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An Empirical Investigation of Exchange Rate Determination in Kenya: Does Current Account Imbalance Play a Role?*

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Abstract

The paper investigates exchange rate determination in Kenya using vector error correction model approach to uncover the long run relationships. The empirical results show that current account balance has a role to play in the determination of the exchange rate. A rise, which denotes an improvement in the current account balance, is associated with an appreciation of the exchange rate. Additionally, higher domestic interest rates relative to foreign interest rates, as well as a rise in foreign price have an appreciating effect on the exchange rate while domestic price increase is associated with depreciation of the domestic currency. The results further show that although there are feedback effects between the exchange rate and the domestic price level, the feedback effect from exchange rate to the

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* The views expressed in this paper are those of the authors and do not necessarily represent those of the Institution they are affiliated to.

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domestic price is not significant once the effect of current account balance is taken into consideration. In terms of policy, strategies aimed at addressing external imbalances as reflected in the current account balance are important in stabilizing the exchange rate in the long run. These should be complemented with pursuit of interest rate path that is consistent with the desired exchange rate outcomes.

JEL classification numbers: E00, E39, F00, F31
Keywords: Exchange rate, VECM, current account, interest rate differential

1 Introduction

Exchange rate play an important role as an indicator of macroeconomic stability and a conduit through which the pass-through effects of external shocks are transmitted to the domestic economy in small open economies like Kenya. Exchange rate movements can have a direct impact on the rate of domestic inflation depending on the degree of the pass- through effect and flexibility of domestic prices. Real exchange rate affects exports and imports of goods and services, which form key components of aggregate demand. Given the vulnerability of African economies to external shocks, exchange rate movements are of immense interest to the policy makers and the business community. In Kenya for instance, the importance attached to the exchange rate was underscored by the public uproar that greeted the unprecedented depreciation of the domestic currency in October 2011, when the Kenya shilling hit all-time low of 107 shillings against the US dollar within a short period. In the same year, the country was faced with worsening of the current account deficit, which more than doubled from -124.14 billion Kenya shillings in 2009 to -296.024 billion in 2011(KNBS 2012). While it has been conjectured that this may have contributed to the fall in value of the domestic currency, there is need for rigorous empirical analysis to establish the impact of the imbalance in the current account on the exchange rate.

Notwithstanding the well-known challenges of determining exchange rate movements, this paper empirically investigates the exchange rate determination in Kenya using a vector error-correction model (VECM) framework, based on quarterly data for the period 1996 to 2011. Additionally, the paper makes a contribution to the empirical literature and the policy discourse by examining the role of external imbalance as measured by current account balance in the determination of the exchange rate, besides the standard variables such as the interest differential and the Purchasing Power Parity (PPP) condition. This is backed by the fact that besides capital inflows, foreign trade is a key source of foreign exchange inflows in Kenya. Whereas the impact of the capital flows on the exchange rate is likely to work via the interest rate differentials between the domestic versus foreign interest rates, the effect of the latter is captured via the impact of the imbalance in current account.

The rest of the paper is organised as follows. Section 2 describes the theoretical framework leading to the specification of empirical model while a synopsis of the empirical literature is given in Section 3. Section 4 outlines the empirical methodology. Empirical results are presented and discussed in Section 5, followed conclusion and policy insights in Section 6.

2 Theoretical Framework and Model Specification

There are a number of models on exchange rate determination. The PPP condition is perhaps one of the most prominent and a key building block under the workhorse monetary models of exchange rate determination. PPP posits that goods market arbitrage will over time move the exchange rate so that prices in two countries are equalized. In essence, the fundamental value of the nominal exchange rate is based on relative consumer price indices. The PPP has been used both as a model of exchange rate in its own right and as a component in monetarist models of exchange rate determination.

