and embracing the rules of good governance, we are witnessing a movement towards the establishment of independent central banks able to implement independent and market-based monetary policies. For example, Kenya has been implementing a market clearing approach since the 1980s and Ghana started in the 1990s.

3. Model Specification and Methodology

3.1 Model Specification

Bahmani-Oskooee and Techaratanachai (2001) note that most of the money demand functions present two basic characteristics. On the one hand, the broader definition of money (M2) is considered instead of M1, while exchange rate is included as a determinant of money holding besides income and the interest rate. With this fact in mind, we use a portfolio-balance model where agents in a given country may hold four types of assets: domestic currency, foreign currency, domestic bonds and foreign bonds. We note that the African countries considered in

this study have an insignificant securities market and these markets, when they exist, are accessible to a few financial institutions. Moreover, the issuance of bonds is not the primary channel for the governments to raise funds. Consequently, this study does not focus on domestic and foreign bonds equations which are overlooked in the portfolio. Money demand would depend on overall economic activities and also on the returns of the assets above.

Using a modified version of Darrat et al. (1996), we specify the following model:

$$\left(\frac{M}{P}\right)^{D} = f(y, i, i^{*}, p^{e}, \Delta e^{e}), \qquad (1)$$

where $\left(\frac{M}{P}\right)^{D}$ is domestic real money demand, y is income, i is the domestic nominal interest rate, i* is the foreign interest rate, p^{e} is the expected rate of inflation and $?e^{e}$ is the expected change in the exchange rate.

As expected, income y represents a key determinant of real money demand in most of African countries since the average household maintains a sizeable amount of domestic balances to pay for day to day expenses. Alternative instruments of payments such as checks are not very well developed as a few households have bank accounts. Moreover, distrust in these instruments has increased the reluctance of people to use them since many checks turn out to be fake or unfunded.[3] As a result, we expect the partial derivative of real money balances with respect to transactions to be positive.

Despite the non-existence of well-developed financial markets, both nominal and foreign interest rates play a noticeable role in African countries in the determination of domestic balances for mainly two reasons. First, notwithstanding the fact that lots of households have little knowledge of the functioning of financial markets in terms of the opportunity cost for holding

[3] For a detailed discussion see Dontsi (2001).

money, more and more educated people along with their involvement in the economic activities have come to understand the benefits for opening a saving or some sort of term accounts that bear interest.

The second reason is that many medium and big size corporations- which represent a substantial part of the demand for domestic real balances- are now extending their activities across borders to take advantage of the many opportunities available due to the proximity of important markets such as the WAEMU[4] countries for Ghana and Nigeria, the South African economy for Kenya and Zambia, and the Egyptian economy for Morocco and Tunisia. As nominal interest rates are increasing, people will hold fewer domestic currency thereby decrease their demand for domestic real money. Thus, the expected signs of i is negative.

Inflationary expectations (p^e) remain a key determinant of the quantity of real domestic balances as it erodes the value of nominal money holding. However, the source of this inflationary expectation is crucial for the relationship between inflationary expectation and money demand. The sign of the derivative of real money balances with respect to expected inflation would be negative if the expectation for an increase in prices is due to pure economic reasons. But if the dominant factor behind inflationary expectation is the political and social instability, we might observe a positive relationship between p^e and money demand. As a matter of fact, during political instability of uncertain duration, the chain of supply of goods and services is either broken or weakened leading to a shortage and, ultimately, to a price increase. Also, people are aware of the fact that depository institutions (banks) will remain close during these times of instabilities and also people want to protect their uninterrupted consumption level. Thus we expect the coefficient of p^e to be positive.

[4] It stands for West African Economic and Monetary Union that include 8 countries: Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo.

We can rewrite the money demand function, i.e. equation (1), in the following linearized form:

$$\left(\frac{M}{P}\right)^{D} = l_0 + l_1 y_t + l_2 i + l_3 i^{*} + l_4 p^{e} + l_5 \Delta e^{e} \qquad (2)$$

where $?_1 > 0$ and $?_2, ?_3, ?_4, ?_5 < 0$. Equation (2) is used for each country.

The real return of foreign bonds (essentially government's bond) also determines the demand for real balances as it is another competing asset. The expected gains in exchange rate differential will add to the nominal return that will be received on a given foreign bond or interest bearing asset. That is, the real return on foreign bonds is the sum of i^{*} and the expected change in the exchange rate $? e^{e}$:

$$(i^{*} + ? e^{e}) \qquad (3)$$

Following the previous research and using (3) in equation (2), we obtain:

$$\left(\frac{M}{P}\right)^{D} = l_0 + l_1 y_t + l_2 i + l_3 (i^{*} + \Delta e^{e}) + l_4 p^{e} + l_5 \Delta e^{e} \qquad (4)$$

Moreover, there is a consensus in the literature concerning the fact that, with an increasingly integrated world coupled with a great deal of liberalization of both financial and goods markets, interest rates (foreign and domestic) vary to equalize each other[5]. This idea is well documented in Giddy (1983), Madura (1992), Francis et al. (2002) and Drakos (2003) in the context of developing countries and is known in the literature as the Interest Rate Parity argument. This equilibrium condition implies that:

$$i = (i^{*} + \Delta e^{e}) \qquad (5)$$

Thus, the final form of the money demand function can be expressed in equation (6):

[5] Although we have a distinct literature about home bias in asset holding, however, we believe that for African countries the home bias would not be pronounced.

$$\left(\frac{M}{P}\right)_t^D = g_0 + g_1 y_t + g_2 i_t + g_3 p_t^e + g_4 \Delta e_t^e \qquad (6)$$

Equation (6) has a distinct advantage as we now excluded the foreign interest rate as a determinant of the domestic real money demand. This is good for modeling money demand for African countries as information on foreign interest is not widely available.

The expected change in exchange rate ($?e^e$) is used to identify the existence of currency substitution in this paper. A few studies conducted for African countries (Elkhafif, 2003; Agénor and Khan, 1996) essentially consider the US dollar as anchor currency. The present study departs from this approach by considering stable currencies of Africa such as the CFA[6] franc as anchor in West Africa for Ghana and Nigeria; the South African Rand for Kenya and Zambia; the Egyptian pound for Morocco and Tunisia in Northern Africa. This approach is realistic because of the proximity of these blocs of countries with respect to the anchor currency economy due to the convenience for domestic agents and the increasing level of exchanges that are being conducted among these countries. Finally, the US dollar is used as anchor for Egypt and South Africa as they serve themselves as anchor for other countries. A significant negative coefficient of the expected fluctuations in exchange rates will identify the existence of currency substitution (Bordo and Choudhri, 1982). As a matter of fact, a negative sign associated with expected changes in exchange rates will indicate that economic agents are reducing their holding of real domestic balances as a depreciation of the domestic currency is anticipated. In other words, they shy away from the domestic currency and substitute it with the anchor currency that is appreciating. People adjust their holdings of real domestic balances by substituting foreign currency (the anchor currency) for domestic currency as the domestic currency is expected to

[6] C.F.A. is a French acronym that stands for "*Communauté Financière Africaine*" or African Financial Community. It's a group of 8 countries in Western Africa. The countries part of the *C.F.A.* are, in alphabetical order, Benin, Burkina-Faso, Côte D'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. They use a common currency called "*Franc C.F.A.*" or C.F.A. Franc in English. This currency is tied to the Euro through the French Franc.

depreciate. We will estimate equation (6) for each of these African countries. A negative and significant g_4 will indicate the presence of currency substitution in a country.

