Sources of Exchange Rate Fluctuations in Kenya: The Relative Importance of Real and Nominal Shocks

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Abstract

The purpose of this study is to determine the factors contributing to real exchange rate fluctuations in Kenya; whether the real exchange rate responds more to real or to nominal shocks. A vector autoregression framework is applied in the analysis yielding impulse responses and decompositions of the forecast error variance. The results demonstrate the important role played by real shocks in causing exchange rate fluctuations, in particular highlighting the predominant role played by demand shocks. It is also shown that shocks hitting the Kenyan economy are asymmetric to shocks affecting the US economy. Thus, the Kenyan economy is buffeted by idiosyncratic shocks which are more country specific. Consequently, it can be argued that the exchange rate plays an important role as a shocks absorber in the Kenyan context.

JEL Classification: C32, E31, F31, F42

Key words: Real and Nominal shocks, exchange rates, vector autoregressions, Kenya

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1. Introduction

Kenya's exchange rates have demonstrated significant appreciation and volatility over the period 2000-2013 (figure 1). Despite some mild depreciation in 2003 and 2008, the tendency for the real exchange rate to appreciate continued unabated. The movements in the real exchange rate could be attributed to various shocks that have hit the economy from time to time. Looking at the variation in exchange rates (measured by standard deviations over the last 6 months) there are noticeable spikes in 2003, 2005, 2006, 2008 and 2012 (figure 2). The fluctuations in real and nominal exchange rates show similar patterns in the period after 2007.

