Exchange Rates and Economic Growth in Kenya:
An Econometric Analysis

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Abstract

The current work expands on an earlier paper which had discussed the relationship between economic growth and exchange rate in Kenya. Based on data for the period 1970 to 1996, we analyze the possible direct and indirect relationship between the real and nominal exchange rates and GDP growth. We derive these relationships in three ways: within the context of a fully specified (but small) macroeconomic model, as a single-equation instrumental variable estimation, and as a vector-autoregression model. The estimation results from the three different settings show that there is no evidence of a strong direct relationship between changes in the exchange rate and GDP growth. Rather, Kenya's rate of economic growth has been directly affected by fiscal and monetary policies, the availability of foreign aid and other economic variables, particularly the growth of exports. Together, these factors have tended to sustain a pattern of real exchange rate over-valuation, which has been unfavorable for growth. Our conclusion is that improvements in exchange rate management alone are not adequate for the revival of growth in Kenya, but have to be part of a broader program of economic reform.

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I. INTRODUCTION

A recent Development Discussion Paper[1] examined the role of the exchange rate in Kenya's economic growth. The paper established that the over-valued real exchange rate had impeded growth but that other factors were the principal causes of Kenya's unsatisfactory economic performance. Such factors included foreign aid dependence, a large and inefficient public sector, low rates of saving and investment, persistent and relatively large budget deficits and inconsistent macroeconomic policy. The basic conclusion was that improvements in exchange rate management could make a difference to Kenya's growth prospects but only within the context of a broader program of adjustment and reform.

In this paper we provide empirical support for the above conclusion. We use a number of approaches that include the following: single equation regressions, a system of simultaneous equations, and a VAR model test. Our intention is to provide a broad range of estimates of the direct and indirect relations between the exchange rate and growth, and highlight the importance of other economic factors affecting their interaction.

The paper is arranged as follows. Section II discusses the theoretical relationship between the exchange rate and economic growth. Section III describes the basic characteristics of the Kenyan economy. The empirical analysis is presented and results are discussed in Section IV. Section V has concluding comments.

II. EXCHANGE RATES AND ECONOMIC GROWTH

A difficulty in determining the impact of exchange rates on the rate of economic growth is that most of the important macroeconomic effects are indirect. The interaction among the exchange rate (the local price of foreign exchange), inflation (the change in domestic prices), and economic growth (the change in real income) are especially important. A typical problem is created by high and rising inflation (due, most often, to widening budget deficits) within the context of a sluggishly adjusting nominal exchange rate, which is being "managed" by the central bank in order to "maintain price stability". The resulting real over-valuation of the exchange rate impedes export growth and creates uncertainty about potential future movements in the exchange rate.

In both theory and practice, there is a close relationship between movements in the exchange rate and the rate of inflation.[2] The Purchasing Power Parity theory of exchange rate determination, which is based on the law of one price, expresses the change in the exchange rate as a function of the difference between the (appropriately weighted) change in "world" prices and the change in domestic prices.[3] The monetary theory of the balance of payments, which relates movements in international reserves (if exchange rates are fixed) or the exchange rate (if it is floating) to shifts in the relative demand for and supply of money, yields a similar functional relationship.[4]

Because it is so visible, the nominal exchange rate is a sensitive policy indicator. Yet, for purposes of growth analysis, economic managers need to focus on trends in the real

exchange rate, i.e. the ratio of the price of tradables and the price of non-tradables[5]. An overvalued real exchange rate represents a persistent misalignment of prices between a particular country and the rest of the world[6]. Such misalignment has an impact on the pattern and level of production, the allocation and level of expenditure; the distribution and level of factor payments; the composition and size of trade flows; the levels of international reserves and external debt; and (in more extreme cases) the emergence of parallel foreign exchange markets, currency substitution and capital flight. Persistent real overvaluation also seriously erodes business and consumer confidence, thereby lowering the rate of savings and investment. The outcome is a decline in growth.

III. CHARACTERISTICS OF KENYA'S ECONOMY

With its nominal exchange rate[7] managed for a larger part of the period under review (Fig. 1 and Fig. 3 in Appendix A), Kenya provides a case study of the adverse effects of a "controlled" exchange rate in the context of imprudent fiscal and monetary policies. The consequences are evident in the macroeconomic data in Table 1.

