I. Introduction

This paper assesses whether the exchange rate is affected by monetary policy and whether these effects are permanent or transitory. The premise is that the choice of the exchange rate regime is determined by various factors–such as the objectives pursued by the policy makers, the sources of shocks hitting the economy and the structural characteristics of the economy in question–but that once this choice is made, the authorities are presumed to adjust their macroeconomic policies (especially fiscal and monetary policies) to fit the chosen exchange rate policy. Furthermore, the chosen exchange rate regime determines the flexibility or independence of monetary policy.

Exchange rate and monetary policy are key tools in economic management and in the stabilization and adjustment policies in developing countries. In most developing countries low inflation and international competitiveness have become major policy targets. The real exchange rate is a measure of international competitiveness, while inflation mostly emanates from monetary expansion, currency devaluations and other structural factors. Despite the importance of monetary and exchange rate policies in economic management, few studies have been done on Kenya to assess the relationship between them. It is already recognized in the literature that the real exchange rate is an endogenous variable that responds to both exogenous and policy induced disturbances and that prolonged real exchange rate misalignment will usually generate macroeconomic disequilibrium (see Elbadawi, 199; Montiel and Ostry, 1991). Part of the policy induced disturbances emanate from the money market. There are some studies that have traced disturbances in the exchange rate to the disturbances in the money market in Latin America (see for example, Hausman and Gavin, 1995).

Few studies have been conducted to explain exchange rate movements in Kenya. Even fewer have linked the exchange rate policy and the monetary policy. Most studies have concentrated on explaining the domestic rate of inflation, where the nominal exchange rate enters as one of the explanatory variables (see Canetti and Greene, 1991; Killick and Mwega, 1989; Mwega, 1990; Ndung'u, 1993, 1995). Others have estimated a money demand equation where the nominal exchange rate enters as one of the explanatory variables (Adam, 1992). Only two of these studies attempt to establish a statistical relationship between money and the exchange rate. For example, in Canneti and Greene (1991) and Ndung'u (1995), money supply growth, inflation and exchange rate (among other variables) are analysed in a vector autoregressive model. The authors find that money supply growth drives nominal exchange rate changes with no feedback effects. However, none of the studies tries to link the real exchange rate movements to monetary policy, or even directly explain the movements in the real or nominal exchange rate.

This study adapts the familiar Dornbusch model, (see Dornbusch, 1988), which is reformulated in De Grauwe (1994), in an attempt to link money supply and other variables to the long-run movements of the nominal exchange rate. The basic questions implicitly asked are the following:

- Does the exchange rate regime have any effect on the real exchange rate? Kiguel (1992) argues that the exchange rate regime has limited effect on the real exchange rate and only affects it in the short run due to rigidities in domestic prices and wages. Our study encompasses four different exchange rate regimes and will thus assess whether movements in the real exchange rates affect the nominal exchange rate.

- Do monetary shocks have any effect on the real exchange rate? Calvo, Reinhart and Vegh (1995) argue that the steady state real exchange rate is independent of (permanent) changes in monetary policy. They assert that this result depends on the fact that there is no direct steady state link in theory between inflation and real exchange rate so that monetary effects are transitory. In this study we thus intend to test whether monetary shocks are related to real exchange rate movements.

- Is there link between nominal money supply and the nominal exchange rate? In the long run, De Grauwe (1994) argues that the correlation between money supply and the nominal exchange rate is relatively strong but tends to be lost in the short run. We would expect this relationship to be stronger in periods of nominal exchange rate flexibility. In Kenya such a period coincides with the crawling period. We thus intend to investigate whether money supply and other variables account for the nominal exchange rate movements over time.

The paper is organized as follows: Section II provides a brief background of the economy. Section III outlines the proposed analytical framework for the study. It starts with the decomposition of the real exchange rate and definitions of monetary shocks and proceeds to specify a model where the nominal exchange rate is explained by money supply, domestic prices, output and the cyclical movements of real exchange rate. The empirical results are in Section 4 and Section 5 concludes.

II. Background

Exchange rate policy in Kenya has undergone various regime shifts mostly driven to a large extent by the economic events, especially balance of payments crises. Up to 1974, the exchange rate was pegged to the dollar, but after discrete devaluations the peg was changed to the SDR.[1] Between 1974 and 1981, the movement in the nominal exchange rate in relation to the U.S. dollar was quite erratic; in general the nominal exchange rate depreciated by about 14% and this depreciation accelerated in 1981/82 with further discrete devaluations. Between 1980 and 1982, the Kenya shilling was devalued by about 20% in real terms measured against the SDR. After these devaluations, the exchange rate regime was changed to a crawling peg in real terms by the end of 1982. This regime lasted until 1990 when a dual exchange rate system was adopted that lasted till October 1993 when, after a series of devaluations,[2] the official exchange rate was abolished. That is, the official exchange rate was merged with the market rate and the shilling was put into a complete float.