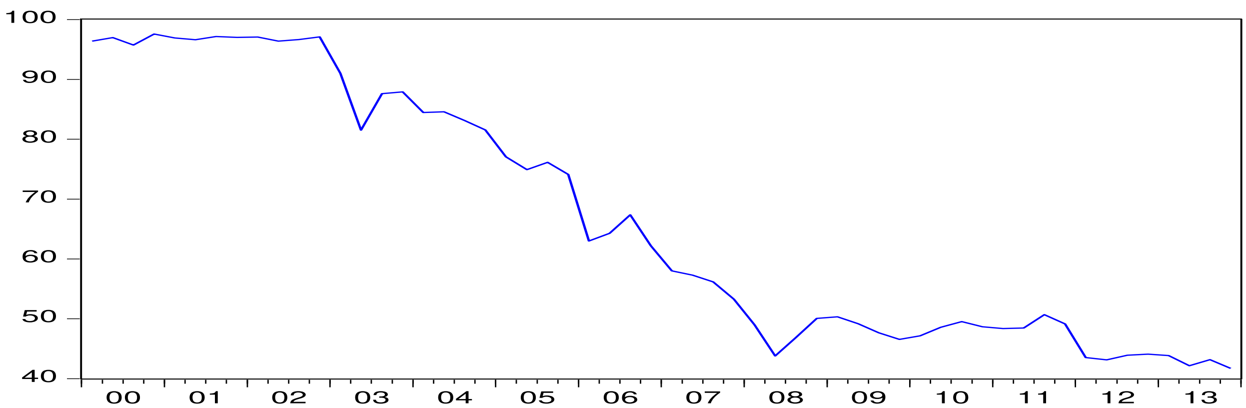


Figure 1: Kenya's Real Exchange Rates Trend

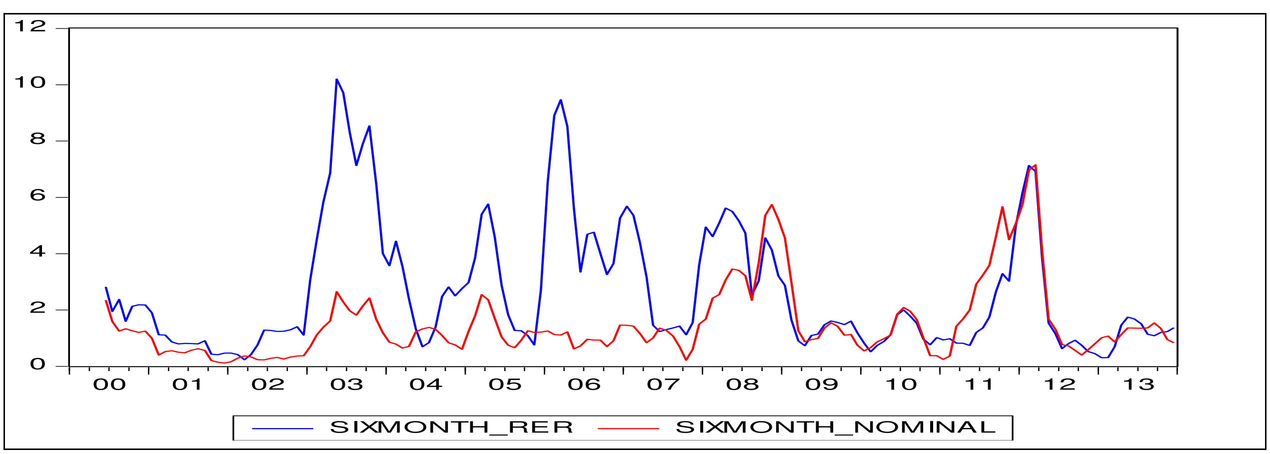


Figure 2: Standard Deviation of Real (SixMonth_RER) and Nominal (SixMonth_Nominal) Exchange Rates over Previous 6 Month Period

There are varied views regarding exchange rate fluctuations. There is the view that the exchange rate is a source of shocks hence necessitating interventions in the foreign exchange market to reduce the impact of exchange rate shocks on economic activity. This view focuses on foreign exchange market dynamics including problems which propagate shocks such as herd behavior in the market and exchange rate overshooting behavior. These speculative tendencies could cause sharp movements in exchange rates and if not dealt with could actually do great harm. Policy intervention is considered imperative in this situation. Another popular view is that the exchange rate is a shock absorber and that its movements are an indication that the economy is being hit by shocks whether nominal or real in nature. This view regards the exchange rate as playing an important role in helping restore equilibrium after a shock has hit the economy.

As argued in An and Kim (2010), measuring the relative importance of various sources of exchange rate movements is an important issue for exchange rate modeling; that is, being able to make a choice between disequilibrium models of exchange rate determination by Dornbusch (1976) which focus on importance of nominal disturbances in explaining exchange rates and equilibrium models of Stockman (1987) which focus on permanent real shocks. Moreover, the relative importance of shocks would determine whether the exchange rate can be considered a stabilizing tool, i.e. whether it can absorb shocks; or a destabilizing tool whether it can cause shocks instead.

For countries considering joining a monetary union its is important to know what kind of shocks have major influence on the exchange rate movements as this knowledge helps to design appropriate policy interventions. If the shocks are supply-related then not much could be done. However, if shocks emanate from monetary policies then a solution is possible and policy intervention could become successful. It is being able to identify the kind of shocks hitting the economy that a country can design an appropriate policy response.

Shocks could be global or country-specific. Global shocks could affect countries in a relatively similar manner. These are the symmetric shocks which move macroeconomic variables in a similar direction. The exchange rates in this case may remain relatively stable despite the symmetric shocks hence not requiring any intervention. Things are rather different in the case of asymmetric shocks which acquire a country-specific dimension so that macroeconomic variables tend to move in opposite direction compared to happenings in other countries. This tends to produce rather sharp movements in the exchange rate which will require policy intervention. Hence, asymmetric shocks are of major concern to policy makers.

The theoretical basis of the response of exchange rates is mostly found in the Mundell-Fleming-Dornbusch model and also in Obstfeld (1985). As shocks hit the economy, the exchange rate moves to restore equilibrium. The response of the exchange rate to supply shocks is to depreciate since domestic prices tend to fall following a positive supply shock. A demand shock such as fiscal policy expansion would raise interest rates and cause an appreciation of the exchange rate. On the other hand, a nominal shock such as an expansion in money supply would be expected to reduce interest rates and hence cause a depreciation of the currency. The movements of the exchange rate will therefore be expected to differ depending on the type of shocks hitting the economy.

The question of whether the exchange rate is a shock-absorber or a source of shocks has been studied in various studies. Results in some of these studies have been consistent but some inconsistencies are also present. Most of the studies have focused on the advanced economies most often studied vis-à-vis the United States of America. Studies have often led to contradictory results such as those on the Japanese and UK economies. While a number of studies attribute real shocks to exchange rate fluctuations in Japan (Enders and Lee, 1997; An and Kim, 2010; Lastrapes, 1992) others emphasize the role of nominal shocks (Fisher and Huh, 2002; Farrant and Peersman, 2006). The same applies to studies covering the UK economy; real shocks are found more important in influencing exchange rates in some studies (Astley and Garatt, 1998) while nominal shocks are found predominant in others (Farrant and Peersman, 2006; Rogers, 1999; Fisher and Huh, 2002).