Over the period 1985 to 1990 real GDP grew at an average rate of approximately 5.5%. However, from 1990 to 1996 the average growth rate was only 2.3%, implying that real per capita income declined significantly in the first half of the 1990s (see also Fig. 5).[8]

There were a number of factors associated with this unsatisfactory performance. Inflation was relatively high and erratic (Fig. 6 in Appendix A). The real exchange rate (Fig. 2 and Fig. 3) has been unstable over the last ten years. Its biggest devaluation is in the period 1990-1994, and it is mirrored by a jump in the parallel market premium (Fig. 7 and Fig. 8). The real interest rate, while mostly positive, was relatively low until recent years. Exports lacked dynamism, leading to a chronic balance of payments deficit. This was reflected in the rapid growth of external debt.

Perhaps the most significant growth-detracting element was the chronic fiscal deficit. This created widespread financial uncertainty, which is reflected in the declining rates of saving and investment. During the analyzed period, Kenya received large inflows of foreign assistance. This, however, was inadequate to offset the negative impact of the factors noted above. The result was a significant decline in the rate of economic growth.

Viewed in broader terms, Kenya's economy has not performed at anywhere near its potential. The exchange rate had some effect, but, as these data show, other factors were more important.

Table 1: Kenya: Basic macroeconomic indicators, 1985-96

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
GDP at market prices (mill. USD) [1]	6131	7241	7972	8519	8341	8572	8152	8209	5753	7399	9095	9272
GDP 1990 Prices (mill. USD) [2]	7387	8488	9080	9372	8734	8572	7838	7679	5244	6595	7909	7911
Real GDP Growth (annual %) [3]	4.2	6.9	5.8	6.0	4.6	4.1	1.4	-0.8	0.4	2.6	4.3	4.1
Inflation Rate (% change CPI, 1990=100)	12.4	4.6	7.4	10.6	12.2	14.5	18.1	25.9	37.7	25.5	0.8	8.4
Exchange Rate (Shillings per USD) [4]	16.4	16.2	16.5	17.7	20.6	22.9	27.5	32.2	58.0	56.1	51.4	57.1
Real Ex. Rate (1990=100) (Shillings per USD) [5]	22.2	21.3	20.8	21.0	22.6	22.9	23.9	22.3	28.3	21.8	20.4	21.4
Real Interest Rate (in %, period average) [6]	1.5	8.6	5.5	2.9	1.7	0.3	-1.5	-9.4	12.1	-2.2	17.5	13.8
Change in Money Supply (M2, annual %) [7]	6.2	28.3	10.6	7.7	12.2	18.3	17.9	32.9	24.7	27.3	15.2	23.2
Export of Goods&NF Serv. (mill. USD) [8]	1553	1870	1701	1864	1923	2234	2200	2151	2326	2644	2967	3038
Import of Goods&NF Serv. (mill. USD) [8]	1615	1857	2108	2315	2540	2679	2302	2143	2051	2420	3503	3417
Export of Goods&NF Serv. (% of GDP)	28.1	29.7	24.1	24.1	24.4	26.2	25.5	22.7	30.2	25.0	24.5	24.6
Import of Goods&NF Serv. (% of GDP)	29.2	29.5	29.8	29.9	32.2	31.4	26.7	22.6	26.6	22.9	28.9	27.7
External Debt (mill. USD) [9]	4178	4589	5755	5781	5862	7056	7455	6907	7118	7160	7381	..
Foreign Aid (mill. USD) [10]	430	445	560	836	1064	1187	921	886	911	677	732	..
Current Account Balance (% of GDP) [11]	-1.9	-0.6	-6.3	-5.5	-7.1	-6.1	-2.6	-2.2	1.2	1.3	-4.4	-0.6
Fiscal Balance w/o Grants (% of GDP) [12]	-6.4	-4.6	-7.5	-5.6	-8.9	-5.7	-4.9	-3.3	-6.2	-6.2	-2.2a	-2.8**a**
Gross Domestic Savings (% of GDP) [13]	24.9	21.9	19.2	19.7	17.3	19.0	19.7	16.4	22.5	21.3	12.9	18.5 **b**
Gross Dom. Investment (% of GDP) [13]	26.0	21.8	24.3	25.0	24.7	24.2	21.0	16.9	17.6	18.6	19.2	21.1

Notes:

[1] African Development Indicators, 1997, World Bank.

