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POLICY RESEARCH and ANALYSIS

Kenya's Exchange Rate Movement in a Liberalized Environment

An Empirical Analysis

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DP/10/2001

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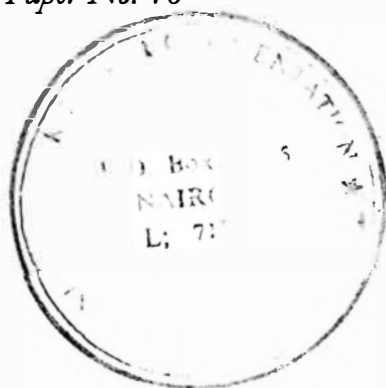# Kenya's Exchange Rate Movement in a Liberalized Environment: An Empirical Analysis

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Abstract

With globalization has come increased emphasis on an outward- looking and a market-oriented economy. Consequently, the 1990s were associated with a greater degree of liberalization of the financial, foreign exchange and domestic goods markets in Africa. Liberalization of the foreign exchange market in Kenya was gradual—from a fixed exchange rate regime to crawling peg before a flexible or floating exchange rate regime was adopted in the 1990s. This paper analyses factors that have influenced exchange rate movements since the exchange rate market was liberalized in 1993. Despite the policy change, empirical studies explaining exchange rate movements in this period are still scant. Furthermore, the existing studies on Kenya have concentrated on applying the traditional theoretical models based on the interest rate and purchasing power parities. This paper adopts a general empirical specification of the exchange rate equation encompassing the interest rate and price differential, as well as current account balance and net external inflows to explain the exchange rate movements in the 1990s.

Using an error correction formulation, the empirical results show that widening of the interest rate differential, improvements in the current account balance and increases in net external inflows are strongly associated with the appreciation of exchange rates. A rise in the price differential (widening gap between domestic and foreign prices) is also associated with an appreciation. In addition, the exchange rate movements are significantly driven by events such as expectations regarding the outcomes of withholding donor funding and other intermittent changes in the economy. This partly explains the high volatility of the exchange rate in the 1990s.

An important implication is that changes in the current account balance have a bearing on the exchange rate market. Thus, policies that affect exports and imports of goods and services also influence the exchange rate movements. Similarly, public capital flows and expectations regarding donor funding influence the direction of the market forces in determining the exchange rate movements. Therefore, the government's decision regarding the use of external public funds and its ability to attract and sustain funded programmes once they are implemented are issues that matter as far as

stability of the foreign exchange market and overall macroeconomic stability are concerned. Private capital inflows, on the other hand, are likely to respond to the interest rate differential. The policy of lowering interest rates is, therefore, consistent with a depreciation of the exchange rate. This implies that a demand for low interest rate regime must lead to a relatively weak shilling internationally. This has to be done in a credible policy framework since expectations do matter. While the policy of maintaining low inflation (through inflation targeting) appears favourable, it also has implications on the exchange rate movements, since the interest rate tends to be the main instrument for stabilizing the exchange rate.

Acknowledgement

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Abbreviations

ADL   autoregressive distributed lag

ECM   error correction model

ECT   error correction term

GDP   gross domestic product

IMF   International Monetary Fund

PPP   purchasing power parity

SPMM   sticky-price monetary model

UIP   uncovered interest parity

Executive Summary

This study analyses factors that have influenced exchange rate movements since the foreign exchange market was liberalized in 1993. Using monthly data, it covers the period from 1993 to 2000. In general, the liberalization period has been characterized by

- market-oriented economic reforms, political liberalization notwithstanding. These include shifts towards a flexible exchange rate system, financial market and external trade liberalization, and liberalization of the domestic goods market.
- increased volatility in nominal variables—interest rate, exchange rate and domestic prices—particularly in 1993/ 94.
- a shift in attention away from the real economy to trade in financial assets.

Despite the policy shift, empirical studies explaining exchange rate movements in the floating period are still scant. Furthermore, the existing studies on Kenya have concentrated on applying the traditional theoretical models based on the interest rate and purchasing power parities. Although it has become increasingly acknowledged that the current account balance has an important influence on exchange rates in the long run, none of the empirical studies in Kenya has analysed the impact of this variable. This paper adopts a general empirical specification of the exchange rate equation encompassing the interest rate and price differential, as well as current account balance and net external inflows to explain the exchange rate movements in the 1990s.

An error correction model is used to capture the long-run relationships and the impact of deviations from the perceived long-run equilibrium exchange rate.

In general, the results indicate that the impact of an increase in the interest differential is to appreciate the exchange rate. This is consistent with the argument that with the liberalization of the market, high interest rates, and therefore the widening interest rate differential, have tended to attract private capital flows, leading to exchange rate appreciation. Similarly, the exchange rate appreciates with an increase in the price differential, contrary to what would be expected. The other significant revelation is that improvements in the current account balance and net external inflows lead to exchange rate appreciation. Events and expectations associated with key announcements, particularly donor funding, also influence exchange rate movements.

Although the error correction term in the original equation showed a very low speed of adjustment (6.6%), normalizing the term with the interest rate differential yielded a higher coefficient (25%). These empirical results are consistent with the policy outcome that shows that the interest rate is used to stabilize the exchange rate. Thus when the exchange rate is unstable, the interest rate tends to rise. This has resulted in a high interest rate regime with a stable nominal exchange rate.

In the light of these results, some policy issues emerge. The current efforts to lower interest rates are favourable and consistent with maintaining a relatively depreciated currency. This has to be done within a credible policy framework since expectations matter a lot. However, using interest rate as the main policy instrument has made it difficult to attain a low interest rate regime.

Measures aimed at improving the current account position, including policies that affect exports and imports of goods and services are also instrumental in stabilizing the exchange rate. Similarly, Kenya's dependence on external financing and expectations regarding donor funds have a bearing on exchange rate movements. Therefore, the government's credibility in the

use of external funds and implementation of the related reforms is important.

Liberalization of the foreign exchange market was done hastily but was necessary. Ideally, liberalization should be gradual and progressive. But this is only possible in an environment where government policy is credible and has no risk of reversal. When there is risk of reversal, as Kenya's case has shown, a big bang is usually the best way to reform policies.

1 Introduction

Although high and sustained economic growth is one of the key economic goals in many countries, attaining it is likely to be influenced by, *inter alia,* appropriate macroeconomic policies aimed at general macroeconomic stability. Among the instruments that are crucial in economic management and stability of basic prices is the exchange rate. As a relative price, the exchange rate is important in making spending and investment decisions (Marrinan 1989). This brings the exchange rate policy into focus. Given the forces of globalization, the importance of the exchange rate policy in macroeconomic management cannot be overemphasized. As the recent currency market turmoil in Southeast Asia demonstrated, globalization can magnify the costs of inappropriate policies. Kenya, being a small but fairly open economy, is bound to be vulnerable to external shocks. This vulnerability is confirmed by its past economic experience.

The exchange rate regime determines the ability of the economy to effectively respond and adjust to exogenous shocks. Besides, the exchange rate movements influence exports and imports of goods and services, which are key macroeconomic variables. For these reasons, it is necessary to have an appropriate model of the exchange rate that reflects the underlying economic factors as well as a feasible model that can be used in policy analysis and forecasting.