Overall, the empirical evidence has emphasized the role of real shocks as opposed to nominal shocks as major contributors to real exchange rate fluctuations (An and Kim, 2010; Enders and Lee, 1997; Yilmaz, 2010; Bjørnland, 2004; Thomas, 1997; Lastrapes, 1992; Astley and Garatt, 1998; Huang and Guo, 2007; Makin and Rohde, 2012). In a few cases however, nominal shocks turn out to be more important (Farrant and Peersman, 2006; Kutan and Dibooglu, 1998; Rogers, 1999; Fisher and Huh, 2002).

The question of whether the real shocks have been symmetric or asymmetric relative to the neighbor has also been examined in the literature. Artis and Ehrmann (2006) find symmetric shocks facing Canada, Sweden and Denmark relative to the US. They however find asymmetric shocks facing UK. Goo and Siregar (2009) carry out a similar exercise for Indonesia and Thailand relative to the US and Japan, and find that the shocks are generally asymmetric.

Most of the studies have focused on major advanced economies: US, Japan, Canada, Germany, UK, Euro area, Norway, Sweden, Denmark, France, and Italy. Others covered are Turkey, Hungary, Poland, China, and Australia. Studies on developing countries, particularly African countries are scanty to say the least. It is therefore necessary to examine the Kenyan case to see if similar results will be obtained. Hence, this study examines movements in real exchange rates in Kenya in the period 2001q1 to 2013q4 so as to identify the shocks responsible for these movements. The findings of this study will serve to improve the policy intervention process and answer various questions relating to the exchange rate: what is the relative importance of real versus nominal shocks in determining exchange rate movements? Is the exchange rate a shock-absorber or a source of shocks? Are shocks buffeting the exchange rate symmetric or asymmetric relative to the large US economy?

2. Methodology

This study adopts the widely applied vector autoregression technique following the work of Artis and Ehrmann(2006) whose model has been applied by Yilmaz (2012) in a study of Turkey as well as Siwei and Siregar (2009) in a study of Indonesia and Thailand. The model adopted in this study however differs as it focuses on the real exchange rate shocks rather than nominal exchange rate shocks. The VAR model consists of five variables as follows,

$$Z_t = [\Delta y_t, \Delta s_t, \Delta p_t, r_t^*, r_t]$$

Where Z_t is the vector of stationary variables; Δy_t, Δs_t, and Δp_t represent output growth, real exchange rate depreciation and inflation respectively while r_t^* and r_t are the foreign and domestic short-term nominal interest rates respectively; the 91-day Treasury bill rates. The structural VAR model can thus be stated as follows,

$$A_0 Z_t = A(L) Z_{t-1} + \varepsilon_t \tag{1}$$

This formulation implies that the economy is subject to various structural shocks given by ε_t.

$$\varepsilon_t = [\varepsilon_t^s, \varepsilon_t^d, \varepsilon_t^\pi, \varepsilon_t^{m*}, \varepsilon_t^m]$$

Where ε_t^s denotes supply shock, ε_t^d is demand shock, ε_t^π inflation shock while ε_t^{m*} and ε_t^m stand for foreign and domestic monetary shocks respectively. The latter three are nominal shocks.

From model (1), it is possible to derive the estimable reduced-form VAR,

$$Z_t = A_0^{-1} A(L) Z_{t-i} + A_0^{-1} \varepsilon_t \tag{2}$$

The VAR model in (2) can be rewritten as follows,

$$[I - A_0^{-1} A(L)] Z_t = A_0^{-1} \varepsilon_t \tag{3}$$

If we let $C(L) = [I - A_0^{-1} A(L)]^{-1}$, then,

$$Z_t = C(L) A_0^{-1} \varepsilon_t \tag{4}$$

Again, letting $A_0^{-1} = B$ yields,

$$Z_t = C(L) B \varepsilon_t \tag{5}$$

This is the restricted form of the moving average representation containing the original disturbances.

From (2) and (5) it is clear that the reduced form residuals can be related with the structural shocks as follows,

$$B\varepsilon_t = e_t$$

B thus captures the contemporaneous reaction of the variables to the structural innovations.