Depending on the hypothesis on price flexibility, monetarist models typically fall in the categories of flexible price model or sticky price monetary model (SPMM). The flexible price model assumes that PPP holds and prices are flexible and consistent with the equilibrium between the money demand and money supply (Isard 1995, Marrinan 1989).[4] On the other hand, SPMM model allows for a slow adjustment in domestic price and deviations from purchasing parity. The Dornbusch (1976) overshooting model as it is commonly referred to, allows for PPP to hold in the long run but not in the short run. Frankel (1979) formulation of Dornbusch (1976) monetary model of exchange rates with sticky prices, i.e. the SPMM of exchange rates has become a workhorse model in modelling exchange rate behaviour. It assumes that nominal output prices are sticky, that is they adjust slowly over time, while the asset markets clear continuously in response to new information or changes in expectations. For a small open economy, foreign interest rates are assumed to be constant. Hence the model adopts the principle of the uncovered interest parity (UIP), but purchasing power parity (PPP) need not hold,

$$s_t = \delta(m - m^*) - \phi(y - y^*) + \alpha(r - r^*) + \beta(\pi - \pi^*) + u \tag{1}$$

where *s* is the exchange rate expressed in units of home currency per foreign currency, *m and m** are the domestic and foreign money supply, y and y* are real

[4] The Frenkel-Bilson model assumes PPP and restricts the coefficients on inflation expectations to zero.

income of domestic and foreign countries, respectively. r and r^* and π and π^* are domestic and foreign rates of interest and inflation, respectively. α is hypothesized negative and β is hypothesized positive. The money stock and income coefficients are hypothesized to be positive and negative, respectively. The negative interest coefficient (α) holds as long as the prices are sticky, otherwise if prices are perfectly flexible, either interest rates or inflation rates should enter positively.

The money demand specification, which is one of the building blocks is given as

$$m_t - p_t = -\lambda i_{t+1} + \phi y_t \qquad (2)$$

where m is money supply, p is the domestic price level and y is domestic output. An increase in interest rates raises the opportunity cost of holding money and lowers the demand for money. Conversely an increase in output increases the demand for money. Assuming that a similar equation for money holds abroad, the difference between the two equations yields,

$$m_t - m_t^* = p_t - p_t^* - \lambda(\pi_t - \pi_t^*) + \phi(y_t - y_t^*) \qquad (3)$$

This specification is general, encompassing the flexible price version of monetary model. Assuming that PPP holds, the fundamental equation of the exchange rate for the flexible-price monetary model can be expressed as follows;

$$s_t = \delta(m_t - m_t^*) + \lambda(i_t - i_t^*) - \phi(y_t - y_t^*) \qquad (4)$$

Nominal exchange rate is expressed in terms of current relative money supplies and factors affecting money demands. Since PPP holds, an increase in money supply causes an increase in prices as domestic agents spend more on goods and services. Moreover, increases in income, by raising the demand for money, leads to an exchange rate (appreciation). On the other hand, a rise in the domestic interest rate leads to exchange rate depreciation. This contrast with the sticky price monetary model arise because of the fact that in the flexible price model, the effects of income and interest rates only affect the exchange rate via their impact on the demand for money (MacDonald, 1988). Additionally, unlike in the sticky-price Dornbusch model, money supply increases do not lead to an exchange rate over– or under-shooting. However, for the PPP assumption to hold it requires very strong preconditions and hence in practice, significant violations of the PPP hypothesis are observed.

Applied studies tend to adopt the SPMM approach by using the UIP specification. However, formulation for the exchange rate equation need not include money or domestic output based on the argument that these correlations are embodied in the price level adjustment mechanism (see Obstfeld and Rogoff, 1996, Ndung'u and Ngugi 1999). This leads to the specification of the form:

$$s_t = \beta_0 + \beta_1(i_t - i_t^*) + \beta_2(p_t - p_t^*) + e_t \qquad (5)$$

β_1 is < 0 which implies an appreciation under the assumption that prices are sticky[5] and $\beta_2 > 0$.