This paper analyses factors that influence exchange rate movements, using monthly data for the period 1993 to 2000. This is a period that witnessed the height of liberalization of both the financial and the foreign exchange market. The period is also characterized by related market-oriented economic reforms, political liberalization notwithstanding. These include shifts towards a flexible exchange rate system, financial market

and external trade liberalization, and liberalization of the domestic goods market. The period is also characterized by high volatility in nominal variables—interest rate, exchange rate and domestic prices—particularly in 1993/94. Thus it is time to take stock of what happened to the exchange rate market.

The rest of the paper is organized as follows. Section 2 outlines the liberalization policies in the foreign exchange market. Section 3 describes theoretical models of exchange rates and a brief overview of the empirical models. Section 4 specifies the empirical model to be estimated. The estimated results are discussed in section 5. Conclusions and policy implications are given in section 6.

2 Liberalization of the Foreign Exchange Market

The shift from a fixed to a flexible exchange rate regime has been gradual in many developing countries, including those in Africa. Although such a shift in the developed countries dates back to the early 1970s, when the Bretton Woods system collapsed, most developing countries continued pegging their exchange rates, either to a single key currency (especially the US dollar or the French franc) or to a basket of currencies (such as the IMF's special drawing rights). It was not until the early 1980s that developing countries started moving explicitly towards more flexible exchange rate arrangements. By 1996, countries that pegged exchange rates accounted for only about 20% of the developing world's total trade, from 70% in 1975 (Caramazza and Aziz 1998). In the 1990s, the shift was broadly worldwide, with a few exceptions—in particular, the CFA franc zone in sub-Saharan Africa and in countries like Argentina that reverted against the trend from flexible to fixed regimes (Caramazza and Aziz 1998). Specific considerations notwithstanding, increased flexibility in the exchange rate has

been greatly associated with a general shift towards increased openness, outward-looking policies on trade, and increased emphasis on market-determined exchange and interest rates. In particular, the general increase in international capital flows to developing countries and globalization of the financial markets has played an important role (IMF 2000).

In Kenya, exchange rate regimes have evolved along the general macroeconomic policies adopted since independence. Kenya's economy in the 1960s and 1970s was predominantly characterized by controls in virtually all key sectors. There were controls on domestic prices, foreign exchange transactions, interest rates and import licensing, among others. This approach seems to have served the economy well as evidenced by the remarkable economic growth witnessed in the first decade after independence—with an average GDP growth rate of 6.6% during the period from 1964 to 1973.

However, when a series of external shocks emerged, this approach to macroeconomic management proved inadequate. This was because adjustment, especially to external shocks, was through the exchange rate and other prices and was delayed, and this worsened the economic performance. There have been several of those shocks. For example, in 1971, Kenya experienced a severe deterioration in trade, which led to the first balance of payments crisis. This was accompanied by an expansionary fiscal and monetary policy. Another major shock came from the oil price hike in 1973/74. This time the economy was so hard hit that signs of instability were quite evident. In the period from 1973 to 1975, inflation rose from 9.3% to 19.2%, domestic credit increased by over 60% and government's external and internal borrowing also increased (Ndung'u 1993). This led to a devaluation of the Kenya shilling in 1975. This was followed by a positive shock in the form of a commodity boom in 1977, but the second oil crisis of 1978/79 compounded the problems and exposed the country's vulnerability to external factors. Relying heavily on the benefits

of the coffee boom, the government did not undertake the necessary reforms that would have helped the economy to withstand the second oil shock.

The trade and current account deficits that had remained relatively low in the 1960s and 1970s reached unprecedented levels during 1978 to 1981. By 1982, it was clear that the macroeconomic policies pursued had glaring loopholes and were unsustainable, forcing the government to change course. Consequently, the government started to liberalize the economy, following typical structural adjustment policies. As an intermediate step, the exchange rate policy was changed to a crawling one. Even though this policy is associated with inflationary accommodation, it did not lead to a high inflation regime as such. Analysis seems to point to the fact that the inflation profile changed because of a loss of nominal anchor, but that only inflation inertia increased. The adjustment process was slow and marked by reluctance to undertake reforms, and thus it worsened the situation. Even with these experiences, the control regimes were still firmly placed, preventing adjustment through prices and exports and encouraging a curbside market to develop.

In the 1990s, liberalization was intensified in both financial and goods markets. Prices in the goods market were decontrolled; interest rates were liberalized. Foreign exchange controls were gradually relaxed. In fact, the exchange rate regime operated under a dual system in 1992 since there was an 'official' exchange rate and a 'market' rate. The latter operated on the basis of the Foreign Exchange Bearer Certificates, which could be purchased at the official exchange rate from the Central Bank in foreign exchange, without having to declare the source of the foreign exchange, and then marketed as any other paper asset (Ndung'u and Ngugi 1999). This facility was a major relief in the foreign exchange market as it entitled the bearer to some

amount of foreign exchange without going through the tedious and time-consuming foreign exchange licensing process.[1] When the certificates were suspended in January 1993, exporters were allowed to retain specified proportions of their foreign exchange earnings, while importers were required to purchase their foreign exchange from commercial banks (Ndung'u 2000).

By March 1993, however, speculation in the foreign exchange market was prevalent. Kenya was in great danger of capital flight. The market was also characterized by uncertainty, especially in regard to future exchange rate transactions such as importation on trade credit. In an attempt to avert the ensuing crisis, the official exchange rate was devalued three times in the first half of the year. Meanwhile, the amount of money in circulation increased, coinciding with the 1992 elections and the financial scams that had involved a few banks.[2] This, combined with the drought of 1992 that continued into 1993, put an enormous pressure on domestic prices. Towards the end of March 1993, price instability had reached unprecedented levels.

The need to mop up the excess liquidity together with the deficit financing requirements led to a steady rise in the weekly Treasury bill auctions from Ksh 1 billion to Ksh 5 billion Consequently, the Treasury bill discount rate, which acts as a benchmark for all interest rates, rose rapidly to levels of 60 to 70%. This meant that the difference between Kenyan and foreign interest rates widened, thereby attracting speculative capital inflows.

In April 1993, both import and foreign exchange licensing were eliminated and 100% retention accounts introduced. However,

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[1] The FEBC bearer applied for a license under 'No Foreign Exchange Required', which was then processed immediately, allowing the bearer to purchase foreign exchange from the Central Bank at the Official rate (Ndung'u 2000).

[2] These banks later collapsed.

the supply and demand for foreign exchange in the trade account did not immediately respond to market forces as would have been expected. Initially, the exchange rate depreciated faster than the gradual devaluation on the official rate, partly because of the backlog of demand and expectations of backtracking on the policy (Ndung'u 2000). By November 1993, the government had abolished the official exchange rate and allowed the public to hold foreign exchange. In response to the widening interest differential, exchange rate expectations and the general stability, holders of foreign exchange abroad took advantage of the liberalized regime by bringing funds back.

The liberalization period is thus characterized by a shift in attention away from the real economy to trade in financial assets. Although devaluation of the shilling partly led to exceptionally high export earnings, imports remained depressed and real investments declined. With rates on government securities attracting excess premiums, it is likely that lending for investment was considered unattractive. This partly explains the poor economic performance as shown by the GDP growth rate of 0.2% in 1993.

Other liberalization measures undertaken in subsequent years include complete liberalization of offshore borrowing in May 1994 and elimination of the remaining restrictions on inward portfolio investment in January 1995.