VAR model (5) can be rewritten as:

$$Z_t = D(L) \varepsilon_t \tag{6}$$

Where $D(L) = C(L)B$

In extended form, VAR model (6) can be written as,

$$\begin{bmatrix} \Delta y \\ \Delta s \\ \Delta p \\ r* \\ r \end{bmatrix} = \begin{bmatrix} D_{11}(L)\ D_{12}(L)\ D_{13}(L)\ D_{14}(L)\ D_{15}(L) \\ D_{21}(L)\ D_{22}(L)\ D_{23}(L)\ D_{24}(L)\ D_{25}(L) \\ D_{31}(L)\ D_{32}(L)\ D_{33}(L)\ D_{34}(L)\ D_{35}(L) \\ D_{41}(L)\ D_{42}(L)\ D_{43}(L)\ D_{44}(L)\ D_{45}(L) \\ D_{51}(L)\ D_{52}(L)\ D_{53}(L)\ D_{54}(L)\ D_{55}(L) \end{bmatrix} \begin{bmatrix} \varepsilon^{s} \\ \varepsilon^{d} \\ \varepsilon^{\pi} \\ \varepsilon^{m*} \\ \varepsilon^{m} \end{bmatrix} \quad (7)$$

From VAR model (6), the impulse responses can be derived as follows,

$$\frac{\delta Z_{t+h}}{\delta \varepsilon_t^{'}} = D_h \quad (8)$$

VAR model (6) can be estimated if the structural shocks can be identified. To recover the structural model, n^2 identification assumptions are required, with n representing the number of variables in the VAR system. To estimate the described model in this paper, 25 identification assumptions are needed. Out of these, 15 [(n(n+1)/2] identifying assumptions can be obtained from the standard orthogonality (assumption that structural shocks have unit variance) and normalization (assuming zero correlation among structural shocks) restrictions. These two restrictions imply that the variance-covariance matrix for the 5-variable VAR is a 5x5 identity matrix, hence $\Omega = E(\varepsilon_t, \varepsilon_t^{'}) = I$. The remaining 10 identifying assumptions will need to be imposed. The following long-run identifying assumptions are made:

(1) Following Blanchard and Quah (1989) supply shock is assumed to be the only shock in the system which has a permanent effect on output. Thus $D_{12} = D_{13} = D_{14} = D_{15} = 0$.

(2) Nominal shocks have no long-run effect on the real exchange rate, hence $D_{23} = D_{24} = D_{25}$=0, i.e. only supply and demand shocks influence the real exchange rate.

(3) Only supply and demand shocks are allowed to influence the price level contemporaneously. Nominal shocks are only expected to have lagged effects on price level. Hence, $D_{34} = D_{35} = 0$.

(4) Domestic monetary shocks are assumed not to influence foreign monetary policy. Put differently, the central bank of the large foreign country does not consider shocks in the small open economy when formulating its monetary policy. However, to test for the presence of symmetric responses to shocks, all other shocks are allowed to influence foreign interest rates. Therefore, $D_{45} = 0$

(5) All shocks, i.e. Supply, demand and nominal shocks are allowed to influence domestic nominal interest rate.

With these long-run restrictions the long-run matrix D(L) becomes lower triangular and therefore is the unique lower triangular Choleski factor described by VAR model (9) below.

$$\begin{bmatrix} \Delta y \\ \Delta s \\ \Delta p \\ r^* \\ r \end{bmatrix} = \begin{bmatrix} D_{11}(1) & 0 & 0 & 0 & 0 \\ D_{21}(1) & D_{22}(1) & 0 & 0 & 0 \\ D_{31}(1) & D_{32}(1) & D_{33}(1) & 0 & 0 \\ D_{41}(1) & D_{42}(1) & D_{43}(1) & D_{44}(1) & 0 \\ D_{51}(1) & D_{52}(1) & D_{53}(1) & D_{54}(1) & D_{55}(1) \end{bmatrix} \begin{bmatrix} \varepsilon^{s} \\ \varepsilon^{d} \\ \varepsilon^{\pi} \\ \varepsilon^{m*} \\ \varepsilon^{m} \end{bmatrix} \qquad (9)$$

The VAR system (9) will be estimated to determine the contribution of each of the shocks. The generalized impulse responses are then derived by applying a variable specific Choleski factor as described by Pesaran and Shin (1998). This way, the impulse responses are not dependent on the ordering of the variables in the VAR system.