While most of the empirical work has focused on the above formulations, there is another strand of literature which takes into account portfolio considerations and regards the exchange rate as the relative price of nominal assets. Allowing for imperfect capital substitutability, the fundamental value of the exchange rate can be explained within a portfolio balance framework (Hooper and Morton 1982). The portfolio balance approach focuses on the link between balance of payments and adjustments in asset stocks. Since their emergence in the late 1960s, these models have undergone several changes. Based on the early drafts of Messe and Rogoff (1983a, 1983b), a specification incorporating cumulative trade/current account balances became widely adapted. However, Messe and Rogoff (1983a and 1993b) interpreted the cumulative trade balance or current account terms as variables that allowed for changes in the long run real exchange rate, rather than variables that allowed for existence of a risk premium. This interpretation is supported by the view that cumulative current account imbalances redistribute wealth internationally, with effects on a country's levels of expenditures, incomes, and current account imbalances, and accordingly, with implications for the level of the exchange rate that is consistent with the long-run current account balance (Isard, 1995).

Within this line of thought, a current account surplus is deemed to be a transfer of wealth to domestic residents from foreign residents. Moreover, if domestic bonds and foreign bonds are imperfect substitutes, an increase in wealth leads to an increase in demand for domestic bonds causing the exchange rate to appreciate. However, different specifications use different measures of external balance. To capture the role of external balance, cumulative current account balance (CAB) is incorporated, leading to the following specification:

$$s_t = \beta_0 + \beta_1(i_t - i_t^*) + \beta_2(p_t - p_t^*) + \beta_3 CAB_t \tag{6}$$

$\beta_3 < 0$ (a rise in current account implies higher exchange rate inflows leading to an appreciation of the shilling). The expected signs for the other coefficients are as indicated before. Domestic and foreign prices are included in the estimable equation independently, thus providing room to empirically test the PPP assumption.

3 A Synopsis of the Empirical Literature

Empirical testing of the PPP hypothesis is extensive, spanning decades. The evidence in support of PPP is, however weak. There is a strand of literature that

[5] This is a more realistic assumption in the case of Kenya and other developing countries.

has concentrated on explaining deviations from PPP (Balassa 1964 and Samuelson 1964, Josip and Izo 2006, Marston 1990). For instance, Balassa and Samuelson (1964) show that deviations from PPP take time to revert in the presence of sectoral productivity shocks. Edison and Klovland (1987) using data on the real exchange rate between Norway and Britain find evidence of a productivity differential effect. On the other hand, some authors have pinned down the failure of PPP to a lack of innovations in econometrics and argued that the marginal rejections are achieved with cross sectional data and several bilateral exchange rates (Abuaf and Jorian, 1990). However, more recent advances in econometric techniques allow one to test for weaker versions of the PPP and a number of studies have applied the cointegration techniques to test for PPP (Mark, 1990). Notwithstanding the challenges of data and advancements in empirical technique, the validity of the PPP hypothesis is still an issue of ongoing controversy.

The flexible price and sticky price models of exchange rate determination have been tested widely but empirical support is mixed. On the basis of a monetary model, Marks (1995) provides evidence that long run changes in the exchange rate have a predictive component while in the short horizon they are dominated by noise which averages out over time. Using panel analysis on US data, Rapach and Wohar (2002) also find support for the monetary model but the assumption of homogeneity is not supported. However, Rapach and Wohar (2002) observe that the failure to find homogeneity may not be a good basis for dismissing the panel data results, a conclusion also reached by Pesaran, Shin and Smith (1999). In the case of developing countries (Argentina, Chile and Israel), McNown and Wallace (1989) find significant role for monetary fundamentals on the exchange rate. Cointegration is strongly supported for all three countries. Further, the long run relations are robust although the parameter magnitudes and signs are sensitive to model specification. Civcir (2003) found evidence in favour of the monetary model for Turkey. The model augmented with relative prices finds strong support that monetary fundamentals affect the exchange rate in the long run. In the case of portfolio balance model, earlier studies found weak empirical support (Meese and Rogoff, 1982, Alexander and Thomas 1987). Karfakis and Kim (1995) investigated the effects of Australian current account news on the exchange rates and interest rates and observed that market participants used the portfolio balance model of exchange rate determination in responding to the news.

With respect to studies based on Kenya, Ndung'u (2000) and Ndung'u and Ngugi (1999) use a modified UIP and argue that the observed rate of domestic interest rate partly reflects the monetary policy action. However, the effect of trade or current account balance is not considered. For a small open economy like Kenya, a substantial amount of foreign exchange is from foreign trade, in addition to short term capital flows which are largely dependent on the differentials between the domestic interest rate and foreign interest. Whereas Were et al (2001) attempted to capture the impact of current account balance on the exchange rate, the current study uses a more robust methodology and recent data.