3. Data

We collected quarterly data for Egypt, Ghana, Kenya, Morocco, Nigeria, South Africa, Tunisia, and Zambia for the period 1976 to 2005 from the *International Financial Statistics (IFS)* published by the IMF. We considered this time period as floating/managed floating exchange rate regimes in these countries would allow us to identify currency substitution by examining the stability of the money demand function using expected depreciation of the exchange rate as a proxy. For each country, we collected data on the domestic real money demand $\left(\frac{M2}{P}\right)$[7]; the real Gross National Income (y); the domestic deposit interest rate (i); expected inflation rate, p^e, measured by the change in the actual rate of inflation, i.e. $?p$; and the expected depreciation in the exchange rate with respect to the anchor country approximated by the inflation differential between the domestic country considered and the anchor currency country. This also allows us to avoid econometric problems related to pegged and managed exchange rates.

4. Results and Policy Implications

Most of the studies in currency substitution examine whether people in a country hold foreign currencies of developed countries like US Dollar, British Pound, or Japanese Yen. However, we examine whether people of these African countries hold some regional currencies.

[7] Inflation is measured as the percentage change in the consumer price index in all countries but for Tunisia and Zambia it is measured by the percentage change in the GDP deflator.

In addition to this, we examine whether they hold US Dollar in their portfolio. The home currency and anchor currencies for each country are reported in Table 1.

Table 1
Home and Anchor Currencies

Country	Home Currency	Anchor Currency
Egypt	Pound	US Dollar
Ghana	New Cedi	CFA Franc
Kenya	Shilling	South Africa Rand
Morocco	Dirham	Egyptian Pound
Nigeria	Naira	CFA Franc
South Africa	Rand	US Dollar
Tunisia	Dinar	Egyptian Pound
Zambia	Kwacha	South Africa Rand

Prior to the estimation of model (6), we need to check the stationarity of each series used here. Thus, to test whether the series are stationary or not a variety of unit root tests are performed.

4. 1. Unit Root Tests

As low power of different tests for unit roots is a recurrent issue and the lack of consensus in the literature about the most appropriate tests, we use 12 different tests on level and first difference for each series[8]. These are Dickey-Fuller tests, Augmented Dickey-Fuller and different variations of Phillips-Perron tests. Regardless of the country considered, we fail to reject the unit root hypothesis for the log of real money balances ($\ln m_t$) and the log of real GDP ($\ln y_t$) except for Egypt in the latter case. These findings are similar with the different variables representing interest rates (i). That is, three-month time deposit (Egypt, Morocco and Nigeria), Treasury bill rate (Ghana, Kenya and South Africa), three-six month time deposit (Tunisia and Zambia) are found to be non-stationary in levels. Inflation differential ($?p_t$) within all countries

[8] To save space the results of unit root tests are not reported but are available from the authors.

are found to be stationary, except in Nigeria and Zambia. On the other hand, results indicate that inflation differential ($?p^*_t$) between the countries considered and their respective anchor country are non-stationary for all countries except Morocco. As a summary, we have a combination of I(0) and I(1) variables in the money demand equation of each country. For Egypt, ln(m_2), i, and $?p^*_t$ are I(1) whereas ln (y) and $?p_t$ are I(0). For Ghana, ln (m_2), ln (y), i and $?p^*_t$ are I(1), and $?p_t$ is I(0); for Kenya, Morocco, South Africa and Tunisia, ln(m_2), ln(y), i and $?p^*_t$ are I(1) while $?p_t$ is I(0); and for Nigeria and Zambia ln(m_2), ln(y), i, $?p_t$ and $?p^*_t$ are all I(1).

4. 2. Long-run Analysis

We investigate the existence of a long-run relationship between real money balances, real income, interest rate, expected inflation and expected exchange rate depreciation. In Table 2, we report the ?-max and ?-trace statistics proposed by Johansen and Juselius (1990) to test[9] for co-integration in all eight countries. The existence of at least one co-integration vector suggest that the variables considered move towards an equilibrium in the long-run. Both ?-trace and ?-max test statistics reveal that there are two co-integrating vectors in the case of Morocco and Nigeria and three and four co-integrating vectors for Egypt and South Africa, respectively. As a matter of fact, ?-max indicates two co-integrating vectors in the case of Ghana, Tunisia and Zambia, whereas ?-trace indicates just one for Tunisia and Zambia, and three co-integrating vectors for Ghana. As far as Kenya is concerned, ?-trace indicates three co-integrating vectors, when ?-max indicates no co-integrating vector. However, for all countries there exists at least one co-integrating vector which in turn means that the relationship between money demand and its

[9] A variety of Johansen and Juselius (1990) tests were used and all, except in a few cases, find the same number of co-integrating vector as mentioned above.

determinants holds in the long-run. Intercepts is tested in each co-integrating vector by using the likelihood ratio statistics[10]. Except for Egypt intercept is significant for all countries.

Table 2
?-trace and ?-max Test statistics

Country	Test statistic	Number of cointegrating vectors				
		r = 0	r = 1	r = 2	r = 3	r = 4
Egypt	?- Trace	154.636	75.076	33.712	10.981	0.155
p=3	?- Max	79.559	41.364	22.731	10.826	0.155
Ghana	?- Trace	137.066	67.053	31.288	11.471	5.148
p=3	?- Max	70.012	35.766	19.817	6.323	5.148
Kenya	?- Trace	93.469	60.590	31.256	8.971	1.297
p=8	?- Max	32.879	29.333	22.285	7.675	1.297
Morocco	?- Trace	104.981	48.127	20.219	9.192	0.313
p=4	?- Max	56.854	27.908	11.027	8.879	0.313
Nigeria	?- Trace	113.281	64.735	21.436	9.538	0.396
p=5	?- Max	48.546	43.299	11.897	9.142	0.396
South Africa*	?- Trace	143.383	91.202	51.524	31.185	11.725
p=8	?- Max	52.181	39.678	20.339	19.461	11.725
Tunisia	?- Trace	79.689	41.806	13.873	4.283	1.479
p=3	?- Max	37.882	27.933	9.590	2.804	1.479
Zambia	?- Trace	116.707	44.664	16.492	3.815	0.478
p=3	?- Max	72.042	28.172	12.677	3.337	0.478
5% Critical values:	*?- Trace*	*69.819*	*47.856*	*29.797*	*15.495*	*3.841*
	?- Max	*33.877*	*27.584*	*21.132*	*14.265*	*3.841*
5% Critical values:*	*?- Trace*	*88.804*	*63.876*	*42.915*	*25.872*	*12.518*
	?- Max	*38.331*	*32.118*	*25.823*	*19.387*	*12.518*

p is the number of lags suggested by AIC

These results validate our model in Equation (6). We then examine the significance levels of these coefficients. A significant coefficient of the expected exchange rate depreciations in co-integrating vectors indicates the instability of the money demand function and the existence of currency substitution. The normalized co-integrating vector with the highest eigen value is discussed next for each country.