The l990s began with a dual exchange rate system, accelerated money supply growth[3] and high inflation, but at the same time there was a move to speed up economic reforms and accelerate the pace of liberalization in line with donor conditionalities. The economic environment, with the severe imbalances in the major macroeconomic variables, was not conducive for reforms especially financial liberalization. This was because macro prices had become severely unstable, particularly the exchange rate and the domestic prices, which were then followed by the treasury bill discount rate. In fact, in March 1993 instability in these variables, especially the exchange rate and domestic prices, had got to such a state that financial liberalization measures could not continue without first establishing some basic stability. These instabilities stemmed from excess liquidity in the economy especially after the December 1992 elections. But when excess liquidity started drying up, inflation responded –albeit hesitatingly; the exchange rate appreciated throughout 1994 and the interest rate started to track domestic rate of inflation down. This meant that macro stability was slowly being achieved.

The events in this period suggest that monetary policy in Kenya is key to the determination of the path of exchange rate, inflation and the rate of interest. In addition, fiscal policies and budget deficit are closely interwoven with monetary policy. Part of the exchange rate depreciation and accelerating inflation, however, could be traced to expectations, which were at the time being driven by either fear of policy reversal or perhaps a backlog of demand for both goods and foreign exchange reserves.

By mid-1994 economic reforms had started showing fruits; macro prices had stabilized and credibility and confidence had started building up. The policy makers were at pains

Figure 1: Real income and domestic credit

Figure 2: Money supply (M2) growth and interest rate changes

Figure 3: Inflation and nominal exchange rate movements

to chart the way for the future path of money supply, inflation, exchange rate and the rate of interest in an attempt to consolidate credibility and confidence. According to *Economic Survey 1995*, inflation declined from 46% in 1993 to 28.8% in 1994 for the following reasons:

- The appreciation of the shilling, which led to reduced import prices.
- Pursuit of measures to contain the expansion of domestic money supply.
- Lowering of import duties on agricultural machinery and tools, kerosene, drinks and tobacco.
- Improved weather conditions, which led to ample food supply and resulted in decrease of basic food prices.

The results were that the economy grew by about 3% in 1994 compared with 0.1% in 1993; interest rate, measured by treasury bill rate, dropped to 14% in 1994 from 70% in 1993, while commercial banks' interest rates fell by over 8 percentage points in the same period.

Figures 1-3 show the behaviour of macro indicators between 1971 and 1994. In all the indicators, the l990s presents a crisis period. Domestic credit expanded rapidly, which also reflects the movements in money supply, interest rate changes, the rate of inflation and exchange rate movements. The rate of inflation responded to both money supply growth and exchange rate movements.

The recurring policy objectives in Kenya have been to maintain an exchange rate that would ensure international competitiveness while at the same time keep the domestic rate of inflation at low levels, conduct a strict monetary stance and maintain positive real interest rates. This has been difficult in practice and it has been made even more difficult by a floating exchange rate that at times moves out of line with its fundamentals in the short run. For example, in July 1995, the nominal exchange rate suddenly depreciated by about 32%, moving to Ksh58 to the U.S. dollar from Ksh44 to the dollar.

When the exchange rate was put to a float in an environment of excess liquidity, massive depreciation and high and accelerating inflation ensued. The mopping up of excess liquidity pushed the treasury bill discount rate up and being a benchmark for other interest rates, all other interest rates shot up to historical high levels. Money supply, on the other hand, has been quite erratic over the years. The Central Bank of Kenya in its July 1995 Monthly Report indicated that the major challenge for monetary policy in Kenya is to control and finally eliminate credit extended to the treasury by the central bank. This is the component that mostly drives money supply growth.

The movements in major macroeconomic indicators for the period 1983 to 1994 are shown in Table 1. Money supply growth in Kenya is mostly driven by domestic credit extended to the treasury by the central bank. The government share of domestic credit has steadily risen in the 1980s and 1990s. This proportion rose to 46% in 1993 and was generally above 40% over most of the 1990s, compared with the 1970s when it was below 30%. Money supply, on the other hand, measured in narrow money, M1, increased sixfold and M2 by more than sevenfold. The period of money supply upsurge coincided with some lag with inflation rate acceleration, exchange rate depreciation and high interest rate.

Table 1: Major macroeconomic indicators, 1983–1994

Year	M1	M2	DC	GDP	INFL	TDR	EXR	DCG
1983	100	100	100	100	14.5	14.04	13.39	31.2
1984	114	111	114	112	9.1	13.27	14.54	31.4
1985	126	124	121	127	10.7	13.27	16.39	30.5
1986	152	152	163	147	5.7	13.77	16.21	36.9
1987	174	182	191	163	10.5	13.21	16.48	39.8
1988	178	192	198	186	12.8	12.84	17.81	34.1
1989	251	272	216	215	14.6	13.46	20.67	30.9
1990	269	288	264	281	17.7	13.86	23.04	40.6
1991	313	348	307	318	19.6	14.78	28.07	42.6
1992	450	466	376	369	27.3	16.59	36.22	35.8
1993	552	585	485	461	46.0	39.3	68.16	46.2
1994	613	765	493	561	28.8	17.90	44.84	41.6

Sources: *Economic Survey*, various issues.
Where M1 and M2 are money supply, DC is total domestic credit, GDP is total domestic output (these are indexes), TDR is the treasury bill discount rate, INFL is the domestic rate of inflation, EXR is the nominal exchange rate to the dollar, and DCG is the government share of domestic credit.