In brief, Kenya has experimented with virtually all types of exchange rate regimes: from fixed to crawling peg to flexible or floating rates. Figure 1 shows this gradual shift to a more flexible exchange rate system. The vertical lines demarcate the three major exchange rate regimes. The figure also shows that there was a marked shift of policy in the 1990s and an increased volatility of the exchange rate. The crawl period, 1982 to 1993, is characterized by continuous depreciation of the currency. Surprisingly, the domestic prices did not mimic this currency
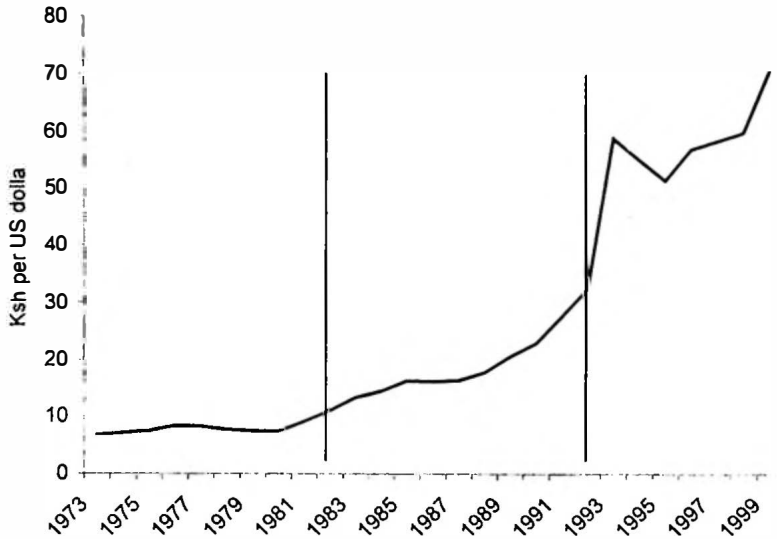
Figure 1. Trend in nominal exchange rate (1973–99).

depreciation. These two periods thus have contradicting and reinforcing outcomes—one with depreciation but no marked inflation outcome and the other with depreciation and appreciation and sporadic inflation. The experience in the 1990s seems to suggest that monetary policy played a key role in filling the gap for a nominal anchor, and when this was relaxed because of electoral greasing and cutback on foreign aid; inflation exploded, even though it was also a transition period for the exchange rate regime (see Ndung'u and Ngugi 1999).

Notwithstanding such interesting exchange rate episodes, empirical studies explaining exchange rate movements in the floating period are still scant. Furthermore, the existing studies on Kenya have concentrated on the application of the traditional theoretical models based on the interest rate and purchasing power parities. However, it is now acknowledged that current account balances are in the long run strongly associated with exchange rate movements (see Calderon et al. 2001). Consequently, a general empirical specification of the exchange rate equation encompassing the interest rate and price differential, as well as current account balance, may be

important in explaining the exchange rate movements and experiences in Kenya in the 1990s.

3   Theoretical and Empirical Models of Exchange Rate

3.1   An overview of the theoretical model

Traditionally, two views of exchange rates have been predominant. One regards the exchange rate as the relative price of two monies; in the other, the exchange rate is viewed as the relative price of domestic and foreign goods. These real and monetary aspects of the exchange rate determination are the most extensively modelled. A third view takes into account portfolio considerations and regards the exchange rate as the relative price of nominal assets. It has been only recently that some interest in the portfolio approach has emerged in the form of an exchange rate theory oriented to the current account (Dornbusch 1980).

The flexible-price monetary approach regards the exchange rate as an asset price. This model makes the assumption that continuous price flexibility maintains the money market in equilibrium. A critical condition in flexible-price monetary models is the assumption that price levels must be consistent with the equilibrium between the demand for and supply of money (MacDonald 1988; Marrinan 1989). The other key assumption is that purchasing power parity (PPP) holds continuously. Given the equilibrium conditions in the domestic and foreign money markets, the equilibrium national price levels are then solved by equating real money supply to money demand in each of two countries. In this approach, therefore, nominal exchange rate is explicitly expressed in current relative money supplies and factors affecting money demands (Marrinan 1989; MacDonald 1988; Isard 1995). The latter

factors include real income and interest rates, where the nominal interest rate incorporates an inflation premium.

Under a strict PPP assumption, there is a one-to-one relationship between (increase in) domestic money supply and (depreciation of) exchange rate. In other words, the exchange rate is homogenous of degree 1 in the money supply (MacDonald 1988). Moreover, an increase in income increases the transaction demand for money. Maintaining the money market equilibrium requires a fall in the domestic price level, which can be achieved, given a strict PPP assumption, only if the exchange rate changes. Assuming that the Fischer closed condition holds, an increase in the interest rates reflects expectations of future inflation and a reduced desire to hold domestic money balances. Consequently, the exchange rate must depreciate. An increase in income, by raising the demand for money, leads to an exchange rate appreciation while a rise in the domestic interest rate leads to exchange rate depreciation (MacDonald 1988).

A major limitation of the simple monetary model is its failure to recognize that the factors that affect money demand will also generally have repercussions in the product markets (Marrinan 1989). Furthermore, extensive empirical evidence has revealed significant violations of the PPP hypothesis (Marrinan 1989; Isard 1995). An alternative to the simple monetary model is a disequilibrium macroeconomic model that considers the differential speeds of adjustment in asset and goods markets. This leads us to the sticky-price monetary approach to the exchange rate.

The most common sticky-price monetary model (SPMM) is the Dornbusch (1976) over-shooting model, which is basically an extension of the Mundell-Fleming model (Obstfeld and Rogoff 1996; MacDonald 1988). Hence this model is also known as the Mundell-Fleming-Dornbusch model. In it, the nominal output prices are assumed to be sticky—they adjust slowly over time.

On the other hand, asset markets clear continuously in response to new information or changes in expectations (Marrinan 1989). The model thus adopts the principle of the uncovered interest parity (UIP), but PPP need not hold. A small country with an open economy is faced with a foreign interest, which is assumed to be constant. With open capital markets and perfect foresight, UIP is assumed to hold continuously.

Because of the sluggish adjustment of the national price level, a purely nominal shock or disturbance can cause short-run deviations from PPP and overshooting of the nominal exchange rate (Marrinan 1989). Hence the model is popularly known for its demonstration of overshooting (and undershooting) behaviour in exchange rates (Dornbusch 1976; Marrinan 1989; Obstfeld and Rogoff 1996). For instance, in a situation of unanticipated permanent rise in the nominal money supply, the unanticipated money change would have to be matched by higher prices or depreciation in the exchange rate or both, so as to maintain asset market equilibrium. The increase in money supply leads to an increase in real money balances since the price is initially fixed. Consequently, the interest rate must decrease to maintain money market equilibrium. At the initial level of prices, the monetary expansion reduces interest rates and leads to anticipation of depreciation in the long run. Thus, at the current exchange rate the expectation of a depreciating exchange rate lowers the domestic interest rates, leading to incipient capital outflows, thereby causing the spot rate to depreciate. The extent of that depreciation needs to be enough to give rise to anticipation of appreciation at a rate just sufficient to offset the reduced domestic interest rate. The effect of monetary expansion is therefore to induce immediate depreciation in the spot rate and one that exceeds the long-run depreciation, since only under these circumstances will the public anticipate an appreciating exchange rate and thus be compensated for the reduced interest on domestic assets (Dornbusch 1988).