[10] The LR statistics to test the significance of intercept for each country is given in parentheses next, i.e. Egypt (-1.91), Ghana (-33.09), Kenya (14.98), Morocco (-29.41), Nigeria (-7.32), South Africa (-19.85), Tunisia (-46.21) and Zambia (-96.02).

Egypt

The normalized co-integrating vector corresponding to the highest eigen value is:

$$m_2 = 1.858 y_t + 0.049 i_t + 0.118 p^e_t + 0.032 ?e^e_t$$
$$\quad (33.93^*) \quad (6.33^*) \quad (4.33^*) \quad (10.57^*)$$

We find no evidence of currency substitution with respect to the U.S. dollar as g_4 is positive and highly significant[11]. These findings suggest that real money demand in Egypt is stable. This is contrary to the findings of Elkhafif (2003) who finds supporting evidence of currency substitution in Egypt using an error-correction model. In his work, currency substitution is approximated by the ratio of foreign currency deposits in commercial banks over money supply. The difference in his and this study may come from the fact that Elkhafif (2003) consider annual data for a shorter period from 1991 to 2001. Indeed, during this period Egypt experienced an increase in foreign currency deposits into her banking system, which could explain why he finds strong evidence of currency substitution.

To further our understanding of the money demand function in Egypt, we derive the impulse response functions (IRFs)[12] and the variance decomposition functions (VDF)[13]. In Figure 1(a), results indicate that innovations in deposit rate have a positive impact on the real money balances. This impact decreases throughout the 15th period where it remains constant until the 40th period. Similarly, innovations in expected changes in the exchange rates have a long-term positive effect on the real money demand and it remains persistent till the 40th period. Also, shocks in expected change in exchange rates are positive but remain negligible and remain smaller than the effects of innovations in money demand and real output. Shocks to domestic deposit rate are initially positive until the 15th period before becoming negative for the remaining

[11] t-statistics are in parentheses. A sign (*) denotes significance at the 5% level.
[12] IRFs for all countries are reported in the Appendix to this paper.
[13] Variance Decomposition results are reported in Table 3.

of the periods. Disturbances in expected inflation essentially have negative effects on money demand. These effects persist although with a low intensity. In addition, all these responses are within a 95% confidence interval. This indicates that our model performs well in describing the behavior the real money demand function. On the other hand, the VDF show that the variations in the domestic real balances are essentially determined by fluctuations in real output that accounts for about 60% of variations in real demand. Consequently, we believe that Egypt should design her monetary policy focusing mainly on domestic factors such as real output.

Ghana

The final model for Ghana is given by:

$$m_2 = \underset{(0.004)}{0.010} + \underset{(0.62)}{0.909}y_t - \underset{(-0.71)}{0.027}i_t - \underset{(-4.78^*)}{0.430}p^e_t - \underset{(-6.83^*)}{0.119}?e^e_t$$

We note that the coefficient for expected depreciation of exchange rate is negative and highly significant. This indicates currency substitution between the Ghanaian Cedi and the C.F.A. franc, which has effects on the money demand function. Monetary authorities cannot operate an independent monetary policy as external variables have significant influence on the money demand. Therefore, they should implement policies that take into account evolution into economies of countries using the CFA franc. People of Ghana find the use the CFA franc in conducting their transactions profitable. This is probably due to the fact that Ghana has borders with the CFA Franc countries. Also the average inflation of 35% in Ghana would encourage people to hold a more stable currency. Bank of Ghana should ensure that domestic inflation does not diverge a great deal from the inflation rate of economies using the CFA franc.

Moreover, IRFs in Figure 1(b) reveal that innovations in expected inflation and expected change in exchange rate create a negative and persistent effect on money demand throughout

from the short-run till the long-run. Innovations in both real output and T-bill rate positively affect the domestic real money demand from the 4th quarter onward with about the same magnitude. However, these impacts are virtually insignificant in the short-run up to the 3rd quarter. The response is even negative for a little while following innovation in T-bill rate. The effects of these shocks remain significant throughout the period considered with a confidence interval of roughly 95 percent. Furthermore, it is found through the VDF that the real income roughly generates 34 percent of fluctuations in the real money demand, whereas expected changes in real exchange rate account for 6 percent. Although generating only about 12 percent of changes in real money demand, T-bill rate remains an important factor responsible for fluctuations in real money demand. On the other hand, when we consider the sample period 1981:1 to 2005:4 using the US dollar as anchor currency, we note that there is no evidence currency substitution between the Ghanaian Cedi and the US dollar[14].

Kenya

The normalized money demand function for Kenya is:

$$m_2 = \underset{(-1.42)}{-0.992} + \underset{(3.96^*)}{2.032}y_t - \underset{(-3.07^*)}{0.0381}i_t - \underset{(-1.93)}{0.398}p^e_t + \underset{(4.47^*)}{0.078}?e^e_t$$

We find no evidence of currency substitution between the Kenyan Shilling and the South African Rand. Thus, our findings suggest that the money demand in Kenya is stable. Monetary authorities may therefore efficiently pursue an independent monetary policy.

The response of real money demand to a one standard deviation shocks are shown in Figure 1c. The response to expected inflation is negative at first up to the 9th quarter where it becomes positive and significant for the remaining of the time period considered. Innovations in

[14] See Appendix Table A1. The US dollar is used as anchor currency for the period 1981-2005 for all other countries, besides Egypt and South Africa.

expected inflation generate the most significant response of m_2. Innovations in other variables- expected change in exchange rate and real output- have less impact on real money demand. For instance, real money demand responds positively at first by reaching a peak around the 6th quarter before dying out in the 16th quarter. Expected changes in exchange rates and T-bill rate disturbances mostly remain insignificant from the short-run to the long run. Another finding in Figure 1(c) is that the shocks to real money demand yields the highest response of real money demand itself and findings are within a 95 percent confidence interval throughout the 40th quarter. Our variance decomposition results reveal that besides real money demand, real output and expected inflation together account for about 30 percent of fluctuations in real money demand with real GDP accounting for about 17 percent. Accordingly, special attention should be paid by decision-makers to both real GDP and expected inflation rate in any attempt to control the real money demand. In addition, using the sample 1981:1 to 2005:5 we find that there is no evidence of currency substitution between the shilling and the US dollar. This is another indication that the money demand is more stable in Kenya.