4 Empirical Methodology

The empirical evidence is derived using Johansen's vector error correction model (VECM). An error-correction modeling framework is best suited to the analysis of exchange rate determination given the exchange rate exhibits both short-run and long-run behavioral characteristics. Although the Engle and Granger's two-step error correction model has been used in a multivariate context, the VECM yields more efficient estimators of cointegrating vectors since it is based on the Johansen's full information maximum likelihood estimation. Moreover, the exogeneity of the right-hand side (RHS) variables under the Granger representation procedure are implicitly assumed.

The VECM is specified as:

$$\Delta Y_t = \sum_{j=1}^{k-1} \Gamma_j \Delta Y_{t-j} + \alpha\beta^{'} Y_{t-k} + \mu + \varepsilon_t \qquad (7)$$

where the first component on the RHS of equation 7 is the vector autoregressive (VAR) component in first differences and the second portion is the error-correction components in levels. Y_t is a vector of variables. Γ matrix captures the short-term adjustments among the variables at the j^{th} lag. β' is the matrix of cointegrating vectors while α is the speed of adjustment parameters. The elements of the α matrix also relate to the issue of weak exogeneity. k is the lag structure. μ is a vector of constants and ε_t is a vector of white noise error terms.

The variables are defined as follows: exchange rate (EXR) is defined in terms of domestic currency, that is, Kenya shillings per US dollar, domestic price (P) is the consumer price index for Kenya; foreign price is the consumer price index for UK (P^+)[6], interest rate differential (RID) is the difference between domestic interest rate (3 months Treasury bill rate) and foreign interest rate (3 months LIBOR). Current account balance is the cumulated balance in each quarter.[7] The variables are in natural logs except RID. Quarterly data for the period 1996 to 2011 was used for the analysis.

[6] Although a trade weighted price index was also considered the UK CPI was found to be highly correlated with the trade weighted price index and yielded better results.

[7] Since CAB data contain negative numbers, the natural logs were obtained by adding a constant number to all the time series observations.

5 Estimation Results and Discussion

All the variables were tested for unit roots to establish their order of integration before testing for cointegration. Based on the Augmented Dickey Fuller (ADF) and Phillips-Person (PP) unit root tests, all the variables were found to be integrated of order one (see Table 1).

Table 1: Unit Root tests

	EXR	**CAB**	**P**	P^+	**RID**
ADF	-2.07	4.01	0.83	0.89	-2.02
PP	-2.32	2.06	1.41	0.92	-2.07

Critical values: 1%(-3.54); 5%(-2.91); 10%(-2.59)

The Johansen cointegration test was conducted on the basis of trace test. For robustness, cointegrating long run relationships were first examined based on equation using exchange rate, interest rate differential, domestic price and foreign price and separately based on equation 6 with all the variables including current account balance. In the first case, the unrestricted VAR is specified using a lag length of 2, selected on the basis of Akaike and Hannan-Quinn information criteria. The estimated VAR satisfies stability and normality conditions. The test statistic for the Jarque-Bera normality test is 10.34 with a probability value of 0.242. Absence of serial correlation was confirmed using the LM test for serial correlation. The cointegration test results based on trace test indicated at least one cointegrating vector (Table 2).

Table 2: Johansen Cointegration Test

Eigenvalue	No. of CE(s)	λ trace	Critical Value (5%)	Prob.**
0.36767	$r = 0$	58.1751	54.0790**	0.021
0.29720	$r \leq 1$	32.9662	35.1927	0.086
0.15907	$r \leq 2$	13.5685	20.2618	0.320
0.07082	$r \leq 3$	4.03987	9.1645	0.406

The cointegrating vector and the speed of adjustment coefficients are given in equation 8 below. The vector was normalized with respect to the exchange rate variable.

$$EXR = -5.82RID \quad +6.42P \quad - \quad 15.46\,P^{+} + \quad 46.4 \tag{8}$$

$$\quad (3.54)^{***} \quad (4.91)^{***} \quad (-5..13)^{***} \quad (5.70)^{***}$$