3. Empirical Results

3.1 Descriptive statistics

Data used in this study is obtained from Kenya National Bureau of Statistics (KNBS) and the International Financial Statistics (IFS) databases. Real output (deseasonalized) is obtained from KNBS. The consumer price indices, exchange rates and interest rates (3-month Treasury bill rates) for Kenya and the United states (large neighbor country in this study) are obtained from the IFS. The real exchange rate is obtained by multiplying the nominal exchange rate by the ratio of foreign to domestic price levels ($s = e * \frac{p^f}{p}$). This implies that an increase in the index indicates a depreciation of the currency.

Prior to estimation, unit root tests were undertaken to confirm if the variables are stationary (Table 1). The unit root tests showed that output, exchange rates and price (CPI) series are integrated of order 1 and hence have unit roots. The logarithms of the variables were computed and the series differenced once to make them stationary. The interest rates series were found to be stationary at levels and therefore were not differenced.

Table 1: Augmented Dickey-Fuller unit-root tests

Series	ADF (lags)	ADF t-value	Series	ADF (lags)	ADF t-value
y	ADF (1)	0.25	Δy	ADF (0)	-9.36*
s	ADF (2)	-0.36	Δs	ADF (1)	-7.54*
p	ADF (0)	-0.12	Δp	ADF (1)	-6.46*
r*	ADF (3)	-3.55*			
r	ADF (1)	-3.24**			

**Significant at 1% level of significance, ** Significant at 5% level*

3.2 Impulse Responses

From analysis of VAR system (9), the impulse response functions indicate significant positive response of real income to supply shocks in line with theoretical expectations (figure 3). It is also shown that inflation shocks exert significant negative impact on income. On the other hand, demand shocks have minor positive effects on income while contractionary monetary policy has insignificant negative effects on income.

The real exchange rate is impacted significantly by demand shocks. Demand shocks cause significant depreciation of the currency. Such an effect of demand shocks emanating from for instance fiscal policy has been attributed to monetary accommodation of fiscal shocks by Muscatelli et al (2007). In such circumstances, an expansion in money supply results in capital outflows which lead to a depreciation of the currency. The expenditure switching effects are expected to increase consumption of domestic output and hence cause an increase in income.

This way, demand shocks have similar effects as positive supply shocks, causing decline in interest rates and a significant depreciation of the currency. Fielding (2014) attributes the depreciation puzzle (following a demand shock) common in the literature to an absence of complete international financial market integration in most of the world.

The results show that the real exchange rate appreciates significantly following an inflation shock as expected. This translates into a significant negative effect of inflation shock on real income. Similarly, contractionary monetary policy (increase in interest rates) also causes an appreciation of the currency and an accompanying fall in real income.