Morocco

The estimated money demand function for Morocco is:

$$m_2 = \underset{(-3.57^*)}{-2.051} + \underset{(11.46^*)}{1.971 y_t} + \underset{(1.56)}{0.045 i_t} + \underset{(7.30^*)}{0.442 p^e_t} + \underset{(3.05^*)}{0.028 ?e^e_t}$$

We find no evidence of currency substitution in Morocco meaning people of Morocco do not substitute their Dirham for Egyptian pound. However, real money demand responds negatively to time deposit rate until the 25th quarter as shown in Figure 1(d). Real GDP disturbances lead to positive and significant response of real money demand from the first period onwards. These findings support the evidence that domestic factors are more important in determining the real

money demand. Moreover, variance decomposition results reveal that almost 30 percent of fluctuations in real money demand are explained by changes in real output in the long run. Innovations in expected inflation and expected changes in exchange rate remain insignificant, while innovations to real money demand generate considerable response from real money demand. This finding is confirmed by the VDC that shows that almost 66 percent, of fluctuations in real money demand are generated by fluctuations in real money demand. External factors are completely negligible as they account for less than 2 percent of variations in real money demand.

Using data from 1981:1 to 2005:4 and the US dollar as anchor currency, we find that the money demand function is relatively stable as there is weak evidence of currency substitution between the dirham and the US dollar. In other words, people in Morocco substitute the US dollar for the Dirham but this substitution is not significant enough to noticeably affect the destabilize the money demand function.

Nigeria

The estimated long-run money demand model for Nigeria is:

$$m_2 = \underset{(0.11)}{0.097} + \underset{(1.80)}{0.692}y_t \underset{(-0.003)}{-0.0000\,97}i_t + \underset{(6.37^*)}{0.388}p^e_t \underset{(-2.67^*)}{-0.027}?e^e_t$$

This money demand function indicates that there is evidence of currency substitution in Nigeria between the Naira and the CFA Franc. Consequently, an independent monetary policy cannot be designed for Nigeria since the real money demand appears to be unstable. So Nigerian central bank should pay a great deal of attention to economic fluctuations in surrounding Western African countries that use the CFA Franc. We also find the existence of currency substitution in

Nigeria when the US dollar is used as anchor currency[15]. Figure 1(e) shows that the response of real money demand to real GDP and it remains positive, steady, and significant over time. On the other hand, the response of real money demand to expected inflation shocks remains negative and significant throughout the 40th period. However, innovations in time deposit rate and expected change in exchange rates have negligible effects on real money demand throughout the long run. Moreover, VDF shows that domestic inflationary expectations are responsible for most, about 30 percent, of the fluctuations in real money demand.

South Africa

The estimated long-run money demand function for South Africa is as follows:

$$m_2 = \underset{(-2.61^*)}{-0.96} + \underset{(10.9^*)}{3.255 y_t} - \underset{(-0.12)}{0.00065 i_t} + \underset{(6.34^*)}{0.355 p^e_t} - \underset{(-4.18^*)}{0.0205 ? e^e_t}$$

This indicates that currency substitution exists in South Africa. It also suggests that the money demand function is unstable and monetary policy makers in South Africa should put more emphasis on the external factors[16].

In Figure 1(f), it appears that the response of real money demand to innovations in real output is positive till the 10th period although insignificant. At that point in time, the response is negative but insignificant up to the 40th period. On the other hand, innovations in domestic inflationary expectations remain insignificant throughout the short-run and long run. Both innovations in T-bill rate and change in expected exchange rate yields a negative response of real money demand that persists over time till the 40th quarter. Disturbances in real money demand remain positive but insignificant throughout any time period considered. However, the VDF

[15] Calvo and Végh (1992), and Agénor and Khan (1996) used the US dollar as anchor currency and find evidence of currency substitution in Nigeria.

[16] Elkhafif (2003) finds evidence of currency substitution in South Africa by using an error-correction model for the period ranging from 1991 to 2001.

results show that the expected change in exchange rate dictates most of the variations in real money demand (accounts for more than 45 percent). In addition, it indicates that monetary authorities should pay a great deal of attention to the changes in the US economy. Other factors like the T-bill rate also account for almost 30 percent of fluctuations in real money demand, which confirms the importance of the T-bill rate in determining the real money demand.

In the case of South Africa, authorities should consider targeting exchange rate between the US dollar and the rand because of the significance of currency substitution. As a matter of fact, it is true that in recent years the South African Reserve Bank (SARB) has devoted most of its efforts targeting the consumer Price index for Metropolitan and urban areas (CPXI) inflation for the past years within a monthly target range of 3-6 percent after a peak of 11.3 percent in November of 2002. Yet, considering the finding of this study, monetary authorities should also consider implementing policies destined to stabilize the exchange rate between the US dollar and the rand. This will in turn contribute to a more stable money function demand, which is crucial to achieving high employment and economic development.

Tunisia

The estimated money demand function for Tunisia is as follows:

$$m_2 = \underset{(-1.34)}{-0.615} + \underset{(4.62^*)}{1.342 y_t} - \underset{(-0.46)}{0.038 i_t} + \underset{(5.55^*)}{0.673 p^e_t} + \underset{(0.16)}{0.002 ?e^e_t}$$

This implies that there is no evidence of currency substitution in Tunisia The *Banque Centrale de Tunisie (BCT)* has clearly defined its goals of targeting inflation to maintain the value of the Dinar both domestically and internationally.

According to Figure 1(g), a shock to the real GDP leads to a positive response of real money demand that is significant and grow persistently over time. However, disturbances in time

deposit are at first positive and become negative after one year throughout the long-term. These disturbances remain insignificant over the long run. Real money demand shocks are positive throughout the long-run but largely remain insignificant, while shocks in expected changes in exchange rate produce no effects whatsoever on real money demand confirming once more the stability of the money demand in Tunisia. Variance Decomposition Functions indicate that real GDP and domestic interest rate largely determine the fluctuations in real money demand in Tunisia. Indeed, real GDP and domestic interest rate account for roughly 36 and 12 percent respectively, of movements in real money demand. Innovations in real demand account for about 50 percent of variations in real money demand.

Similarly, we have no evidence of currency substitution when we consider the US dollar as the anchor currency for the period ranging from 1981:1 to 2005:4. These results indicate that the money demand in Tunisia is fairly stable.

Zambia

For Zambia, we estimate the following money demand function:

$$m_2 = \underset{(-2.39^*)}{-676.9488} + \underset{(0.03)}{0.0277 y_t} + \underset{(1.86)}{0.0034 i_t} + \underset{(0.002)}{0.00324 p^e_t} + \underset{(1.23)}{2.35E\text{-}09?}\, e^e_t$$

These results indicate that currency substitution is not significant in Zambia. People of Zambia do not substitute their domestic currency for the South African Rand. A stable real money demand in Zambia allows authorities to have an independent monetary policy. Impulse response functions in Figure 1(h) shows that the responses of real money demand to real output, deposit rate and expected change in exchange rate shocks are completely negligible. Only innovations in domestic inflationary expectations generate a negative response of real money until the 10^{th} quarter and dye out afterwards in the long run. Also, disturbances in real money demand

generate at first the most significant response in real money demand but it sharply declines throughout the long run. The VDF confirms that domestic factors, namely the domestic inflationary expectations and domestic interest rates the driving force behind fluctuations in real money demand as they both account for about 45 percent of variations in real money demand, while real money itself accounts for 50 percent. When we use the US dollar as anchor currency we still find that there is no currency substitution between Kwacha and US dollar.