(t-values in parentheses)

The long run coefficients in the cointegration equation for the exchange rate are all significant and have the expected signs in line with theory. Under the sticky price monetary model, we expect an appreciation of the exchange rate following a rise in domestic interest rates relative to foreign interest rates (interest rate differential). On the other hand, a rise in domestic price has a depreciating effect on the exchange rate while a rise in foreign price is associated with an appreciation of the local currency. The PPP assumption was tested using Likelihood Ratio (LR) test on linear restrictions and rejected at 5% significance level.

The existence of long run cointegrating relationship was also examined by including the current account balance in addition to the variables considered above. The VAR was specified with one lag selected on the basis of Swartz information criterion which indicated statistical significance at one lag. The Johansen cointegration test indicated one cointegrating vector as before. The identified cointegrating vector and speed of adjustment are analyzed below:

$$\underset{}{EXR} = \underset{(7.26)^{***}}{-5.74RID} + \underset{(3.40)^{***}}{2.30P} - \underset{(-2.42)^{***}}{4.70P^{+}} - \underset{(-3.33)^{***}}{0.59CAB} + 22.59 \qquad (9)$$

(t-values in parentheses)

The long run coefficients are consistent in terms of theoretical expectations and statistical significance as before. However, the impact of both domestic and foreign prices is reduced by the inclusion of the effect of the current account balance. On the other hand, the impact of interest rate differential is robust to the inclusion of current account variable as it remains more or else the same. A rise, which denotes an improvement in the current account balance is associated with an appreciation of the exchange rate. The LR test for linear restrictions to test whether the coefficient on CAB is zero was rejected at 1% percentage significance level, implying the impact of cumulative current account balances is important in explaining determination of the exchange rate in the long run. These results are consistent with the fact foreign trade which is the key component of the current account is a critical source of foreign exchange inflows such that huge imbalances as has recently been witnessed in the current account balance have implications on the exchange rate.

The results of the VECM based on the cointegrating vector in equation 8 are reported in Table 3. The adjustment coefficients (αs) in the VECM are shown in the second row. The LR tests for linear restrictions were used to test for zero restrictions on αs in the respective equations. The speed of adjustment coefficient in the exchange rate equation is significant but small, implying a slow adjustment to the long run equilibrium. On the other hand, the hypothesis that the αs in the interest rate and foreign price equations are equal to zero cannot be rejected, implying that these variables are weakly exogenous (see Engle et al 1983). In other words, when deviations from the long run equilibrium occur, it is primarily the exchange rate that adjusts rather than the foreign price. These results are consistent with what we expect since Kenya being a small country, adjustments in the local currency is unlikely to influence foreign prices. The only other equation in which the adjustment coefficient is significant is the domestic price equation, which implies there are feedback effects between the nominal exchange rate and the domestic price—both nominal exchange rate and domestic price level adjust to restore long term equilibrium. These results are consistent with the fact that deviations from the long run equilibrium exchange rate have implications on domestic prices, and are likely to be passed through to the domestic prices, particularly given the high reliance on imported intermediate and capital goods. Normality in the residuals was achieved by incorporating an impulse dummy for 2008Q3 in the error correction model to capture the impact of the shock in the exchange rate owing to the destabilizing effects of the post-election violence and the on-set of the global financial crisis. The dummy was found to be significant in the exchange rate and foreign price equation.

Table 3: Error Correction Model (Based on Cointegrating Vector in Equation 8)