[2] Calculated from 1 using the US GDP deflator (1990=100).

[3] Calculated from GDP 1990 Prices, IFS, IMF, 1997.

[4] Principal rate (period average), IFS, IMF, 1997.

[5] Calculated as ratio of US to Kenyan CPI times the nominal exchange rate, IFS, IMF, 1997.

[6] Calculated as $[(1+i)/(1+\pi)]-1$, where i is Kenya's Treasury Bill Rate (percent per annum) and π is the inflation rate based on the CPI, IFS, IMF, 1997.

[7] Percentage change over previous year of Money plus Quasi-Money, IFS, IMF, 1997.

[8] Converted to US Dollars using the Principal exchange rate (period average), IFS, IMF, 1997.

[9] World Development Indicators, World Bank, 1997.

[10] African Development Indicators, World Bank, 1997.

[11] World Development Indicators, World Bank, 1997.

[12] Government deficit minus Grants received as a fraction of GDP, IFS, IMF, 1997.

[13] World Development Indicators, World Bank, 1997.

a From HIID. Notes on Kenya's Economic Situation, April 1997, Table 1.

b From Central Bank of Kenya, Monthly Economic Review, March 1997.

IV. EMPIRICAL ANALYSIS AND RESULTS

For the purpose of our analysis, we treat Kenya as a small open developing economy which is affected by world market fluctuations. We analyze the relationship between the growth rate of GDP and the exchange rate in three different settings. First, we estimate single equation regressions of the real output growth and the real exchange rate. We then present a structural macroeconomic model of the Kenyan economy. And finally, we consider a VAR model test of the real exchange rate and real income.

We use annual data covering the period 1970-96. A list of all variables and their definitions and source appears in the Appendix B. We could have used quarterly data but they cover a much shorter period. The principal results of the paper, however, can be illustrated just as well using annual data.

As a working definition of the real exchange rate, in this paper, we use the nominal exchange rate (in terms of units of Kenyan Shillings per British Pound) adjusted with the ratio of the foreign price level (United Kingdom CPI, as a proxy for the price of tradables) and the domestic price level (Kenyan CPI, as a proxy for the price of non-tradable good).[9] This definition follows the purchasing power parity condition, which, tested for the period 1970-96, gives the following result:

Dependent Variable: Exchange Rate

Variable	Coefficient	Std. Error	t-Statistics
Constant	2.760	0.205	13.474
p_t	1.129	0.073	15.450
p^f_t	-0.970	0.113	-8.610
R^2=0.96			

where p_t is the domestic price level, p^f_t is the foreign price level and t indicates the time period.

All estimations in the next two sections are made using first differences (with the exception of the interest rates and the interest rate spread) in order to remove the dominance of the trend (or the long term movement) in the series. We consider a possible long-run relation between real exchange rate and real income in the section **c.**

Readers will note that we only present one version of each equation. Several coefficients are relatively insignificant. Our intention has been to highlight the relation between the growth of income and changes in exchange rates within a theoretically plausible statistical relation. We leave it to others to refine the relationships in ways that raise the significance of other variables.

a. Single Equation Estimations

1. The estimated equation for the real income growth follows the standard monetary theory for an open economy. It investigates the effect of the money supply, inflation, and the exchange rate on the real output growth (a small letter denotes logarithm of the variable, e.g., $e = \mathbf{Log(E)}$):

$$\Delta yr_t = f\,[\,\Delta m_t, \Delta m_{t-1}, \Delta yr_{t-1}, \Delta p_t, \Delta p_{t-1}, \Delta er_t, \Delta er_{t-1}\,],$$

where Δyr_t is the real output growth rate at time $\mathbf{t}$, Δm_t is the change in nominal money supply (defined as M2), Δp_t is the domestic inflation rate based on the consumer price index, Δer_t is the change in real exchange rate, and $\Delta yr_{t-1}, \Delta m_{t-1}, \Delta p_{t-1}, \Delta er_{t-1}$ are their lagged values.