5. Conclusion

In this paper we examine the existence of currency substitution in eight African countries. We know that currency substitution by making money demand function unstable makes monetary policy making difficult. Using a portfolio balance model we estimate money demand functions where expected depreciation rate of the exchange rate is an explanatory variable. A significant negative coefficient for this expected depreciation rate of the exchange rate would indicate the presence of currency substitution. We examined currency substitutions related to regional currency and we find the existence of currency substitution in three countries- namely, Ghana (Anchor Currency: CFA Franc), Nigeria (Anchor Currency: CFA Franc) and South Africa (Anchor Currency: US Dollar). We also estimated the money demand function using the US dollar as anchor currency for all countries using data from 1981:1 to 2005:4. We find that currency substitution exists in Nigeria but we find no currency substitution in Ghana. Also for Morocco we find weak evidence of currency substitution when US Dollar is the anchor currency. These results indicate that we need to be careful about choice of anchor currency when we are conducting analysis related to currency substitution.

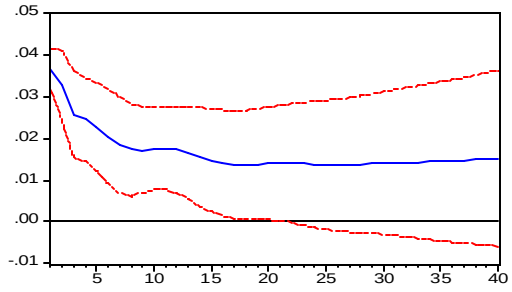
Table 3. Variance Decomposition Functions

Country	Period	m_{2t}	y_t	i_t	p^e_t	$? e^e_t$
Egypt	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	92.97761	0.975980	4.810015	0.281939	0.954458
	8	87.94814	4.953059	5.175104	0.205946	1.717749
	16	67.34911	27.66516	3.144908	0.423662	1.417159
	20	58.37268	37.38439	2.538068	0.455588	1.249268
Ghana	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	89.57480	1.574020	0.101239	7.083936	1.666011
	8	87.24964	1.916673	1.319191	6.546448	2.968047
	16	76.31614	8.500240	5.118946	6.476387	3.588284
	20	69.14322	13.03569	6.519295	7.076805	4.224988
Kenya	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	79.39958	9.870534	4.894703	3.840717	1.994464
	8	55.92893	35.49093	4.973468	2.452012	1.154655
	16	56.21587	30.13922	3.851435	8.026400	1.767073
	20	60.28929	25.77762	3.567978	8.297655	2.067456
Morocco	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	76.33791	12.19832	6.392333	0.641469	4.429969
	8	73.88648	14.28782	4.600800	0.515510	6.709389
	16	70.09305	21.51237	3.993681	0.287681	4.113211
	20	69.49976	23.44587	3.385523	0.244478	3.424368
Nigeria	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	83.10610	3.938745	2.274429	10.41252	0.268210
	8	56.66596	13.58147	9.461708	20.09305	0.197808
	16	37.73986	25.71082	7.563934	28.86273	0.122660
	20	32.62684	30.57514	6.667654	30.01351	0.116857
South Africa	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	87.81662	1.410677	4.332827	1.443700	4.996178
	8	66.24894	0.855775	8.683572	2.069071	22.14265
	16	31.76269	0.639697	31.41110	1.717584	34.46893
	20	24.02173	0.886494	32.77252	1.347099	40.97216
Tunisia	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	90.69525	5.491330	0.496211	3.246833	0.070379
	8	85.81170	11.21174	0.523892	2.384018	0.068650
	16	74.77071	21.78406	1.855041	1.541747	0.048440
	20	69.52326	25.96669	3.091045	1.378024	0.040981
Zambia	1	100.0000	0.000000	0.000000	0.000000	0.000000
	4	82.62120	1.176578	3.593366	12.43451	0.174339
	8	64.65337	3.954204	9.993803	21.28359	0.115029
	16	54.63525	5.390561	12.04138	27.73643	0.196375
	20	53.09112	5.242031	12.66429	28.81622	0.186340

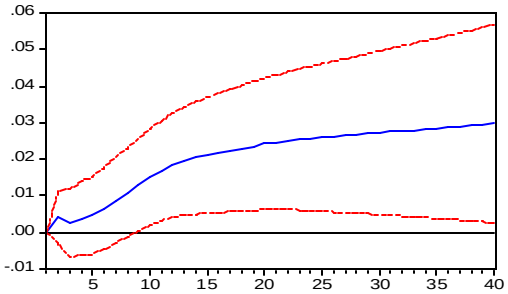
Figure 1. Impulse-Response Functions

(a) Egypt

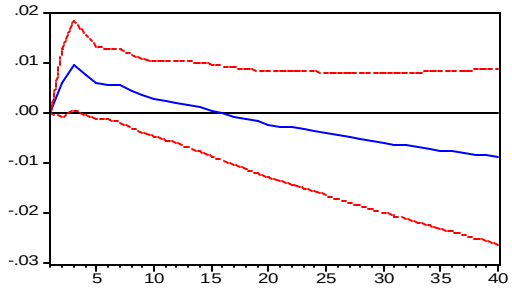
Response of m_2 to one S.D. shock in m_2



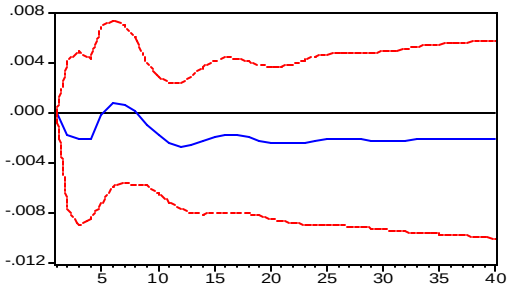
Response of m_2 to one S.D shock in y



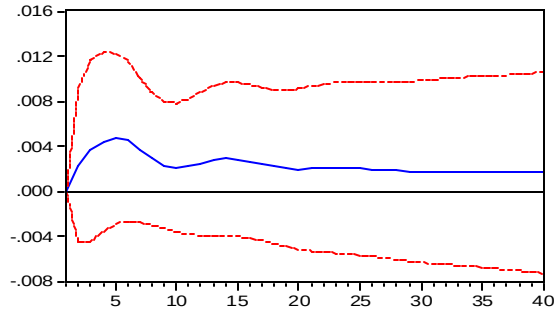
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