Monetary policy

Money supply growth has been erratic over the years (Table 2). In the 1970s, the movements of the money supply aggregates were mainly dominated by changes in foreign reserves associated with the volatile balance of payments situation (Mitra, 1994). The most spectacular period was the 1976–1978 commodity boom, which the authorities did little to sterilize. During this period, the government allowed both foreign exchange reserves and public expenditures to rise simultaneously, which fed quickly into the growth of money supply. When foreign exchange reserves fell, money supply continued to grow in line with widening fiscal deficits. The other period of excessive money supply growth was the crisis period of the 1990s, when quick disbursement aid was frozen and the government resorted to central bank credit to finance its deficit, including the first multi-party elections of 1992.

The major instruments of monetary policy in Kenya have been open market operations, cash and liquidity ratios, credit ceilings, and reserve requirements. However, they have not been active instruments, at least before the 1990s, and some, like credit ceilings and the cash ratio, have been at times severely resisted by the commercial banks. In the 1990s, the authorities have relied more on the indirect instruments, the most active being open market operations.

Table 2: Money, domestic credit and the rate of interest: 1973–1982

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
TDR	-	100	139	128	49	95	139	118	170	285
DC	100	128	160	235	191	318	359	404	502	596
M1	100	104	128	190	207	231	265	265	274	307
M2	100	117	127	158	227	272	303	341	366	400

Source: *Economic Survey*, various.

Growth of domestic credit, which may be regarded as a policy variable that reflects the monetary stance pursued, was also expansionary in most of the years. The series of domestic credit growth indicates that any overshooting can be associated with increased lending to the public sector. There is nothing in tables 1 and 2 to suggest a strict monetary stance in most of the years. We also note that when domestic credit overshoots, M2 also grows faster. In the period between 1973 and 1982, the growth of DC and M2 was quite spectacular, while Ml was less spectacular, in relative terms.

Table 3 shows the indexes for the period 1983–1994. Money supply increased rapidly in the l990s, but the rate of interest did not follow until 1993; it came down drastically the following year, but still money supply continued to grow rapidly.

Table 3: Money, domestic credit and the rate of interest: 1983–1994

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
TDR	100	95	95	98	94	91	96	99	105	118	280	127
DC	100	114	121	163	191	198	216	264	307	376	485	493
M1	100	114	126	152	174	175	251	269	313	450	552	613
M2	100	111	124	152	182	192	272	288	348	466	585	765

Source: *Economic Survey*, various.

These trends in money supply for the period 1970–1994 are shown in Figure 4. Money supply measured in M2 is seen to have an upward accelerating trend. In Figure 5, we try to relate the trends in money supply with that of the nominal exchange rate. From Figure 5, the nominal exchange rate and money supply seem to track each other quite well.

Exchange rate policy

Kenya's foreign exchange policy has undergone a marked evolution over the past three decades. A fixed exchange rate was maintained in the 1960s and 1970s with the currency becoming over-valued, though not extremely so as most studies have shown. In addition, exchange controls were maintained from the early 1970s.

The basic motive behind the foreign exchange controls stemmed from the balance of payments crisis of 1971/72: to conserve foreign exchange and control pressures on the balance of payments, the government chose controls instead of liberalization. Other controls on domestic credit, interest rates, imports and domestic prices were also instituted. These controls were an easy response to contain balance of payments and inflationary pressures, but created major distortions in the economy that were not evident until the early 1980s.

The historical policy regime shifts of the exchange rate can be divided into two phases: the fixed exchange rate period before 1982 and the flexible exchange rate after 1982. The most interesting period for analysis is the flexible period, with crawling peg up to 1990 and dual and floating rates in the 1990s. The crawling peg, mostly associated with inflationary accommodation did not, however, lead to a higher inflation rate than the fixed period. But a floating rate in 1993 led to an explosive inflation rate and a huge response on interest rates. One contradiction in the crawling peg regime was the presence of controls on foreign exchange transactions and imports. Perhaps this prevented inflationary shocks from having permanent effects and more open to speculative attacks on the currency.

The floating exchange rate system adopted in the 1990s was expected to have several advantages for Kenya. First, it would allow a more continuous adjustment of the exchange rate to shifts in the demand for and supply of foreign exchange. Second, it would equilibrate the demand for and supply of foreign exchange by changing the nominal

Figure 4: Trends in money supply

Figure 5: Trends in money supply and the exchange rate

exchange rate, rather than the level of reserves. Third, it would allow Kenya the freedom to pursue its own monetary policy without having to be concerned about balance of payments effects. Thus the country would have an independent monetary policy, but one that was consistent with the exchange rate management. Fourth, under the floating system external imbalances would be reflected in exchange rate movements instead of reserve movements. However, as it turned out, a floating regime was adopted with disequilibrium in the money market and supply constraints in the economy. The first effect was to raise inflation and to depreciate the exchange rate. After 1993, the exchange rate appreciated under the influence of short-term capital flows taking advantage of the high interest rate on treasury bills. Overall, the exchange rate was no longer stable and imposed risks on importers, exporters, and those whose future contracts were denominated in dollars or hard currencies. For example, the official exchange rate was devalued by 25% on 9 March 1993, 31% on 20 April and 6% on May 1993. Those who were importing on trade credit during this time were uncertain as to what price they would have to pay for foreign exchange when their letters of credit were called, and hence were writing the expected foreign exchange redemption into their price structure. This produced a spiral of inflation. The benefits of a floating exchange rate were not obvious from these experiences.