APPENDIX 2

Table A2-1. Preferred model results when ECT is normalized by the interest rate differential

Variable	Coefficient	Std. error	*t*-values
Constant	−0.0001	0.004	−0.03
CA_Y	−0.97	0.52	−1.84
CA_Y_4	−1.28	0.52	−2.46
NET_Y	−1.62	1.08	−1.51
DLNE_1	−0.23	0.07	−3.31
DLPD	−0.47	0.16	−2.85
DLPD_3	0.36	0.17	2.13
DLPD_4	0.43	0.16	2.59
DLID	−0.51	0.13	−3.76
DLID_3	0.42	0.10	4.40
DLID_5	0.21	0.11	1.92
DLM3_5	−0.26	0.14	−1.85
ECT_1	−0.25	0.05	−4.64
i1995p5	0.13	0.02	5.66
i1994p9	−0.16	0.02	−6.82
i1994p10	−0.20	0.03	−7.63
i1997p8	0.12	0.02	5.09

R^2 = 0.78 F(16, 64) = 14.17[0.0]; s.e. = 0.02; n = 81 AR 1–5F(5, 59) = 0.05[0.998]
ARCH 5 F(5, 54) = 1.20[0.32]; normality chi^2(2) = 0.68[0.71]; RESET F(1, 63) = 1.43 [0.24]

Table A2-2. Solved regression results

Variable	Coefficient	Std. error	*t*–value
Constant	−0.0001	0.003	−0.03
DLID	0.10	0.14	0.71
DLPD	0.26	0.22	1.18
DLM3	−0.21	0.11	−1.91
CA_Y	−1.82	0.68	−2.68
NET_Y	−1.32	0.87	−1.52
ECTt−1	−0.20	0.04	−5.00
D955	0.11	0.02	5.50
D949	−0.13	0.02	−6.50
D9410	−0.16	0.02	−8.00
D978	0.11	0.02	5.50

Wald test chi^2(10)** = 213.85(0.00)

previously discussed models, the uncovered interest rate parity condition does not prevail (Isard 1995).

The portfolio balance models have, since their emergence in the late 1960s, undergone several changes. Until the early 1980s, attempts to explain the behaviour of exchange rates with this approach were based on ad hoc assumptions about exchange rate expectations. In addition, early empirical applications of these models were often based on the valiant assumption that currency composition of financial portfolios could be measured simply by cumulating current account flows. The initial effort to construct more accurate data on the currency composition is that of Dooley and Isard in 1982 (see Isard 1995).

In the early 1980s, empirical tests of portfolio-balance models took two directions. In the first, tests were developed under the premise that the difference between the change in the expected *ex ante* (that is, the interest differential minus the risk premium) and the change observed *ex post* was a serially uncorrelated random error. These tests looked for statistically significant evidence that the risk premium varied over time in the manner predicted by the portfolio balance model. The second type of test adapted the sticky-price monetary model to formulate an estimable exchange rate equation that allowed, among other factors, for the existence of a risk premium (see Isard 1995)

Based on an earlier work of Meese and Rogoff (1983a,b), a specification incorporating cumulative trade and current account balances became widely adapted. Clearly the classification of this specification as a portfolio balance model can be misleading. In Hooper and Morton (1982), the cumulative current account (adjusted for cumulative official intervention flows) appears as a risk premium term. Including a measure of the non-transitory unexpected change in the current account, it captures changes in the expected long-run real exchange rate.

Meese and Rogoff (1983a,b), on the other hand, interpret the cumulative trade balance or current account terms as variables that allows for changes in the long-run real exchange rate, rather than variables that allow 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 real exchange rate that is consistent with the long-run current account balance (Isard 1995).

3.2 An overview of empirical models

Experience has shown that the reduced-form single-equations models, which are based on the theoretical insights above, have performed poorly empirically (Isard 1995; Obstfeld and Rogoff 1996; Humpage 1998; Marrinan 1989). Exchange rate movements have not been consistent with the prediction of the economic models. Instead, exchange rates have been found to be more volatile under floating regimes than had been anticipated, with frequently large month-to-month variability. One of the key explanations is linked to the market's expectations about the future exchange rate (Marrinan 1989). That notwithstanding, most large-scale macroeconometric models contain the interest rate parity condition as a specific equation for the exchange rate or a modified UIP that includes either an exogenous residual or an endogenous risk premium (Isard 1995). This implies that exchange rate is linked to the short-term interest rate differential and the expected level of the next period's exchange rate. For instance, in the econometric evaluation of the exchange rate equations used in five different models of the UK economy (Fisher et al. 1990), a general equation is specified within which various specific exchange rate equations can be nested. Following Fisher et al. (1990) this general equation is of the form

$$q_t = E_t(q_{t+1}) - i_t + i_t^* - \gamma(CA\_Y)_t$$

where

q_t $=$ $e_t + p_t - p_t^*$

q_t $=$ logarithm of the real exchange rate at time t

E $=$ expectations operator

e_t $=$ nominal exchange rate

CA_Y $=$ current account balance expressed as a proportion of the nominal gross domestic product

p_t and $p_t^*=$ domestic and foreign prices

i_t and i_t^* $=$ real one period interest rates given by

$$i_t = r_t - [E_t(p_{t+1}) - p_t] \qquad i_t^* = r_t^* - [E_t(p_{t+1}^*) - p_t^*]$$

where

r_t and r_t^* are domestic and nominal interest rates at time t.

By substitution, we obtain an equation for the nominal exchange rate:

$$e_t = E_t(e_{t+1}) - r_t + r_t^* - \gamma(CA\_Y)$$

The above equation is basically an alternative form of a modified UIP condition that includes an endogenous or time-varying risk-premium term represented by the current account balance expressed as a proportion of nominal GDP. This framework can be applied to study exchange rate movements and identify its major determinants.

Recently there have been a growing number of exchange rate studies in Africa. Most tend to focus on exchange rate management and policy issues (see for instance Ogiogio 1996; Barungi 1997; Odbogun 1995; Atta et al. 1999; Njinkeu and Bamou 2000). The most important points that seem to come from these African-based studies are, first, that there is a strong relationship between prices (both domestic and imported) and exchange rate movement (see for instance Atta et al. 1999; Ndung'u 1997; Ajakaiye and Ojowu 1994). Second, most studies found that the movement of exchange rate is strictly linked to both fiscal and monetary policy discipline, in

particular monetization of the fiscal deficit (see Njinkeu and Bamou 2000; Dordunoo et al. 1997; Ogiogio 1996; Barungi 1997). Finally, in most of these studies the institutional aspect of managing exchange rate as well as real sector performance is emphasized as a long-run solution to sustainability of a stable exchange rate system. Although most of these African-based studies used an SPMM-type approach and noted the importance of the external sector (balance of payment position and external inflows in particular), they have not explicitly modelled it.

Applied studies in Kenya have also tended to adopt the SPMM approach by using the UIP specification. For example, Ndung'u (2000) and Ndung'u and Ngugi (1999) used a modified UIP, in which the exchange rate is specified as a function of price differential and real interest rate differential. Like others (MacDonald 1988; Frankel 1979; Obstfeld and Rogoff 1996), they circumvent the PPP notion by arguing that interest differential will absorb deviations from PPP. Ndung'u (1999) analyses the effects of expansionary monetary policy on real and nominal exchange rates by specifying an equation that encompasses real income, price and money supply. The results show that real income drives appreciation of the nominal exchange rate while money supply growth and inflation leads to its depreciation.