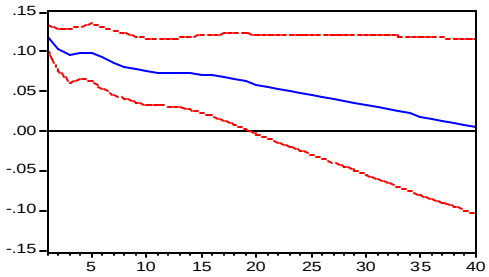


Response of m_2 to one S.D. shock in $?e^e$

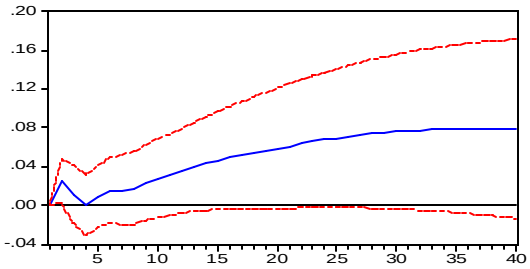


(b) Ghana

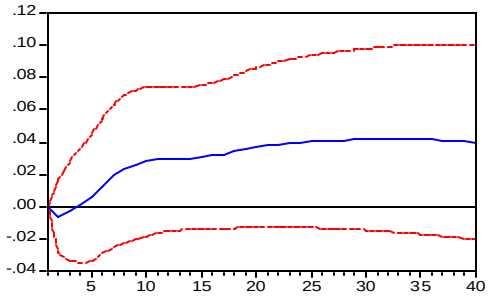
Response of m_2 to one S.D. shock in m_2



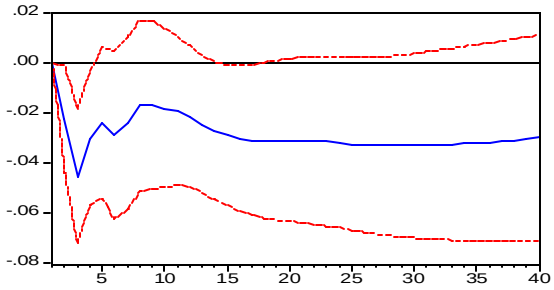
Response of m_2 to one S.D. shock in y



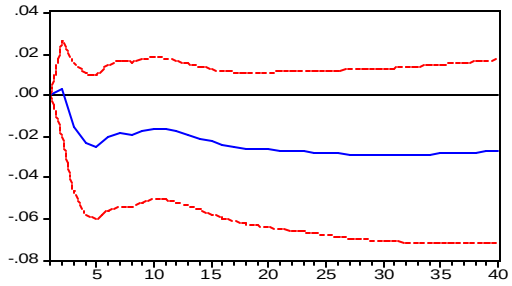
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

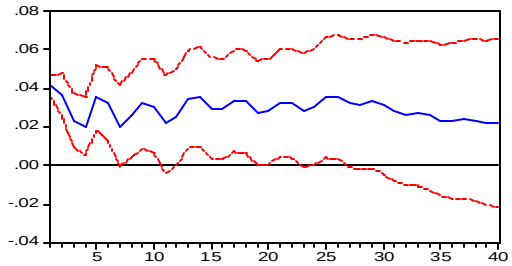


Response of m_2 to one S.D. shock in ?e^e

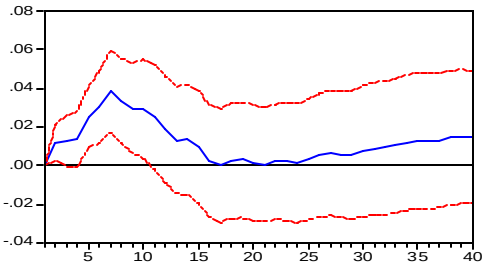


(c) Kenya

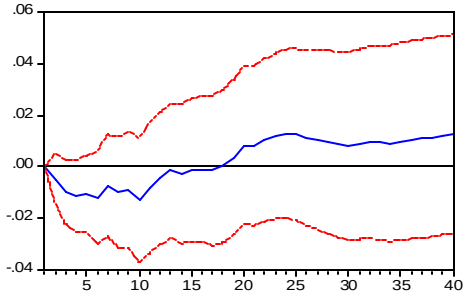
Response of m_2 to one S.D. shock in m_2



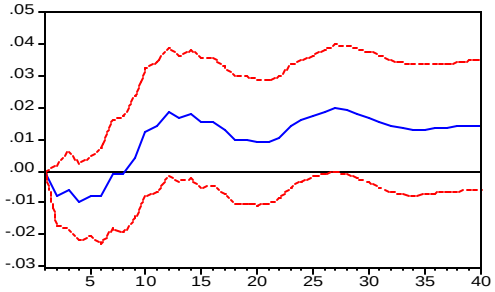
Response of m_2 to one S.D. shock in y



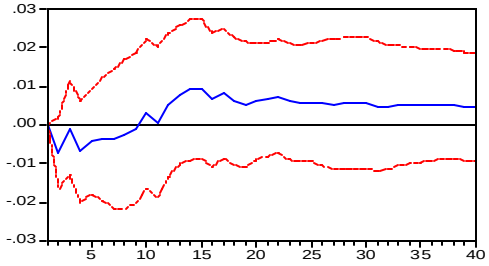
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