III. Analytical framework

This section outlines the analytical framework that will be applied in this paper. The major motivation is to assess whether the exchange rate in Kenya is affected by monetary policy. The section is organized as follows: the first part outlines the decomposition of the real exchange rate into permanent and cyclical components. The cyclical components of the real exchange rate together with a measure of monetary shock will determine whether the monetary authorities contribute to short- run fluctuations in the real exchange rate through the money market. This part ends with a specification of a structural equation where nominal exchange rate is explained by movements money supply, the domestic price level, real output and the cyclical component of the real exchange rate.[4] The assumption is that cyclical movements of the real exchange rate would signal corrective measures through the nominal exchange rate since this depicts disequilibrium behaviour. Finally, the section ends with a highlight on empirical implementation.

The real exchange rate (RER) and monetary shocks

The real exchange rate (RER) has taken the centre stage in most empirical models of adjustment and stabilization. This is because it plays a crucial role in the stabilization and adjustment process. In developing countries, the RER, being a measure of international competitiveness, has become a policy target and in most exchange rate regime changes, the aim is to maintain a stable and competitive RER.

As Elbadawi (1994) notes, there is a growing agreement that prolonged RER misalignment will usually generate severe macroeconomic disequilibrium that is painful to correct. It is thus accepted that the RER is an important endogenous variable that responds to both exogenous and policy induced disturbances (see Montiel and Ostry, 1991). This may perhaps explain why most developing countries attempt to target the RER in order to maintain international competitiveness. This is largely achieved by linking the nominal exchange rate to the differential between domestic and international inflation rates (or inflation differential with major trading partners).

In most empirical models the RER exchange rate is computed from a purchasing power parity relation.[5] This shows an underlying tendency of movements in the nominal exchange rate to offset movements in the ratio of foreign and domestic price levels (see among others Edwards, 1994; Elbadawi, 1994; Faruqee, 1995). This relationship is generally formulated as,

$$RER_t = \frac{EX_t * P^*_{Tt}}{P_{Nt}} \quad (1)$$

where EX_t is the effective nominal exchange rate index, P^*_{Tt} is the foreign price of tradeable goods (usually proxied by the wholesale price index of major trading countries) and P_{Nt} is the domestic price of non-tradeable goods (usually proxied by the domestic consumer price index), and all the variables are in logs. Usually EX_t and P^*_{Tt} are trade weighted.

The computation of RER entails that it is a non-stationary process since the purchasing power parity condition is not expected to hold in Kenya, that is, it has deviations from its long-run value. We can thus decompose the RER into its temporary (or cyclical) and permanent components.[6] Hence

$$Log(RER_t) = RERP_t + RERC_t \quad (2)$$

where $RERP_t$ is the permanent component and *RERC* is the cyclical or temporary component. We view $RERP_t$ as the equilibrium real exchange rate to which the actual *RER* reverts via the adjustment in the nominal exchange rate and/or domestic prices, while $RERC_t$ measures the temporary deviations from this equilibrium.

The next stage is to consider what constitutes monetary shocks in the economy. This could be induced from the fiscal side through domestic credit extended to the treasury by the central bank to finance fiscal deficits. Several measures have been used in the empirical literature. Eichenbaum and Evans (1993) use three measures in the United States of America: the orthogonalized components of the innovation to the rate of non-borrowed to total reserves, the orthogonalized components of the innovation to the Federal Reserve Fund rate, and the Romer and Romer index of monetary contraction. These measures may be inappropriate in a country with a shallow financial market dominated by multinational banks. Furthermore, the appropriate measure of credit squeeze or ease in a country like Kenya with shifts in the exchange rate regimes is best reflected by the growth of domestic credit. The monetary stance in Kenya should be reflected by growth of domestic credit. We thus follow Edwards' (1994) definition of excess supply of domestic credit:

$$EXDC_t = [\Delta \log(DC_t) - \Delta \log(Y_{t-1})] \quad (3)$$

where $EXDC_t$ is excess domestic credit, DC_t is domestic credit, *Y* is national output and the delta indicates the first difference. In addition, growth of domestic credit can also be used. On the other hand, Elbadawi (1994) uses excess money supply, *EXMS*, which is defined as:

$$EXMS_t = (\frac{\Delta DC}{M2})_{t-1} - \Delta \log P_{Tt}^{*} - \Delta \log EX_t - \Delta \log RY_t \quad (3')$$

where *RY* is real national output. That is, excess money supply is defined as the ratio of growth in domestic credit to money supply in excess of foreign rate of inflation, exchange rate movements and the real growth of output. We thus have three measures of monetary shocks for our empirical investigation. The investigation will show whether the cyclical component of the real exchange rate is driven by monetary shocks. If at all the authorities aim at a competitive exchange rate, then they should pursue a monetary policy consistent with this target. If the policies were consistent, then $RERC_t$ should not be correlated with monetary shocks or movements in monetary aggregates.