In general, empirical models based on Kenya include the short-term nominal interest rate differential as one of the explanatory variables. However, none of the empirical studies in Kenya has analysed the impact of the current account balance in determining the exchange rate, yet practitioners at the Central Bank argue that this is an important variable. It has become increasingly acknowledged that the current account balance has an important influence on exchange rates over the long run (Isard 1995; Humpage 1998; Calderon et al. 2001). This is based on the notion that the current account, which also measures net indebtedness to the rest of the world, is expected to be in

equilibrium in the long run. Large and persistent current account imbalances are unsustainable and therefore, given the time paths of other variables that affect the current account, the real exchange rate cannot be sustained at a level that will generate large and persistent current account imbalances (Isard 1995). The current account developments influence the prevailing nominal exchange rate through their influence on the expected long-run level of the real exchange rate. In Kenya, exchange rate movements also tend to be associated with both inflows of external donor funds and their expectation. Nevertheless, no attempt has been made to empirically investigate the relationship. This paper goes beyond the traditional specification of the exchange rate based on UIP by incorporating the current account balance and net external inflows in an extended model framework.

4   The Model

Using evidence from the studies and theoretical models discussed, we postulate a model that combines features of both the monetary and the portfolio models. The empirical variant of SPMM is based on a specification form introduced by Frankel (1979). He argued that in the short run, as in the SPMM model, prices are sticky and thus PPP does not hold continuously. Ndung'u (2000) argues in the same way but maintains that interest rate differential will absorb deviations from PPP. Frankel modified the basic assumptions of the original Dornbusch model to allow for differences in secular rates of inflation. That is,

$$E(\Delta e) = \theta(\bar{e} - e) + (\rho - \rho^{\bullet}) \qquad [1]$$

where

$\bar{e}$ = equilibrium value of nominal exchange rate (e), conditional on maintaining m, m^*, y, y^* at their current values

$E(\Delta \dot{e})$ = expected rate of depreciation of the domestic currency

θ = coefficient of adjustment

$(\rho - \rho^*)$ = expected inflation differential

m and m^* = domestic and foreign money supply

y and y^* = levels of domestic and foreign real income

Letters in lowercase indicate that the variables are in logarithm form.

We introduce the UIP condition, given as

$$i = i^* + E(\Delta e) \tag{2}$$

where i and i^* are domestic and foreign interest rates, respectively.

We substitute equation 1 into equation 2 and solve for $(\bar{e} - e)$ to obtain

$$(\bar{e} - e) = \frac{1}{\theta}\left[(i - i^*) - (\dot{\rho} - \dot{\rho}^*)\right] \tag{3}$$

Equation 3 states that where PPP does not hold in the short run, the current exchange rate differs from its long-run equilibrium value in proportion to the real interest rate differential (MacDonald 1988; Isard 1995). The relative monetary equilibrium equation

$$\left\{m - m^* = (p - p^*) + \phi(y - y^*) - \lambda(\bar{i} - \bar{i}^*)\right\}$$

and the PPP assumption imply that

$$\bar{e} = \bar{p} - \bar{p}^* = (m - m^*) - \phi(y - y^*) + \lambda(\bar{i} - \bar{i}^*) \tag{4}$$

Instead of substituting equation 4 back to 3, we assume that in the long run $\bar{p}$ is known, and thus equation 4 is captured in equation 3 in the form of price differential:

$$\bar{e} = p - p^*$$

stability of the foreign exchange market and overall macroeconomic stability are concerned. Private capital inflows, on the other hand, are likely to respond to the interest rate differential. The policy of lowering interest rates is, therefore, consistent with a depreciation of the exchange rate. This implies that a demand for low interest rate regime must lead to a relatively weak shilling internationally. This has to be done in a credible policy framework since expectations do matter. While the policy of maintaining low inflation (through inflation targeting) appears favourable, it also has implications on the exchange rate movements, since the interest rate tends to be the main instrument for stabilizing the exchange rate.

the complexity of capturing this variable, net external inflows as a proportion of GDP have been used as a proxy.

Using $e_t = LNE$, $p_t - p_t^* = LPD$ and $i_t - i_t^* = LID$, equation 6 is rewritten as an autoregressive distributed lag (ADL) model with n lags

$$LNE = \sum_{i=0}^{n} \alpha_{1i} LID_{t-i} + \sum_{i=0}^{n} \alpha_{2i} LPD_{t-i} + \sum_{i=0}^{n} \alpha_{3i} CA\_Y_{t-i} +$$

$$\sum_{i=0}^{n} \alpha_{4i} LM3_{t-i} + \sum_{i=0}^{n} \alpha_{5i} NET\_Y_{t-i} + \sum_{i=1}^{n} \alpha_{6i} LNE_{t-i} + u_i$$

[7]

where:

LNE	=	logarithm of nominal exchange rate
LID	=	logarithm of interest rate differential, computed using the short-term London Interbank Offer Rate (LIBOR) and the 91-day Treasury bill rate
LPD	=	logarithm of the price differential, computed as the difference between the domestic price index and the US wholesale price index
$LM3$	=	logarithm of money supply (M3)
CA_Y	=	current account balance as a proportion of nominal (quarterly) GDP
NET_Y	=	net external public inflows (official inflows less outflows) as a proportion of nominal GDP

A priori, we expect

$$\alpha_{1i} < 0, \quad \alpha_{2i} > 0 \quad \alpha_{3i} < 0, \quad \alpha_{4i} > 0 \quad \alpha_{5i} < 0$$

Given the nature of time series data, equation 7 contains non-stationary variables, which on being differenced become stationary. However, that would imply that the long-run properties of the theoretical model are lost. To recover the long-run information, parameters for equation 7 need to be reset into an error correction model (ECM), assuming that the non-stationary variables are integrated of the first order.

Therefore, equation 7 parameters are reset into equation 8 with the error correction term in brackets.

$$\Delta LNE = \sum_{i=0}^{n-1} \beta_{1i} \Delta LID_{t-i} + \sum_{i=0}^{n-1} \beta_{2i} \Delta LPD_{t-i} + \sum_{i=0}^{n-1} \beta_{3i} CA\_Y_{t-i} +$$

$$\sum_{i=0}^{n-1} \beta_{4i} \Delta LM3_{t-i} + \sum_{i=0}^{n-1} \beta_{5i} NET\_Y_{t-i} + \sum_{i=1}^{n-1} \beta_{6i} \Delta LNE_{t-i} + \qquad [8]$$

$$\beta_7 \left[LNE - \varphi_1 LID - \varphi_2 LPD - \varphi_3 LM3 \right] + u_i$$

5 Data and Estimation Results

5.1 Time-series properties

To start with, time series properties of the data to be used in the estimations are examined using the Augmented Dickey-Fuller and the Phillips-Perron tests. The unit root test results are summarized in table 1.

Table 1. Unit root tests

Variable → Test ↓	LNE	LPD	LID	LM3	CA_Y	NET_Y
ADF	−2.07	−3.21	−2.52	−2.36	−7.30	−4.68
PP	−2.76	−4.75	−2.05	−2.78	−6.47	−7.77

Critical values are −3.49 and −2.89 at 1% and 5% significance level respectively, for both tests.