The estimated parameters along with the standard errors and the t-statistics are:

Dependent variable: Real Income Growth

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.034	0.021	1.638
Δer_t	0.012	0.066	0.178
Δm_t	0.067	0.057	1.178
Δp_t	-0.200	0.093	-2.143
Δyr_{t-1}	0.280	0.236	1.185
Δer_{t-1}	0.054	0.070	0.774
Δm_{t-1}	0.097	0.070	1.382
Δp_{t-1}	-0.028	0.088	-0.316

R^2=0.52   **D.W.**=1.76

The most statistically significant variable in the regression is the rate of inflation. Its contemporaneous and lagged values have a negative effect on real income growth. The relation between real money growth and real income growth is positive. These results are consistent with the theory. The coefficient, however, is not statistically significant.

2. The theoretical basis of the regression equations for the exchange rate is a set of well known economic relationships: the purchasing power parity (PPP), based on the law of one price: $\mathbf{P=E.P^f}$, the money market equilibrium condition: $\mathbf{M^D=(P.Y)/V(i)=M^S}$, and the interest arbitrage condition: $\mathbf{i\text{-}i^f=\Delta E}$. Considered together, they motivate the following model of the changes in the real exchange rate:

$$\Delta er_t = f\,[\,\Delta yr_t, \Delta mr_t, ir_t, \Delta er_{t-1}, \Delta yr_{t-1}, \Delta mr_{t-1}, ir_{t-1}\,],$$

where ir_t is the domestic real interest rate based on the 3-month Treasury bill rate. The estimation results are as follows:

Dependent Variable: Change in Real Exchange Rate

Variable	Coefficient	Std. Error	t-Statistics
Constant	-0.047	0.035	-1.330
Δyr_t	0.318	0.776	0.410
Δmr_t	-0.160	0.204	-0.787
ir_t	0.008	0.003	2.944
Δer_{t-1}	0.412	0.246	1.677
Δyr_{t-1}	0.952	0.812	1.173
Δmr_{t-1}	0.050	0.210	0.237
ir_{t-1}	-0.005	0.003	-1.671
R^2=0.41 D.W.=2.09			

As illustrated above, real income growth and the change in the real exchange rate are positively related. This relation, again, is not statistically significant. The contemporaneous value of the real interest rate has a positive and significant effect on the real exchange rate. This is inconsistent with the theory, in which a rise in real interest rates leads to an appreciation of the real exchange rate. However, the lagged real interest rate is negatively related to the real exchange rate. There are a number of explanations for this. One is that the monetary authorities adjust interest rates in response to pressure on the exchange rate. A second explanation is that capital flows to Kenya (including donor support) have simultaneously appreciated the real exchange rate and reduced the increase in prices. Since nominal interest rates have, until recently, adjusted sluggishly, this has led to a simultaneous decline in real interest rates.

The next regression introduces an important external effect through the price of coffee. Since coffee is one of the Kenya's major exports, its price movements are a good indicator of the world market influence on the Kenya's trade and hence, output growth.

Dependent Variable: Change in Real Exchange Rate

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.014	0.034	0.417
Δyr_t	0.872	0.650	1.342
Δmr_t	0.084	0.181	0.462
ir_t	0.004	0.002	1.832
Δp_t^{cw}	-0.097	0.049	-1.981
Δer_{t-1}	0.189	0.220	0.864
Δyr_{t-1}	-0.458	0.787	-0.581
Δmr_{t-1}	0.085	0.179	0.477
ir_{t-1}	-0.004	0.003	-1.657
Δp_{t-1}^{cw}	-0.153	0.054	-2.860
R^2=0.66 D.W.=2.33			

As expected, an increase in the world market coffee prices is negatively and significantly related to the change in the real exchange rate. The link, which is even stronger after one period, is the increase in export revenue as coffee price rises. This leads to an appreciation of the real exchange rate. But even when this variable is included, the relation between the real exchange rate and real income growth remains weak.

b. Simultaneous Equations Model

The single equation estimations above show that the effect of the exchange rate on output growth (and vice versa) is indirect. Based on the structure of the Kenya's economy, this effect is mediated by the interaction of monetary changes, the world market conditions for Kenya's exports, and shifts in domestic and world interest rates.

To capture these inter-relations, we have estimated a simple structural model of the Kenyan economy. It includes equations for the inflation rate, real income growth, changes in the exchange rate, changes in government revenue, changes in imports and the real output growth in agriculture; and also includes accounting identities for the money supply, balance of payments and the domestic credit.