In order to analyse more closely the links between the nominal exchange rate, the money and goods market, and the cyclical movements of real exchange rate, we follow De Grauwe (1994).[7] The estimation is shown in Equation 4 where, unlike De Grauwe (1994), the $RERC_t$ is included as one of the explanatory variables (see De Grauwe,1994):

$$Log\ EX_t = \beta log M_{St} - a\beta log Y_t - \beta a_2 log P_{Nt-1} + \alpha log RERC_{t-1} + \in_t \quad (4)$$

where EX_t is the nominal exchange rate, M_{st} is money supply, Y_t is domestic output, P_{nt} is domestic prices, $RERC_t$ is the cyclical component of the real exchange rate and $\in_t$ is a white noise process. Equation 4 can thus be estimated to explain nominal exchange rate movements[8] in terms of money supply, income, domestic prices and deviations from the trend of the real exchange rate in the previous period, which we consider a disequilibrium movement.[9]

Empirical implementation

The study uses quarterly series from 1970 to 1995. Domestic output, GDP, is interpolated from annual to quarterly. The first thing to be noted is that the data series are likely to be I(1) processes, so the first stage in the empirical investigation is to analyse the time series properties of the data. The next stage is to formulate and estimate a vector autoregressive model of Equation 4. Our major interest is to test for the long-run relationships between these variables, that is, to generate the cointegrating vectors that show whether the nominal exchange rate, money supply and other variables have a long-run relationship. The final stage is to estimate a dynamic error correction specification of Equation 4 and assess the contribution of the variables in the model toward explaining nominal exchange rate movements in Kenya.

IV. Empirical results

Time series properties of the data

We first report the data properties by showing the unit root test[10] results $_t$ of the variables in the analysis (Table 4).

Table 4: Unit root tests

Test,	EX	CPI	M2	WP	RY	RER
WS	-1.91[.707]	-.73[.988]	-.20[.952]	-.91[.979]	-.75[.999]	.189[.999]
DF	-2.255[.459]	-1.60[.791]	-1.81[.698]	-1.55[.810]	-2.41[.376]	-.953[.95]
PP	-11.71[.332]	-4.57[.851]	-4.83[.833]	-2.09[.968]	-7.47[.626]	-2.999[.937]

The three tests used are the weighted symmetric test (WS), Dickey-Fuller tests (DF) and the Phillips-Perron test (PP). The figures in the brackets are the probability values for the null. In all cases, the hypothesis of stationarity was rejected. The results thus show that the variables are integrated of order one and thus become stationary after first difference. The real exchange rate (RER) follows an I(1) process so that $RERC_t$ is a stationary process. These tests are complemented by the graphs of these variables (not shown), which show that the variables become stationary after the first difference. We thus ignore I(2) tests for these variables.

Monetary shocks and the real exchange rate

After generating the real exchange rate, we decomposed it into cyclical (RERC) and permanent (RERP) components. This, as argued earlier, enables us to test whether the cyclical component is driven by shocks from money supply as defined in equations 3 and 3'. The results are shown below.

1. Excess domestic credit[11]

RERC ⩾⩾ EXDC F(8,74) = 9.108[.0012] RERC predicts EXDC

EXDC ⩾⩾ RERC F(8,74) = 2.679[.5446] No feedback effects

Eight lags of each variable were used and we also tested the reverse causation. The results of the F-test are shown and the figures in the brackets are the probability values. These results are interpreted as follows: RERC predicts EXDC with a probability value of less than 1%, while the reverse effects can only hold with a probability of 54.5% and so are not significant. Thus, EXDC does not predict RERC; that is, there are no reverse or feedback effects.

2. Excess money supply

RERC ⩾⩾ EXMS F(8,74) = 6.96[.000] RER predicts EXMS

EXMS ⩾⩾ RERC F(8,74) = 7.7891[.001] Feedback effects present

Excess money supply as defined from Equation 3' is seen here to predict cyclical movements of the RER with strong feedback effects. The results are different from domestic credit perhaps because money supply contains net foreign assets, which have an effect on the exchange rate.

3. Domestic credit growth

RERC ⩾⩾ ΔDC F(8,73) = 2.953[.0064] RERC predicts ΔDC

ΔDC ⩾⩾ RERC F(8,73) = 0.790[.6133] No feedback effects

Domestic credit growth is seen to drive the cyclical component of the RER but with no feedback effects. This replicates the results for excess domestic credit.

The conclusion we draw from this set of results is that monetary shocks drive real exchange rate movements but also that the real exchange rate movements have an impact on monetary shocks, that is they drive each other. This implies that when money supply or domestic credit grows excessively out of line of the growth in economic activity it feeds into the real exchange rate movements with feedback effects with excess money supply growth. Thus, domestic credit has no feedback effects with the real exchange rate, but excess money supply has, through the channel of net foreign assets.

Parallel exchange rate and the official rate: Causality tests

We provide causality test results for the link between the official exchange rate and the parallel market rates. Since the relationship is likely to be disturbed or enhanced by the regime changes, we conduct the tests for the whole sample, for the fixed exchange rate period and for the flexible exchange rate. The results are shown below.