The results in table 1 should be interpreted cautiously since they appear to be very sensitive to sample size, particularly with inclusion of the 1993 figures, which have significant shocks and outliers. Both tests show that price differential, current account balance and net external inflows as proportions of GDP are stationary while exchange rate, interest rate differential and money supply are non-stationary. To arrive at conclusive results we first plot and examine the graphs of the variables (exchange rate, money supply, price and interest rate differentials) in levels and in their first differences as shown in figures 2 and 3.
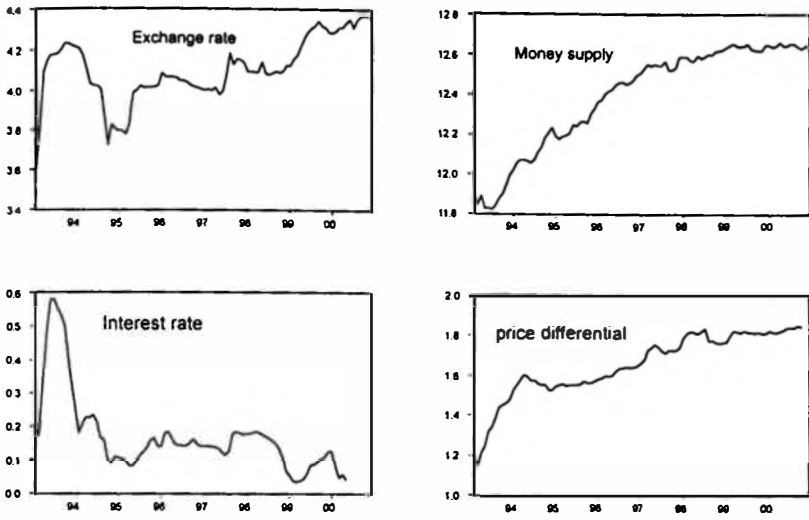
Figure 2. Movements in the exchange rate, money supply, and price and interest rate differentials.
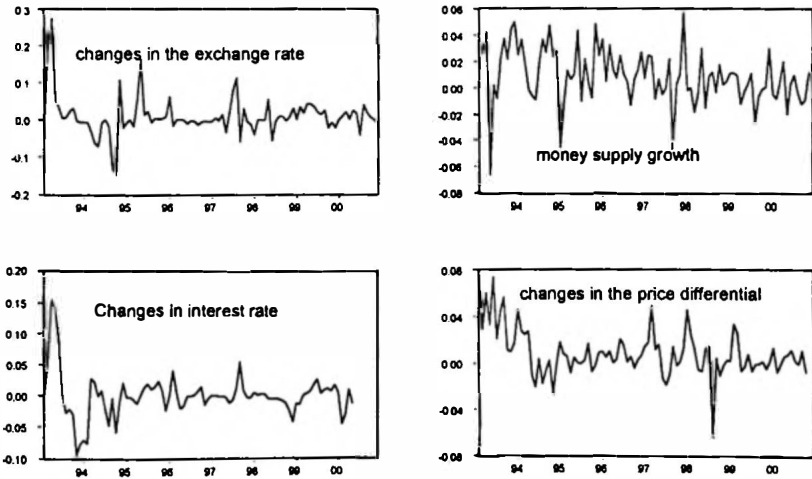

Figure 3. Movements in the growth of exchange rate, money supply, and price and interest rate differentials.

Then we model the shocks using a recursive estimation technique. Despite the evident shocks, the graphs of the variables in levels show some presence of a trend in the data, which implies that the variables, including the price differential, are unlikely to be stationary. Figure 3 shows that these variables become stationary when differenced once. Similarly, the recursive estimation results show that these variables are not stationary. The results lead us to the conclusion that the exchange rate, price and interest rate differentials are non-stationary and integrated of the first order.

Having found that the exchange rate, money supply, price and interest rate differentials are integrated of the first order, we tested for cointegration. The results of the Johansen cointegration test are reported in table 2.

Table 2. Johansen cointegration test

Null hypothesis	Eigen value	λ trace	5% level	1% level
$r = 0$	0.36	77.02	47.21	54.46
$r \leq 1$	0.27	37.01	29.68	35.65
$r \leq 2$	0.06	8.91	15.41	20.04
$r \leq 3$	0.04	3.38	3.76	6.65

The cointegration test results in table 2 indicate that there are two cointegrating vectors at the 1% significance level. This allows us to proceed with the determination of the long-run relationships between cointegrated variables through an ECM formulation. Based on the PPP condition, domestic and foreign prices are incorporated individually in ECM formulation instead of using price differential as a variable. This is in line with theoretical debate that PPP is likely to hold only in the very long run. Thus ECM is formulated using the interest rate differential, money supply, and domestic and foreign prices. One option of formulating the long-run relationship is by estimating an ADL for the variables of interest, which can then be solved to obtain the long-run coefficients (Charemza and

Deadman 1992). This enables us to obtain a cointegrating vector of the form

$$ECT = LNE + 0.714LID + 0.684LP - 2.461LP* -$$
$$0.347LM3 + 7.134 \qquad [9]$$

The error correction term (ECT) is found to be stationary and forms a linear combination of variables—nominal exchange rate, interest rate differential, money supply, domestic (*LP*) and foreign prices (*LP**). Interest rate differential and money supply have the expected signs in the long run.

The other option of formulating the long-run relationship is through direct estimation (without using the ADL approach). The resultant vector is of the form

$$ECT = LNE - 0.7269LID - 0.9956LP - 4.063LP* +$$
$$0.59LM3 + 13.7 \qquad [10]$$

Only domestic price has the expected sign in the long run. Foreign price has a consistent sign in both cases.

Using real interest rate differential (*RID*), domestic prices (*P*) and foreign prices (*P**), Ndung'u (2000) found a cointegrating vector of the form:

$$ECT = LNE - 0.8395RID + 0.495P + 0.241P* - 6.12 \qquad [11]$$

In comparison, the vectors differ from each other mainly in terms of signs. Ndung'u (2000) used the real interest rate differential instead of the nominal, and did not include money supply.

The regression results of the error correction model specified in equation 8 incorporate the error correction term in equation 9. The regression results are reported in subsection 5.2. Further analysis showed that the results in terms of significant number of lags and signs of the other (explanatory) variables in the equation do not differ significantly, whether one uses the error correction term from the long-run equations (as in equations 9

or 10) in the ECM equation reported in table 3. However, the coefficient of the error correction term using ECT in equation 10 was found not to be significant. Based on these results, including the long-run relationships, the ECT in equation 9 was used in preference to equation 10.

5.2 Estimation results

Before we present the final regression results, it is worth noting that we made an exhaustive analysis of models, based on different measurements of variables—specifically in regard to current account deficit and net capital inflows. These variables were measured both as a proportion of GDP and in logarithm form (levels and differences).[3] The results reported here are based on the model with the two variables defined as a proportion of GDP. They do not differ significantly from the results obtained when the variables are defined in log-form (this result is reported in appendix 1 tables A1-2 and A1-3). However, using the differenced variables did not yield similar results—current account had the wrong sign while net capital inflows, though maintaining the correct sign (negative), was found to be insignificant in the final equation.[4] Nevertheless, not much attention was given to these results since by using the augmented Dickey-Fuller and the Phillips-Perron tests the two variables were found to be stationary.

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[3] Obtained by cumulating the variable (current account) using a constant because of the negative values.

[4] Given the nature of these variables (having been netted out and therefore containing negative and positive values), perhaps the results are not surprising. The alternative is to get log-form of the total inflows and outflows that form the current account before netting out. This was not possible because the data were not available in that format. While the balance on exports and imports (trade balance) was available, the balance on services was available only in net form, making it difficult to tell what goes out and what comes in.