1. Inflation
$$\Delta p_t \; = \; f_1 \, [\, \Delta m_t, \Delta yr_t, \Delta p_{t-1}, \Delta e_t, \Delta p^f_t \,]$$

2. Real Income Growth
$$\Delta yr_t \; = \; f_2 \, [\, \Delta mr_t, \Delta er_t, \Delta er_{t-1}, \Delta p_t, \Delta yr_{t-1}, \Delta aid_t \,]$$

3. Exchange Rate
$$\Delta e_t \; = \; f_3 \, [\, \Delta y_t, \Delta y_{t-1}, \Delta e_{t-1}, \Delta m_t, \Delta p_t, \Delta p^f_t, \Delta aid_t, (i_t - i^f_t) \,]$$

4. Government Revenue
$$\Delta t_t \; = \; f_4 \, [\, \Delta y_t, \Delta y_{t-1}, \Delta im_t, \Delta aid_t, \Delta t_{t-1} \,]$$

5. Import Growth
$$\Delta im_t \; = \; f_5 \, [\, \Delta y_t, \Delta y_{t-1}, \Delta e_t, \Delta e_{t-1}, \Delta aid_t, \Delta im_{t-1} \,]$$

6. Real Output Growth in Agriculture
$$\Delta yr_t^{agr} \; = \; f_6 \, [\, \Delta yr_t, \Delta er_t, \Delta p_t^{cw}, \Delta aid_t \,]$$

7. Money Supply
$$\Delta M^S_t \; = \; \Delta DC_t \; + \; \Delta NFA_t$$

8. Balance of Payments
$$\Delta NFA_t \; = \; EX_t \; - \; IM_t \; + \; CAP_t \; + \; AID_t$$

9. Domestic Credit
$$\Delta DC_t \; = \; G_t \; - \; T_t \; + \; \Delta CP_t$$

This model draws on the structural macroeconomic model of Khan and Knight (1991). It includes all the basic elements of the financial programming framework used by the International Monetary Fund. We have enhanced the original Khan-Knight model by

adding open economy indicators: exchange rate, exports, and imports. We have also added some details relevant to Kenya's economy: the important role of the agricultural sector and its dependence on foreign aid. The basic idea has been to attempt to determine the relation between growth and exchange rate while allowing for other key influences on both variables.

The system was estimated using Three-Stage Least Squares (3SLS). The results for each equation are presented in the tables below:

Dependent Variable: Inflation Rate

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.073	0.025	2.910
Δp_{t-1}	0.166	0.124	1.340
Δyr_t	-1.275	0.283	-4.508
Δm_t	0.266	0.069	3.826
Δe_t	0.039	0.065	0.593
Δp^f_t	0.276	0.118	2.341

Dependent Variable: Real Income Growth

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.046	0.018	2.504
Δmr_t	0.096	0.058	1.670
Δer_t	-0.048	0.053	-0.902
Δer_{t-1}	-0.032	0.042	-0.767
Δp_t	-0.214	0.115	-1.860
Δyr_{t-1}	0.304	0.211	1.439
Δaid_t	0.022	0.028	0.806

Dependent Variable: Change in Exchange Rate

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.159	0.083	1.904
Δy_t	-0.758	1.245	-0.609
Δy_{t-1}	-0.981	0.510	-1.923
Δe_{t-1}	0.214	0.174	1.230
Δm_t	0.189	0.259	0.729
Δp_t	0.180	0.932	0.193
Δp^f_t	0.534	0.476	1.122
Δaid_t	0.204	0.090	2.280
$i_t - i^f_t$	0.007	0.003	2.848

Dependent Variable: Change in Government Revenue

Variable	Coefficient	Std. Error	t-Statistics
Constant	0.010	0.052	0.196
Δy_t	-0.812	0.273	-2.979
Δy_{t-1}	1.468	0.259	5.666
Δaid_t	-0.070	0.048	-1.460
Δim_t	0.319	0.083	3.840
Δt_{t-1}	0.130	0.130	0.999