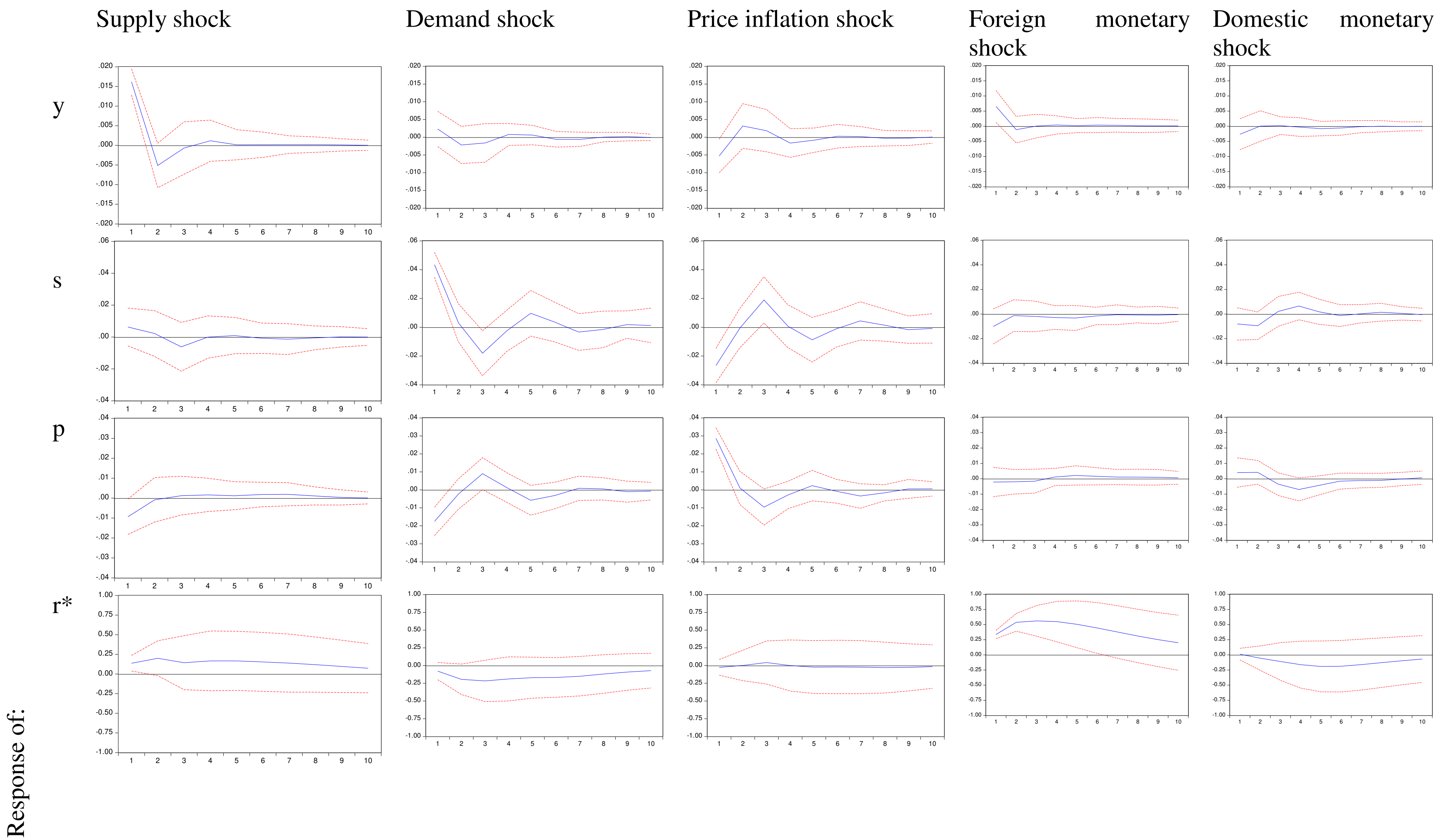
An examination of the reactions of foreign and domestic interest rates to supply and demand shocks shows that shocks hitting the Kenyan economy are asymmetric to shocks hitting the US economy. Therefore, Kenya is buffeted by shocks that are more country specific (idiosyncratic shocks). Similar results have been found by Yilmaz (2012) in a study of Turkey and also Goo and Siregar (2009) in a study of Indonesia and Thailand. The two studies concluded that demand and supply shocks are predominantly asymmetrical relative to US. The results obtained in this study imply that the exchange rate could actually play a stabilizing role in Kenya. This is true if indeed the exchange rate absorbs real shocks and is less affected by controllable nominal shocks. The impulse responses show that demand shocks play an important role in influencing the exchange rate. Hence the real exchange rate is affected predominantly by real shocks.

3.3 Decomposition of the forecast error variance

From VAR system (9), the variance decomposition of the forecast error variance shows that supply shocks account for 96 per cent of output fluctuations in the long run (table 2). Demand and nominal shocks have negligible effect on output. This result is in line with the findings of An and Kim (2010) who found that demand shock has little output effect.

Nominal shocks account for most of the fluctuations in price level, accounting for 54 per cent of the movements in the long run. Real shocks account for a sizable proportion of the fluctuations in prices with supply shocks accounting for 9 per cent while demand shocks account for 36 per cent.

The real exchange rate movements are attributable mainly to demand shocks. Demand shocks account for 86 per cent of the fluctuations in the real exchange rate in the long run demand. Nominal shocks account for only 11 per cent of the movements in the real exchange rate. Real shocks therefore account for most of movements in the real exchange rate in the long run, thus emphasizing the role of the exchange rate as a shock absorber in Kenya. The dominant role played by demand shocks in driving movements in the real exchange rate is reported in studies covering other countries as well such as An and Kim (2010) for Japan, Enders and Lee (1997) for Canada, Japan and Germany, Thomas(1997) for Sweden and Astley and Garatt (1998) for the UK.