1.The official rate is predicted by the parallel market rate:[12]

EX ⩾⩾ PEX F(6,69) = 0.816[.5612] 1971:3 - 1993:4 No prediction

EX ⩾⩾ PEX F(6,27) = 0.439[.846] 1971:3 - 1982:4 No prediction

EX ⩾⩾ PEX F(6,26) = 2.2677[.068] 1983:1 - 1993:4 EX predicts PEX at 6.8%

2.The parallel rate is predicted by the official rate:

PEX ⩾⩾ EX F(6,69) = 0.998[.434] 1971:3 - 1993:4 No feedback effects

PEX ⩾⩾ EX F(6,27) = 0.078[.998] 1971:3 - 1982:4 Weak effects, at 7.8%

PEX ⩾⩾ EX F(6,26) = 1.232[.323] 1983:1 - 1993:4 No feedback effects

The parallel market rate and the official rate do not predict each other when the whole period is considered. The parallel market exchange rate predicts the official rate in the flexible exchange rate period, 1983–1993, but the predictions are weak. This covers the period of the crawl and floating rate. It may thus appear that the level of the crawl reflected the parallel market exchange rate. Put differently, when the central bank decided on the movements of the crawl, it likely took into account the developments in the parallel market exchange rate.

Still, these results do not confirm whether the official exchange rate was indexed to the parallel exchange rate. However, we would expect these two rates to drive each other if the official rate was indexed to the parallel rate. The results thus reject this proposition. The tentative conclusion from these results is that even though the parallel market was illegal, the central bank, in determining the crawl, took into account the value of the currency in the parallel market, but did not hook the crawl entirely on the parallel market developments. This is consistent with backward indexation of the official exchange rate to the parallel rate.

Cointegration analysis

The next set of analyses is to determine the cointegrating vectors that span the variables in Equation 4, which were found to be integrated of order one. That is, we test whether the domestic price level, the nominal exchange rate, money supply and real income have a long-run relationship, that is, whether they are cointegrated. The test results are shown in Table 5.

Table 5: Cointegration analysis

Eigen values	Null hypothesis	Trace test	P-value
0.364	$r = 0$	77.91	.0001
0.235	$r \leq 1$	37.234	.023
0.103	$r \leq 2$	13.099	.223
0.036	$r \leq 3$	3.309	.430

Note: It should be noted from the graphs of these I(1) variables, they have been affected by shocks. The Johansen procedure applied requires that the residuals from the equations be white noise processes. This required adding dummies to remove the effects of these shocks. But these dummies should be introduced into the dynamic re-parameterization of Equation 4, that is the single equation estimation with the cointegrating vectors.

The table shows the eigen values, the trace test for the significant eigen vectors and the probability values. The hypothesis that we have three cointegrating vectors is rejected; that is, $r \leq 2$. The results thus show that we have two significant vectors. It should be noted that in a system of N variables, we should expect to generate or identify N-1 cointegrating vectors. The method used here helps us to get the most significant vectors. These vectors were identified jointly and normalized with money and the nominal exchange rate consistent with the objectives of the study. These vectors are formed as:

M2 - 1.558CPI - 2.822RY - 0.998EX

EX + 12.66RY- 5.57M2 + 4.18CPI-11.41

The first vector is normalized with money supply, a form of long-run money demand where the exchange rate enters weakly. We see that the coefficients of this vector for prices and real income are larger than those predicted by theory, but they are consistent with theory in terms of direction. The second vector is normalized with the nominal exchange rate and has a drift term. This was not easy to motivate but seems to reflect a form of aggregate demand relation. We normalize with the nominal exchange rate in order to show in the estimated equation how the nominal exchange rate adjusts to its own disequilibrium in the short run.

We thus reparameterize Equation 4 as an error correction model using these two cointegrating vectors. In estimating this model, we start from a general over-parameterized statistical model and then proceed to reduce the model until we arrive at the preferred model. The general and preferred models are shown in the Appendix. The preferred model is solved to obtain the results shown in Table 6.

Table 6: The solved equation for ΔEX

Variable	Coefficient	s.e.	t-ratio
Constant	0.173	0.057	3
RERC	0.126	0.046	2.7
ΔRY	-2.18	0.33	-6.6
ΔM2	0.35	0.12	2.9
ΔCPI	1.12	0.251	4.4
ECM1	0.31	0.087	3.5
ECM2	-0.015	0.006	-2.6
D73:2	-0.076	0.02	-3.8
D73:3	0.082	0.021	3.8
D75:4	0.089	0.022	4.1
D80:2	-0.093	0.021	-4.6
D81:4	0.078	0.02	3.98
D93:2	0.14	0.033	4.3
Seasonality	-0.04	0.016	2.5

WALD test χ^2 (13) = 138.4 [0.0000] **
The Wald test is a linear restrictions test with the null that the coefficients are all zero and this case the null is rejected.
The general model and the preferred model results are shown in the Appendix.

The results from the estimation show that real income significantly drives exchange rate appreciations while money supply[13] and the rate of inflation depreciate the nominal exchange rate. The cyclical component of the real exchange rate shows that on average it will depreciate the nominal exchange rate. The error correction terms show that they will contribute to depreciation and an appreciation of the nominal exchange rate, respectively, reinforcing the short-run effects in the model. The adjustment speed is high for the first error correction term, ECM1, at 30.44%, and low for the second one, ECM2, at -1.5%. Since we have two error correction terms normalized with money and nominal exchange rate, respectively, this differential in adjustment speed reflects the fact that the nominal exchange rate movements responds quickly to one type of disequilibrium and slowly to the other. For ECM1, this adjustment speed is consistent with an exchange rate policy that accommodates monetary disequilibrium in order to protect reserves or with a market determined exchange rate responding to excess money supply. The second, ECM2, shows that the nominal exchange rate adjusts to its own disequilibrium very slowly. In addition, the nominal exchange rate movements are weakly driven by a seasonal effect.