Dependent Variable: Import Growth

Variable	Coefficient	Std. Error	t-Statistics
Constant	-0.221	0.150	-1.474
Δy_t	1.102	0.883	1.247
Δy_{t-1}	1.537	0.969	1.586
Δe_t	0.336	0.365	0.919
Δe_{t-1}	-0.085	0.334	-0.254
Δaid_t	0.121	0.184	0.658
Δim_{t-1}	-0.333	0.221	-1.510

Dependent Variable: Real Output Growth in Agriculture

Variable	Coefficient	Std. Error	t-Statistics
Constant	-0.017	0.015	-1.170
Δyr_t	0.967	0.274	3.545
Δer_t	-0.251	0.089	-2.834
Δp_t^{cw}	0.085	0.022	3.801
Δaid_t	0.051	0.040	1.252

The principal determinants of inflation have been real output (as a supply variable), the growth of money supply and the change in foreign prices. The exchange rate was statistically insignificant.

In statistical terms, there were few important determinants of real income growth. It is interesting to note that growth and real exchange rate were negatively related, though the estimated coefficient was not statistically significant. This is the opposite of what is normally expected, i.e. a real exchange rate depreciation associated with a decline in growth. This outcome is repeated in the next equation. Nonetheless, it is useful to note that the exchange rate and imports and real exchange rate and agricultural output growth have the correct signs on the respective coefficients. Thus, within the context of the model, the direct relation between the real exchange rate and real income growth is negative; the indirect relation, through exports and agricultural growth, is positive. Part of

the negative association may be attributed to the role of foreign aid. In the model, aid shows up with a positive effect on real income growth (though the estimated coefficient is relatively insignificant). Aid, however, had a highly significant positive impact on the exchange rate. One explanation is that slower income growth has put pressure on the exchange rate leading to an increase in aid. An alternative explanation stems from the negative relation between aid and government revenue. An increase in aid reduces government revenue and raises the growth of money supply to cover the budget deficit. This raises the rate of inflation, depreciates the shilling, and lowers the rate of growth.

c. VAR Model and Cointegration Test Results

The single equation estimates and the simultaneous equations model results provide some indication of the direct and indirect links between exchange rate movements and growth. They expressed the short run dynamics of the real exchange rate--real income growth relationship. These results, and the basic conclusions of this paper, do not concern the question of whether the two variables are related in a long run.

However, we address this issue by running a Johansen cointegration test based on a VAR model of the real income and the real exchange rate. Since there is no direct <u>theoretical</u> connection between these two variables, the structure of the VAR model we use has to be seen as a <u>statistical</u> relationship only.

Estimating VAR models of the real exchange rate and real income with different number of lags (from 1 to 4) and comparing the value of the Akaike Information Criteria (AIC) statistics suggest that the optimal VAR structure has one lag for each variable:

$$yr_t = c_1 + \beta_{11}\, yr_{t-1} + \beta_{12}er_{t-1} + u_1$$
$$er_t = c_2 + \beta_{21}\, yr_{t-1} + \beta_{22}\, er_{t-2} + u_2,$$

We then use the Johansen method for the VAR model with one lag to test for cointegration. The likelihood ratio test finds no cointegration in this case[10].

These results are consistent with our earlier findings. The real exchange rate and the real income are not significantly related. At most, there is a weak long-run relationship between the two variables.

V. CONCLUSIONS

This paper has provided empirical estimates of the relation between exchange rates and economic growth in Kenya. The results show that there is not a statistically significant direct relationship between the two variables. They, however, are indirectly linked through several channels, including money, imports, agricultural production, and foreign aid. The vector autoregression results show that the real exchange rate and the real income are not significantly cointegrated. In the long run, the exchange rate and income may not drift apart, but in the short run their relationship is weak and indirect. Together, these results provide statistical confirmation of our earlier conclusion: improvement in exchange rate management in Kenya can influence the rate of income growth, but only in the context of a broad-based structural adjustment and reform.