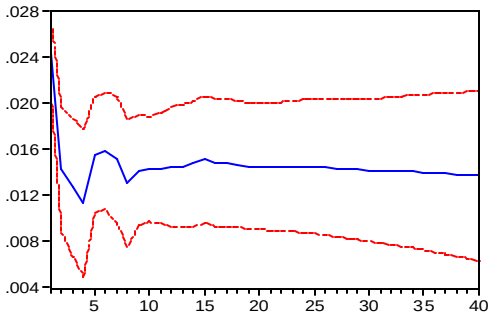


Response of m_2 to one S.D. shock in ?e^e

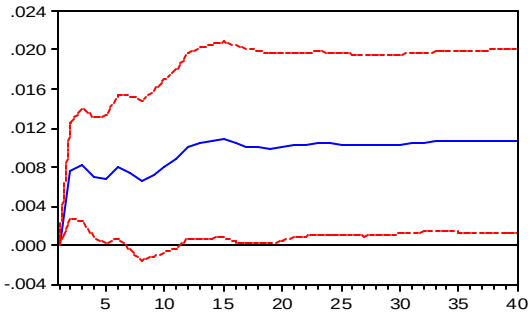


(d) Morocco

Response of m_2 to one S.D. shock in m_2



Response of m_2 to one S.D. shock in y



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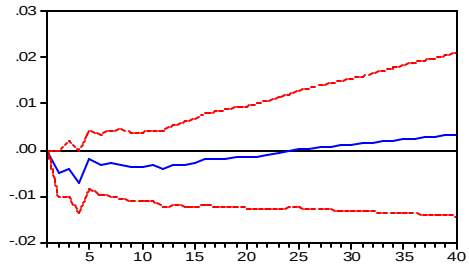
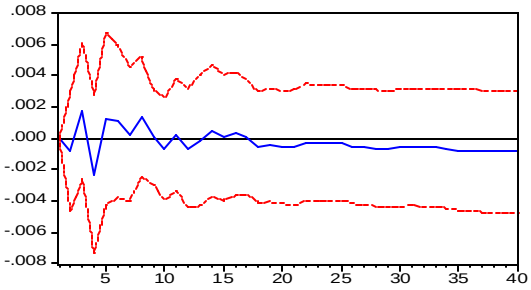
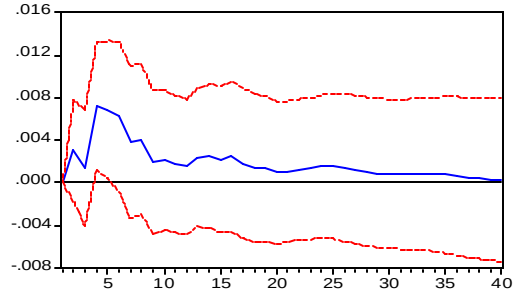


Response of m_2 to one S.D. shock in p^e

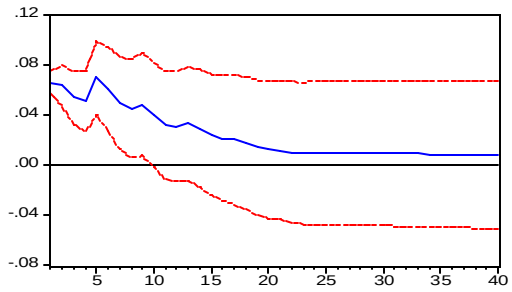


Response of m_2 to one S.D. shock in ?e^e

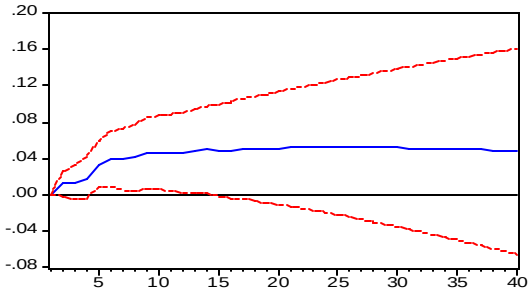


(e) Nigeria

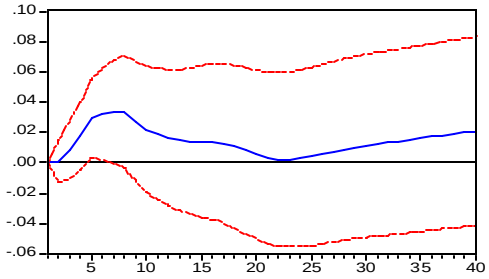
Response of m_2 to one S.D. shock in m_2



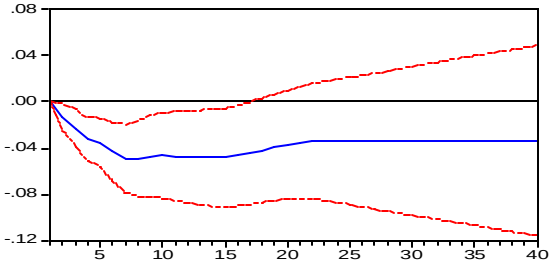
Response of m_2 to one S.D. shock in y



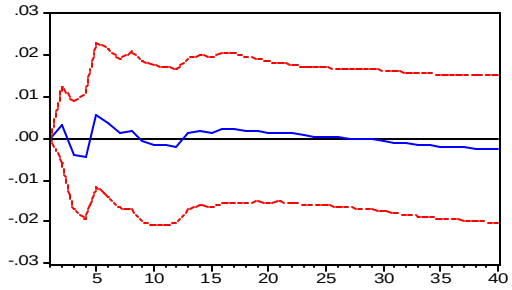
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

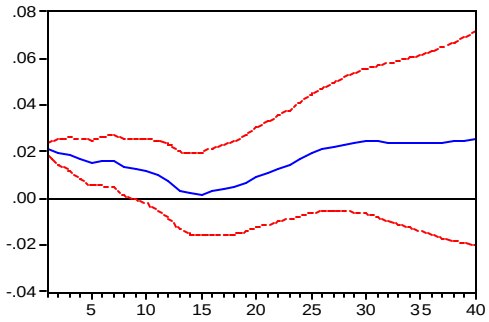


Response of m_2 to one S.D. shock in ?e^e

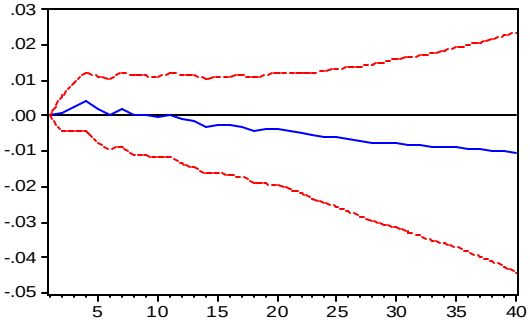


(f) South Africa

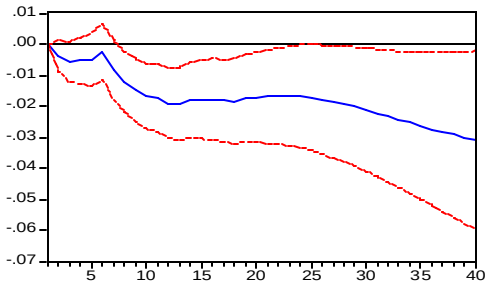
Response of m_2 to one S.D. shock in m_2



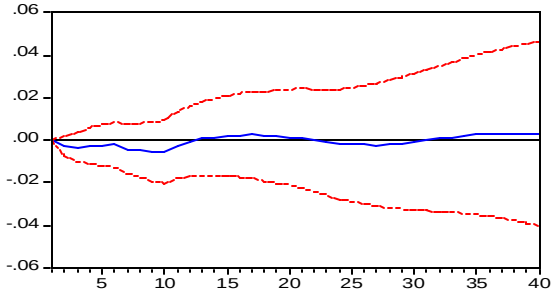
Response of m_2 to one S.D. shock in y



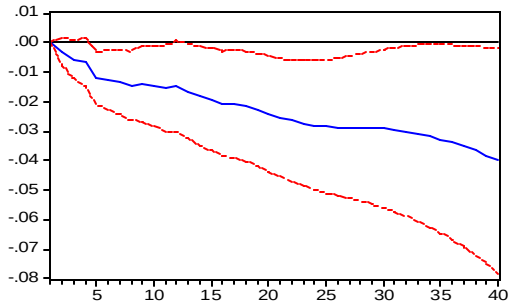
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