The model results show that the nominal exchange rate movements have been affected by discrete devaluations and shocks, which are reflected by dummies. The dummies were introduced into the model after recursive estimations portrayed episodes of numerous single shocks in the residuals that made the regression parameters unstable.[14] Some of these dummies correspond to some significant macroeconomic events, for example, the first balance of payments crises in 1972 (D73:2-3). There followed extended crisis in the balance of payments due to oil price shocks and at the same time the peg to the U.S. dollar was not changed even after the breakup of the Bretton Woods system, the net effect was to appreciate the shilling. In 1975, (D75:4), a devaluation and a shift of the peg to a basket of currencies had the effect of depreciating the shilling (these results are consistent with the movements in the nominal exchange rate). With the commodity boom and a fixed exchange rate, there was monetary and fiscal explosion between 1976 and 1979; the effects produced a balance of payments crisis in 1980–1982 and there was a series of devaluations in this period before the shift to a crawling exchange rate in 1982 (D82:2 and D81:4). The net effect was a depreciation of the shilling. Finally, in 1993 (D93:2), the exchange rate was partially floated through an inter-bank market rate, but still, there was an official exchange rate, retention accounts and high treasury bill rates attracting capital to flow in, so that by the end of 1993 the exchange rate was appreciating in reaction to the inflows of foreign capital and an accumulation of reserves unmatched by foreign exchange demands. Thus, the results from this equation tentatively reflect the data used and address the objectives of the study.

V. Conclusion

The paper analysed the effects of expansionary monetary policy on the real and nominal exchange rate. The results show that excess domestic credit or excess money supply feed into the cyclical movements of the real exchange rate. In addition, the cyclical movements of the real exchange rate drive each other with excess money supply growth. These results tend to confirm the hypothesis in this paper that monetary shocks affect the real exchange rate.

The results further show that there are feedback effects between monetary shocks and the cyclical movements of the real exchange rate and that this cyclical component appreciates the nominal exchange rate. In addition, money supply growth depreciates the nominal exchange rate, exchange rate interventions have been important in explaining nominal exchange rate movements, and real income and inflation are negatively associated with the nominal exchange rate movements. These dummies in the model correspond to major devaluation episodes and major exchange rate regime changes in Kenya and an attempt to motivate them shows that they correspond to some macroeconomic events.

In addition, the results from causality tests between the official exchange rate and the parallel rate show that even though the parallel market was illegal, the central bank in determining the crawl (during the crawling rate regime) took into account the value of the currency in the parallel market, but did not hook the crawl entirely to the parallel market developments. This shows an element of backward indexation.

What are the policy implications? First, the exchange rate policy has not been supported by the appropriate monetary policy. This is because we find that the short-run monetary shocks affect the real exchange rate with feedback effects. Second, the long-run part of the model shows that the exchange rate policy accommodated monetary disequilibrium in order to protect reserves or to have a market determined exchange rate responding to excess money supply. This is inconsistent with the floating exchange rate policy, where the exchange rate should move to equilibrate reserves while monetary policy is independent. Finally, inflation and money supply depreciates the nominal exchange rate while the cyclical component of the real exchange rate depreciates the real exchange rate. These results provide evidence and reinforce the thesis in this paper that monetary policy is crucial to exchange rate management in Kenya.

Notes

1 Before the peg to the dollar, the Kenya shilling was pegged to the sterling pound after the break-up of the East African Currency Board.

2 The official exchange rate was devalued by 25% in March, 31% in April and 6% in May 1993.

3 There are several events that contributed to money supply expansion in this period, but the most spectacular is the aid freeze in 1991 and the multiparty elections in 1992. Given that the central government was very reliant of foreign funds, deficit financing had to resort to domestic sources, mostly the Central Bank.

4 The cyclical component could be consistent with deviations from equilibrium real exchange rate (misalignment) if a model of real exchange rate equilibrium were formulated. In this paper we maintain the term cyclical component of the real exchange rate rather than misalignment since we have not formulated a model of real exchange rate and real exchange rate equilibrium in order to determine misalignment.

5 This formulation is usually dictated by lack of data on non-traded goods prices.

6 The method usually followed is the univariate Beveridge and Nelson (1981) and the modifications of computation that have followed. However, Enders (1995) has argued that this method is not unique in that it forces the correlation coefficients between innovations in the trend and the irregular components to be unity. Enders (1995) shows that an alternative restriction can be imposed in which the correlation between the trend and irregular component is zero. This solves the problem in the way in which the trend and irregular component are partitioned because economic theory does not always provide the relationship between the two innovations. We adopt this alternative method for decomposition (see exposition in Enders, 1995:186–210).

7 This is related to Dornbusch (1988). In this equation, a cyclical component of the real exchange rate is added. As argued before, the cyclical component could be consistent with deviations from equilibrium real exchange rate (misalignment) if a model of real exchange rate determination were formulated. This equation summarizes the argument in the paper. Details of derivation are in De Grauwe (1994).