The estimation procedure starts with a general model encompassing five lags of each variable and a lagged ECT. The estimation data range from January 1993 (July 1993 including the first differences and the lags) to March 2000. Through recursive estimation, the instability in the regression coefficients caused by influential points in the data is identified. The instability is taken care of by using a number of dummies to capture the shocks that might have occurred in the foreign exchange market. The general model is reported in appendix 1 table A1-1. Table 3 shows the preferred model and table 4 is obtained by solving the preferred model in table 3.

Table 3. Preferred model results

Variable	Coefficient	Std. error	*t*–value
Constant	−0.01	0.00	−1.51
CA_Y	−1.04	0.49	−2.11
CA_Y_4	−1.57	0.50	−3.15
NET_Y	−2.32	1.16	−1.99
DLNE_1	−0.15	0.07	−1.99
DLNE_5	0.10	0.06	1.71
DLPD	−0.55	0.17	−3.21
DLPD_4	0.31	0.16	1.95
DLID	−0.43	0.13	−3.35
DLID_3	0.23	0.09	2.62
DLM3_5	−0.29	0.13	−2.20
i1995p5	0.15	0.03	5.81
i1994p9	−0.15	0.03	−6.14
i1994p10	−0.18	0.03	−6.59
i1997p8	0.12	0.02	4.84
ECT_1	−0.07	0.02	−3.25

$R^2 = 0.75$; s.e. = 0.024; $F(15, 65) = 12.88 [0.00]$; $n = 81$
AR 1–5 $F(5, 60) = 0.41 [0.84]$; ARCH 5 $F(5, 55) = 0.59 [0.71]$
Normality chi^2 = 2.17[0.34]; Xi^2 $F(26, 38) = 0.71 [0.81]$
RESET $F(1, 64) = 1.15 [0.29]$

The regression results show that the impact of a positive change in the interest rate differential on exchange rate movements is negative. The mechanism works to attract private capital inflows, thus appreciating the exchange rate. The solved model in table 4 also shows that the overall impact of an increase in the interest differential is to appreciate the exchange

Table 4. Solved regression results

Variable	Coefficient	Std error	*t*-value
Constant	−0.01	0.00	−1.50
DLID	−0.19	0.15	−1.26
DLPD	−0.22	0.23	−1.00
DLM3	−0.28	0.13	−2.17
CA_Y	−2.49	0.73	−3.39
NET_Y	−2.21	1.11	−1.99
ECT-1	−0.06	0.02	−2.86
D955	0.14	0.03	5.39
D949	−0.15	0.03	−5.92
D9410	−0.17	0.03	−6.44
D978	0.12	0.02	4.79

Wald test $chi^2(10)^{**}$ = 117.34 (0.00)

rate. These results are consistent with the argument that with the liberalization of the market, high interest rates, and therefore the widening interest rate differential, have tended to attract private capital flows, leading to exchange rate appreciation (Ndung'u 2000). However, the results also show that a three-month lag has a positive impact on the exchange rate (table 3).

Similarly, a current rise in the price differential (that is, a rise in domestic prices relative to foreign prices) is associated with an appreciation of the exchange rate, contrary to what would be expected. The fourth lag is, however, found to have a positive effect on exchange rate movements. Ndung'u (2000), using foreign and domestic prices separately (instead of the differential), also found a negative coefficient for current changes in domestic prices. As documented in the introductory part, however, the history of the exchange rate movements in Kenya shows that even the crawling peg period that is associated with inflationary accommodation was not accompanied with a high inflation regime. Nevertheless, the results indicate that the fourth lag is significant and positive— price differential takes some time before depreciating the

currency. Compared with the interest rate differential, there appears to be a longer time lag, with lags of up to four months.

Consistent with theoretical expectation, another significant finding is that an improvement in the current account balance is associated with an appreciation of the exchange rate. The key components that are likely to improve the current account balance are services such as tourism, and coffee, tea and horticulture in the goods sector. This variable is also significant for a four-period lag.

Likewise, the exchange rate appreciates with increases in the net external inflows as a proportion of GDP. The main components of public capital inflows likely to be captured are the multilateral and bilateral donor funding. This is an important finding and confirms what tends to be observed in practice.

Unexpectedly, increases in money supply growth (with a five-period lag) are associated with an appreciation of the exchange rate. The immediate impact of current growth in money supply, though positive, was found to be very insignificant. However, since money also works through prices and interest rates, perhaps the finding could simply imply that the equation is overspecified.

Exchange rate movements appear to be very sensitive to shocks—key events and the associated expectations—as reflected by significant dummies for particular months. This partly explains the high volatility in the exchange rate over the period. The 1995 dummy is associated with expectation of an aid freeze, which led to exchange rate depreciation. The drought that occurred in 1994 had a profound impact on the economy, leading to relief and external inflows that appear to have significantly appreciated the exchange rate in September and October. The announcement of an aid freeze in August 1997 led to massive private capital outflows, thereby causing the currency to depreciate.

Finally, the cointegrating vector captured through the lagged ECT shows that exchange rate disequilibrium from its long-run path will appreciate the current exchange rate. However, the speed of adjustment is slow, with only about 6.6% of the disequilibrium from previous period being transmitted to the current period. Apparently this is perplexing because exchange rates usually adjust quickly. However, this result is consistent with the macroeconomic management policies in Kenya. The exchange rate is a passive variable and most likely influenced by the outcome of Central Bank policies—mostly through the interest rate (mainly Treasury bill rate). In Kenya, the government uses inflation as an implicit target.[5] The policy outcome shows that the interest rate is used to stabilize the exchange rate so that when the exchange rate is unstable, the interest rate has to rise. That is why we have a tight interest rate regime with a stable nominal exchange rate. To test this proposition, we normalized the error correction term by interest rate differential. Using the resultant ECT, the estimation results showed a higher speed of adjustment of 25% in the preferred equation and 20% in the solved equation— when adjustments in the model are solved out (see the results in appendix 2).

6   Concluding Remarks and Policy Implications

This paper investigates some of the key factors that are likely to have influenced the exchange rate movements since the foreign exchange market was liberalized in 1993. Traditionally, interest rate and price differentials have been thought to be among the key determinants of changes in the exchange rate. However, the role of the current account balance has become increasingly

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[5] The current inflation target is 5%.

recognized. In addition to these variables, the study incorporates changes in money supply and net external inflows mainly as proxies to capture expectations. An ECM formulation is used to capture the long-run relationships and the impact of deviations from the perceived long-run equilibrium exchange rate. Shocks and significant events are modelled using dummies.

In general, the results indicate that exchange rate appreciates with an increase in the short-term nominal interest rate differential and increases in the price differential. The other significant revelation is the impact of current account balance and net inflows. Improvements in the current account balance and net external inflows lead to exchange rate appreciation. Key events and expectations associated with key announcements, particularly donor funding, also influence exchange movements. That notwithstanding, it is worth noting that a wide range of happenings—economic, political, natural and external—that have occurred during the liberalization period make a comprehensive and meaningful analysis of the foreign market complex. Although ECT in the original equation showed a very low speed of adjustment (6.6%), normalizing ECT with the interest rate differential yielded a higher coefficient (25%). These empirical results are consistent with the policy outcome that shows that the interest rate (mainly the Treasury bill rate) is used to stabilize the exchange rate. This has resulted in a high interest rate regime with a stable nominal exchange rate.