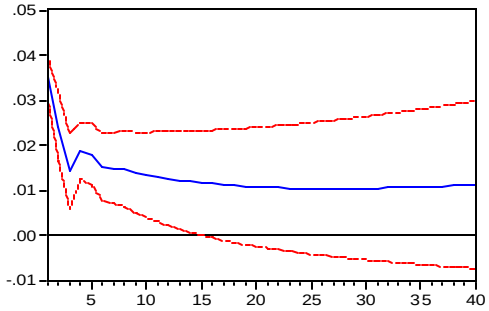


Response of m_2 to one S.D. shock in ?e^e

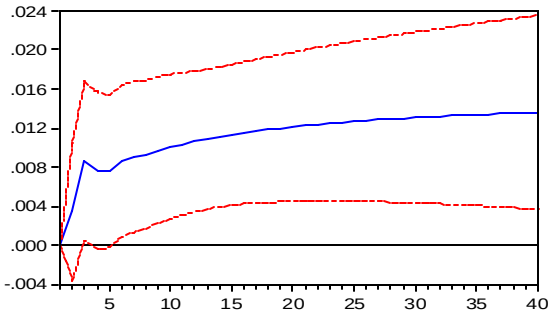


(g) Tunisia

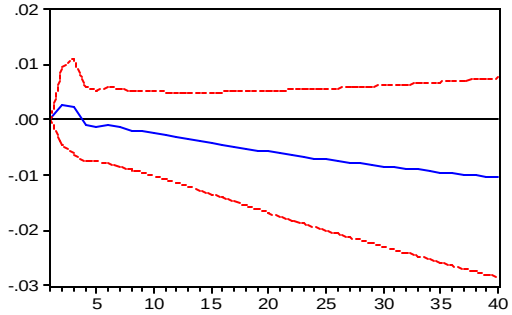
Response of m_2 to one S.D. shock in m_2



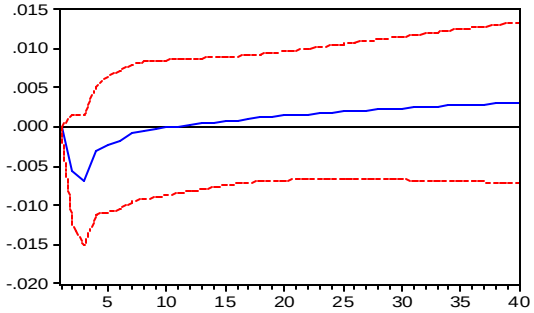
Response of m_2 to one S.D. shock in y



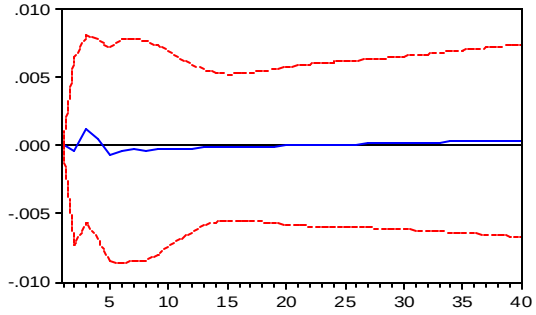
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e

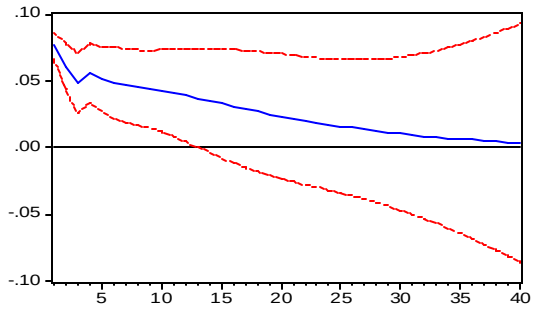


Response of m_2 to one S.D. shock in change in ?e^e

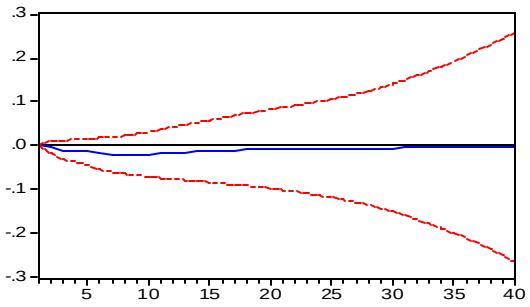


(h) Zambia

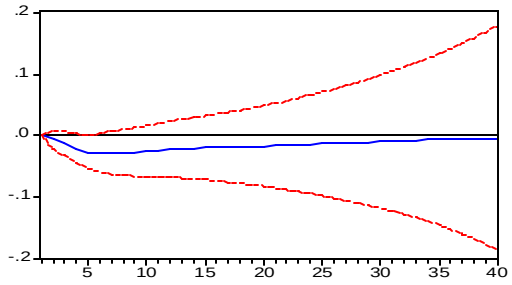
Response of m_2 to one S.D. shock in m_2



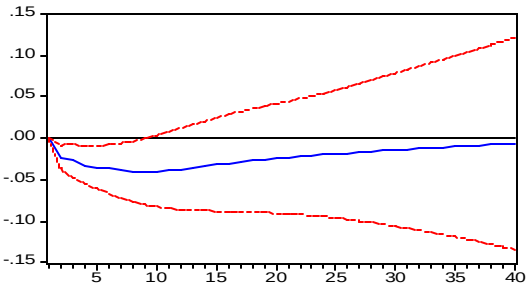
Response of m_2 to one S.D. shock in y



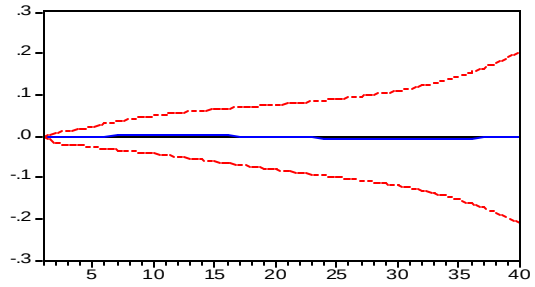
Response of m_2 to one S.D. shock in i



Response of m_2 to one S.D. shock in p^e



Response of m_2 to one S.D. shock in ?e^e



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Appendix Table A1

Normalized Cointegrating Vectors: The Anchor Currency is US Dollar

	Variables				
Countries	m2	y	i	p^e	? e^e
Ghana	1	-7.679	0.0990	-7.5440	-0.1884 (-44.01*)
Kenya	1	-8.565	0.0541	5.1068	-0.0519 (-0.91)
Morocco	1	-2.587	-0.0213	1.0314	0.0576 (1.75)
Nigeria	1	-0.033	-0.0468	0.8697	0.0314 (4.86*)
Tunisia	1	-0.435	1.1058	-3.9735	-0.0157 (-0.24)
Zambia	1	-7.167	0.0100	0.0157	-0.0043 (-1.49)

Note: For consistency in our results and analysis, we follow the same specifications as the ones used in determining the number of cointegrating vectors. To save space, we have reported vectors that make economic sense.
(*) denotes significance at the 5 percent level.