Supply shock
Demand shock
Price inflation shock
Foreign monetary shock
Domestic monetary shock
y
s
p
r*
Response of:

r

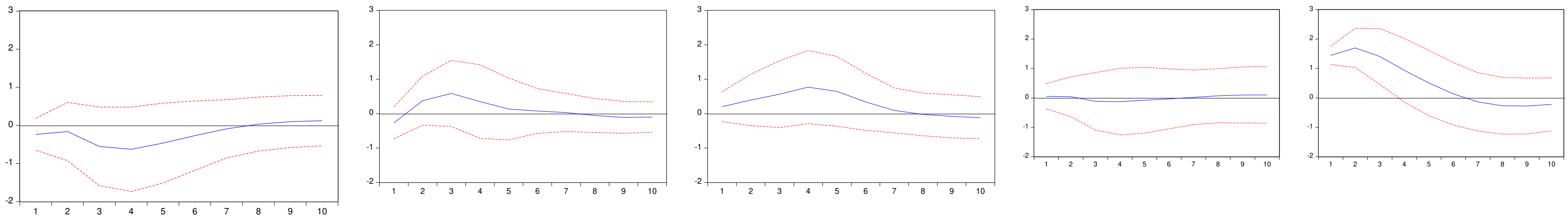


Figure 3: Impulse Responses

Table 2: Forecast Error Variance Decomposition

Horizon (quarters)	ε^{s}	ε^{d}	ε^{π}	ε^{m*}	ε^{m}
Forecast error variance of Δy					
1	100	0	0	0	0
2	98.4	0.7	0.3	0.2	0.4
3	97.3	1.5	0.6	0.2	0.4
4	96.7	1.6	1.1	0.2	0.4
5	96.3	1.7	1.2	0.2	0.6
6	96	1.9	1.2	0.2	0.7
7	95.9	2	1.2	0.2	0.7
8	95.8	2	1.2	0.2	0.7
9	95.8	2	1.2	0.2	0.7
10	95.8	2	1.2	0.2	0.7
Forecast error variance of Δs					
1	2.1	97.9	0.0	0.0	0.0
2	2.2	93.5	0.3	0.1	4.0
3	3.4	88.8	3.9	0.6	3.3
4	3.3	86.6	3.8	1.4	4.9
5	3.1	86.0	4.2	1.4	5.2
6	3.1	86.0	4.2	1.4	5.2
7	3.2	85.7	4.5	1.4	5.2
8	3.2	85.6	4.5	1.4	5.2
9	3.2	85.6	4.5	1.5	5.3
10	3.2	85.6	4.5	1.5	5.3
Forecast error variance of Δp					
1	10.7	32.6	56.7	0.0	0.0
2	10.4	32.0	54.8	0.9	1.9
3	9.3	36.5	51.4	0.8	2.0
4	9.1	34.6	49.1	0.8	6.4
5	8.6	35.9	46.2	0.8	8.5
6	8.7	36.1	45.8	0.8	8.6
7	8.9	35.6	46.1	0.8	8.6
8	9.0	35.5	46.1	0.8	8.6
9	9.0	35.5	46.0	0.8	8.6
10	9.0	35.6	46.0	0.8	8.6

Forecast error variance of r

1	2.7	2.7	0.0	0.4	94.3
2	1.3	3.5	9.4	2.7	83.1
3	3.7	6.5	15.7	4.3	69.7
4	5.9	6.6	21.3	5.2	61.0
5	6.9	6.3	24.0	5.5	57.2
6	7.3	6.3	24.8	5.7	56.0
7	7.3	6.3	24.7	5.7	56.0
8	7.2	6.3	24.6	5.7	56.2
9	7.2	6.3	24.6	5.7	56.2
10	7.3	6.3	24.6	5.6	56.1

4. Conclusion

This study sought to examine real and nominal shocks to determine whether the real exchange rates in Kenya respond more to real or nominal shocks. The study adopts a VAR framework analysis. The results from the VAR analysis indicate that real shocks have major influence on the real exchange rate and that nominal shocks have negligible effects. The results also indicate that shocks hitting the economy are asymmetric relative to shocks on the US economy. The Kenyan economy therefore experiences idiosyncratic shocks that are more country specific.

The results derived in the analysis imply that indeed the real exchange rate responds predominantly to demand shocks while on the other hand demand shocks do not have major impact on real income, demonstrating the important role of the real exchange rate in absorbing these shocks so that the shocks do not impinge economic activity. Instead, real income significantly responds to supply shocks. Thus, the real exchange rate plays an important role as a shock absorber in the Kenyan context.

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