From the results, clear pointers in terms of policy emerge. Short-term interest rate differentials are paramount in determining exchange rate movements. Thus, the current efforts to lower interest rates are favourable and consistent with maintaining a relatively depreciated currency. This has to be done in a credible policy framework since expectations do matter a lot. However, using interest rate as the main policy instrument has made it difficult to attain a low interest rate regime. On the other hand, measures aimed at improving the current account position, for example through exports, are also

instrumental in stabilizing the exchange rate—through appreciation. Similarly, Kenya's dependence on donor funds—net external inflows—have a bearing on exchange rate movements. Big swings in external funding could cause instability.

Liberalization of the foreign exchange market was done hastily but was necessary. However, liberalization should be gradual and progressive—accompanied by strategic and supportive policies for the specific sectors that require protection in the short run. The exchange rate in a liberalized economy should be an incentive for both exports and imports, keeping in mind the high import content of domestic production.

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APPENDIX 1

Table A1-1. General model results used in the main text

Variable	Coefficient	Std. error	t–value
Constant	−0.02	0.01	−2.00
NET_Y_1	−1.43	1.54	−0.93
NET_Y_2	−1.91	1.50	−1.28
NET_Y_3	−0.59	1.65	−0.36
NET_Y_4	−1.24	1.59	−0.78
NET_Y_5	−1.08	1.56	−0.69
CA_Y	−1.28	0.99	−1.30
CA_Y_1	0.90	0.93	0.97
CA_Y_2	−0.32	0.86	−0.37
CA_Y_3	−0.12	0.84	−0.14
CA_Y_4	−0.93	0.82	−1.14
CA_Y_5	0.06	0.77	0.07
NET_Y	−3.12	1.53	−2.04
DLNE_1	−0.12	0.11	−1.15
DLNE_2	0.08	0.10	0.76
DLNE_3	0.12	0.10	1.25
DLNE_4	0.07	0.10	0.65
DLNE_5	0.09	0.11	0.82
DLPD	−0.57	0.25	−2.29
DLPD_1	0.09	0.25	0.38
DLPD_2	0.08	0.24	0.34
DLPD_3	0.23	0.25	0.93
DLPD_4	0.41	0.25	1.66
DLPD_5	0.14	0.26	0.52
DLID	−0.48	0.29	−1.65
DLID_1	−0.22	0.23	−0.98
DLID_2	−0.19	0.24	−0.80
DLID_3	0.19	0.23	0.82
DLID_4	0.01	0.24	0.04
DLID_5	0.10	0.21	0.49
DLM3	0.08	0.22	0.37
DLM3_1	−0.25	0.21	−1.18
DLM3_2	0.01	0.21	0.07
DLM3_3	−0.13	0.21	−0.59
DLM3_4	0.07	0.22	0.33
DLM3_5	−0.36	0.21	−1.70
ECT_1	−0.13	0.04	−3.07
i1995p5	0.13	0.04	3.70
i1994p9	−0.17	0.04	−4.76
i1994p10	−0.19	0.04	−4.64
i1997p8	0.11	0.03	3.49

R^2 = 0.81 F(40, 40) = 4.2[0.0]; s.e. = 0.03 n = 81 AR 1–5F(5, 35) = 0.17 [0.97]

ARCH 5 F(5, 30) = 0.07[0.995]; normality chi^2(2) = 2.50[0.29]; RESET F(1, 39) = 0.02 [0.89]

Table A1-2. Preferred model results with current account balance and net inflows in log-form

Variable	Coefficient	Std. error	t-value
Constant	0.30	0.09	3.19
DLNE_1	−0.17	0.07	−2.37
DLNE_3	0.09	0.05	1.74
DLPD	−0.62	0.17	−3.65
DLPD_3	0.42	0.17	2.48
DLM3_5	−0.32	0.13	−2.42
i1995p5	0.15	0.02	6.28
i1994p9	−0.14	0.02	−5.96
i1994p10	−0.20	0.03	−7.48
i1997p8	0.11	0.02	4.58
ECM_1	−0.07	0.02	−3.74
LCUMCUR_4	−0.03	0.01	−3.22
LNETINFL	−0.01	0.00	−2.37
DLID	−0.34	0.12	−2.77
DLID_4	0.29	0.08	3.49

$R^2 = 0.75$ F(14, 66) = 14.28 [0.000]; s.e. = 0.023; n = 81 AR 1–5F(5, 61) = 0.18 [0.97]; ARCH 5 F(5, 56) = 0.81 [0.54]; normality chi^2 (2) = 1.8703 [0.3925]; Xi^2 F(24,41) = 1.192 [0.30]; RESET F(1, 65) = 0.053 [0.82]

LCUMCUR = logarithm of current account balance

LNETINFL = logarithm of net capital inflows

Table A1-3. Solved regression results

Variable	Coefficient	Std. error	t-value
Constant	0.28	0.09	3.20
DLID	−0.06	0.14	−0.39
DLPD	−0.18	0.21	−0.87
DLM3	−0.30	0.12	−2.43
LCUMCUR	−0.03	0.01	−3.10
LNETINFL	−0.01	0.00	−2.25
ECM_{t-1}	−0.07	0.02	−3.35
D955	0.14	0.02	5.92
D949	-0.13	0.02	−5.54
D9410	−0.19	0.03	−7.12
D978	0.11	0.02	4.38

Wald test chi^2(10)** = 122.83(0.00)

APPENDIX 2

Table A2-1. Preferred model results when ECT is normalized by the interest rate differential

Variable	Coefficient	Std. error	*t*-values
Constant	−0.0001	0.004	−0.03
CA_Y	−0.97	0.52	−1.84
CA_Y_4	−1.28	0.52	−2.46
NET_Y	−1.62	1.08	−1.51
DLNE_1	−0.23	0.07	−3.31
DLPD	−0.47	0.16	−2.85
DLPD_3	0.36	0.17	2.13
DLPD_4	0.43	0.16	2.59
DLID	−0.51	0.13	−3.76
DLID_3	0.42	0.10	4.40
DLID_5	0.21	0.11	1.92
DLM3_5	−0.26	0.14	−1.85
ECT_1	−0.25	0.05	−4.64
i1995p5	0.13	0.02	5.66
i1994p9	−0.16	0.02	−6.82
i1994p10	−0.20	0.03	−7.63
i1997p8	0.12	0.02	5.09

R^2 = 0.78 F(16, 64) = 14.17[0.0]; s.e. = 0.02; n = 81 AR 1–5F(5, 59) = 0.05[0.998] ARCH 5 F(5, 54) = 1.20[0.32]; normality chi^2(2) = 0.68[0.71]; RESET F(1, 63) = 1.43 [0.24]

Table A2-2. Solved regression results

Variable	Coefficient	Std. error	*t*–value
Constant	−0.0001	0.003	−0.03
DLID	0.10	0.14	0.71
DLPD	0.26	0.22	1.18
DLM3	−0.21	0.11	−1.91
CA_Y	−1.82	0.68	−2.68
NET_Y	−1.32	0.87	−1.52
ECTt–1	−0.20	0.04	−5.00
D955	0.11	0.02	5.50
D949	−0.13	0.02	−6.50
D9410	−0.16	0.02	−8.00
D978	0.11	0.02	5.50

Wald test chi^2(10)** = 213.85(0.00)

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