	ΔEXR	**ΔRID**	**ΔP**	**Δ P^+**
Adj.coefficients	-0.030	-0.003	0.044	-0.001
(αs)	(-2.0)**	(-0.31)	(3.86)***	(-0.23)
ΔEXR(-1)	0.374	0.222	0.017	-0.123
	(2.53)**	(2.32)**	(0.179)	(-2.31)**
ΔEXR(-2)	-0.162	0.057	0.306	0.11
	(-1.14)	(-0.62)	(3.23)***	(2.6)***
ΔRID(-1)	-0.351	0.654	-0.312	-0.056
	(-1.46)	(4.19)***	(-1.95)**	(-0.93)
ΔRID(-2)	0.101	-0.230	-0.091	-0.002
	(0.44)	(-1.55)	(-0.60)	(-0.05)
ΔP(-1)	-0.030	0.115	0.118	0.137
	(0.19)	(0.91)	(0.92)	(2.19)**
ΔP(-2)	0.308	0.107	0.217	0.069
	(1.43)	(0.77)	(1.52)	(1.29)
ΔP^+ (-1)	0.315	0.07	-0.133	0.223
	(0.54)	(0.20)	(-0.34)	(1.53)
ΔP^+ (-2)	0.336	-0.229	0.310	0.302
	(0.58)	(-0.60)	(0.80)	(2.08)**
2008Q3	0.11	0.005	-0.028	-0.024
	(3.00)***	(0.23)	(-1.20)	(-2.53)**

t-statistics in parentheses. *** ** indicates significance at 1% and 5% levels.
The LM test for autocorrelation indicated no serial correlation in the residuals.

The adjustment coefficients in the VECM based on the cointegrating vector in equation (9) are reported in Table 4.[8] The LR test for zero restrictions on the α's in the respective equations indicate that the αs in the exchange rate and interest rate equation are significant whereas the hypothesis that the rest of the αs are zero cannot be rejected. These include the adjustment coefficient for the current account balance, which implies weak exogeneity of this variable in the exchange rate equation. The results imply that the feedback effect between the exchange rate and the domestic price does not hold when the current account effect is taken into account—in other words, the domestic price becomes weakly exogenous in the exchange rate equation when current account effect is taken into consideration. This has important policy implications, i.e. the concerns about the effects of depreciation of the local currency against foreign currency on domestic price level can be partly addressed by addressing the question of persistent external imbalances.

Table 4: The αs in the VECM Based on Cointegrating Vector in Equation 9

	ΔEXR	**ΔRID**	**ΔP**	**Δ P$^+$**	**ΔCAB**
Adjustment coefficients	-0.078 (-2.16)**	-0.082 (-4.80)***	-0.018 (-0.80)	-0.012 (-1.40)	0.253 (1.28)

(t-values in parentheses)

6 Conclusion and Policy Insights

Whereas the literature on exchange rate determination is wide, not much empirical evidence with respect to African countries exist, despite the role the rate of exchange plays in small open market economies like Kenya. The paper uses the VECM methodology to examine exchange rate determination in Kenya, focusing on the long run relationships. The results indicate that higher domestic interest rates relative to foreign interest rates as well as a rise in foreign prices lead to appreciation of the domestic currency while a rise in domestic prices is associated with the depreciation of the domestic currency in long run. Additionally, the external imbalances captured by the current account balance have implications on the exchange rate. Improvements in current account balance are associated with an appreciation of the domestic currency, implying that the fairly persistent deterioration in the current account balance witnessed in the recent past played a role in the depreciation of the domestic currency. The empirical results further

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[8] Only the adjustment parameters are reported here since the main interest is on the long run. Moreover the impact of the short term components is already captured in Table 3.

indicate that although there are feedback effects between the exchange rate and the domestic price level, the feedback effect from exchange rate to domestic prices is not significant once the effect of current account balance is taken into consideration. On the other hand, the weak exogeneity of foreign prices in the exchange rate equation is consistent with the fact that Kenya is a small economy that is unlikely to influence foreign prices in the developed economies.

The results point to a number of policy implications. There is need to address external imbalances and structural bias towards imports e.g. through export strategies such as high-value exports that boost the country's foreign exchange flows vis-à-vis import demand, as this has implications on the exchange rate determination in the long run. Moreover, concerns about the disequilibrium or volatility in the exchange rate feeding into the domestic prices could be partly curtailed by addressing the external imbalances in the current account in the long run. Additionally, the domestic interest rates vis-à-vis foreign interest rates have a bearing on the exchange rate as higher interest rates attract short term capital flows leading to exchange rate appreciation. Consequently, the choice of the domestic interest rate path should be consistent with the desired exchange rate path.

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