8 The parallel market has not been very active in Kenya due to regulations. But there is a feeling that the parallel market exchange rate and the official exchange rate could drive each other and even that the official exchange rate could have been indexed to the parallel exchange rate. Results for causality tests are provided later in the paper.

9 Edwards (1994) specifies almost a similar but dynamic specification for changes in the real exchange rate, but has changes in the nominal exchange rate and the spread in the parallel market exchange rate among the explanatory variables.

10 We use several unit root tests here. In particular, the Phillips-Perron test, PP, is used since it is a generalization of the Dickey-Fuller test procedure but does not require the errors to be serially uncorrelated or homogenous. Instead the PP test allows the residuals to be weakly dependent and heterogeneously distributed. The WS dominates the other tests in terms of power, (See Pantula, S.G. et al).

11 The results should be read as, RERC ⩾⩾ EXDC, RERC is predicted by EXDC. What has been done is to run a regression equation with RERC as the dependent variable and its low lags and lags of EXDC as explanatory variables. Then exclude the lags of EXDC and re-estimate with these linear restrictions. This generates a series of F-tests and probability values that are reported. For example, in RERC and EXDC equation, 8 lags are used, hence 8 restrictions when we exclude EXDC lags.

12 The analysis was conducted with variables in first difference. The two variables were not strongly cointegrated for the whole sample. Conducting causality tests in stationary variables ensured that the statistical tests, F-test, were not invalidated.

13 There is a possibility of an endogeneity problem because of the presence of money supply growth and the cyclical component of the real exchange rate, inflation rate and real income growth in the same equation. In the estimation, we maintained the assumption of weak exogeneity and then tested recursively the stability of the regression parameters, endogeneity was not found to be a problem. It is unlikely to find stable regression coefficients if this assumption is violated.

14 These dummies were also used in the multivariate cointegration analysis in order to obtain white noise residuals.

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Appendix : Model results

General model results (1974:4 – 1994:4) (t-values in the brackets)

Lags Variable	0	1	2	3	4	5	6
Constant	.396 (2.533)						
ΔEX		-.623 (-1.612)	-.126 (-.411)	.462 (1.561)	-1.183 (-3.618)	-.0866 (-.301)	.192 (.734)
RERC	.361 (1.278)	-.513 (-.106)	-.809 (-1.654)	1.742 (3.477)	-.838 (-1.848)	-.642 (-1.685)	.514 (1.902)
ΔRY	-3.309 (-6.878)	.099 (.111)	.167 (.246)	1.249 (1.867)	-4.068 (-4.393)	1.291 (1.258)	-.508 (-.810)
ΔM2	.0234 (.154)	.0457 (.222)	.666 (4.420)	-.196 (-1.110)	-.218 (-1.64)	.526 (2.960)	-.0199 (-.103)
ΔCPI	-.243 (-.956)	-.367 (-.935)	-.343 (-1.120)	-1.104 (-3.75)	.374 (1.119)	.147 (.514)	-.901 (-3.034)
ECM1		.737 (1.951)					
ECM2		-.0238 (-1.225)					
D73:2	-.174 (-4.21)						
D73:3	.187 (3.890)						
D75:4	.202 (4.517)						
D80:2	-.216 (-4.720)						
D81:4	.169 (3.913)						
D93:2	.331 (4.600)						
Seasonal	-.0244 (-1.619)	-.0603 (-2.597)	-.0239 (-1.450)				

R^2 = .9402, F(45,47) = 16.427 [.000], s.e. = .036986, DW = 2.10, RSS = .064293, for 46 variables and 93 observations; Diagnostic tests {probability values in the brackets}:AR1-5 F(5,42) = 1.016[.4205], ARCH 4 f(4,39) = .194[.940], Normality, $\chi^2(2)$ = .575[.7500].

Preferred model results (t-values in the brackets)

Lags Variable	0	1	2	3	4	5	6
Constant	.398 (3.395)						
ΔEX		-.437 (-2.992)		.374 (1.586)	-1.235 (-4.351)		
RERC	.179 (3.214)		-.513 (-2.626)	1.7068 (4.110)	-1.026 (-3.749)	-.364 (-3.356)	.375 (2.295)
ΔRY	-3.152 (-10.67)			1.658 (3.595)	-4.158 (-6.672)	.646 (1.106)	
ΔM2			.642 (5.818)	-.193 (-1.447)	-.161 (-1.202)	.521 (3.814)	
ΔCPI	-.231 (-1.101)	-.429 (-1.714)	-.483 (-2.687)	1.0561 (4.386	.463 (1.783)		.8321 (-4.811)
ECM1		.699 (3.515)					
ECM2		-.0247 (-1.616)					
D73:2	-.174 (-4.721)						
D73:3	.184 (4.562)						
D75:4	.204 (5.224)						
D80:2	-.215 (-5.295)						
D81:4	.163 (4.253)						
D93:2	.323 (5.946)						
Seasonal	-.0203 (-1.628)	-.0515 (-2.860)	-.019 (-1.521)				

R^2 = .937, F(34,58) = 25.367 [.000], s.e. = .034182, DW = 2.05, RSS = .067766, for 35 variables and 93 observations; Diagnostic tests {probability values in the brackets}:AR1-5 F(5,53) = 1.033[.4205], ARCH 4 f(4,50) = .225[.923], Normality, χ^2 (2) = .956[.6199].