APPENDIX A

DEFINITION OF VARIABLES

Δp_t	- rate of inflation (P is the Kenyan Consumer Price Index, 1990=100)
Δp_{t-1}	- a proxy for the expected inflation rate at time t
Δy_t	- growth rate of nominal GDP (market prices)
Δyr_t	- growth rate of real GDP (market prices, 1990=100)
Δyr_t^{agr}	- growth rate of real output in agricultural sector (market prices, 1990=100)
Δp_t^f	- foreign rate of inflation (P^f is the U.K. Consumer Price Index, 1990=100)
e_t	- nominal exchange rate in units of domestic currency per British Pound
er_t	- real exchange rate (nominal exchange rate adjusted for domestic and foreign prices)
m_t	- nominal stock of money (Money plus Quasi-Money)
mr_t	- real money balances
i_t	- nominal domestic interest rate
i_t^f	- nominal foreign interest rate
$i_t - i_t^f$	- interest rate spread
p_t^{cw}	- world market coffee price
im_t	- imports of goods and services
ex_t	- export of goods and services
g_t	- nominal government expenditure
t_t	- nominal government revenues
CAP_t	- a proxy for capital flows
aid_t	- aid flows
NFA_t	- net foreign assets
DC_t	- domestic credit
CP_t	- claims of the banking system on the domestic private sector and other financial institutions

Note: Lower-case letter denotes the logarithm of the upper-case variable.

12

DATA SOURCES

From International Financial Statistics, IMF

National Accounts

Y   - Gross Domestic Product at market prices, in millions of Kenyan Shillings.
Yr - Real GDP (at 1990 market prices), in millions of Kenyan Shillings.
IM - Imports of Goods and Non-Factor Services, in millions of Kenyan Shillings.
EX - Export of Goods and Non-Factor Services, in millions of Kenyan Shillings.

Prices

P   - Consumer Price Index (1990=100).
P^f - Consumer Price Index of the U.K. (1990=100).
E - Official Exchange Rate (period average), in Kenyan Shillings per British Pound.
Er - Real Exchange Rate (Kenyan Shillings per British Pound), calculated as $Er = E*(P^f/P)$.
P^{cw} - Coffee Price (US cents/pound) of Other Milds (New York), converted into Kenyan Shillings/pound using the Official Exchange Rate (period average).

Monetary Survey

M   - Broad Money (Money plus Quasi-Money), in millions of Kenyan Shillings.
Mr   - Real Money Balances calculated as M/P, in millions of Kenyan Shillings.
NFA - Net Foreign Assets, in millions of Kenyan Shillings.
DC   - Domestic Credit, in millions of Kenyan Shillings.
CP   - Claims on Private Sector plus Claims on Other Financial Institutions, in millions of Kenyan Shillings.

Interest Rates

i   - 3-Month Treasury bill Rate (percent per annum).
i^f - 3-Month Treasury bill Rate (percent per annum) of the U.K.
ir - Real Interest Rate, calculated as $ir = [(1+i)/(1+\pi)]-1$, where $\pi = \Delta logP$ is the inflation rate.

Government Finance

G - Government Expenditure, in millions of Kenyan Shillings.
T - Government Revenue, in millions of Kenyan Shillings.

From World Tables, World Bank

Y^{agr} - Real Output in Agriculture, as a percent of GDP, recalculated in millions of Kenyan Shillings and calculated in real terms using the GDP deflator (1990=100).
      Note: The numbers for 1993-96 are IMF Staff estimates.

AID - Foreign Aid, calculated using Foreign Aid per capita (in US Dollars) and Population (total) series from WDI and the Official Exchange Rate (period average) series from IFS, IMF.

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NOTES

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[1]. Malcolm F. McPherson, "Exchange Rates and Economic Growth in Kenya," *Development Discussion Paper No. 607*, October 1997, HIID.

[2]. There is a large literature on this relationship--Niehans (1978: Ch. 11), Frenkel and Mussa (1985), Hallwood and MacDonald (1986) MacDonald (1988), Goodhart (1989:Ch. 8), Edwards (1989), and Sachs and Larrain (1993: Chs. 10, 11).

[3]. Sachs and Larrain (1993: pp.297-300).

[4]. The demand for money can be written as domestic prices multiplied by a function of real income and interest rates. For a fixed exchange rate, any excess demand for (supply of) money will be reflected as the accumulation (depletion) of international reserves. For a floating exchange rate, any excess demand for (supply of) money will lead to an appreciation (depreciation) of the exchange rate. These portfolio changes directly influence domestic prices. Under a fixed exchange rate, excess demand for (supply of) money reduces domestic demand thereby reducing (increasing) the rate of inflation. These changes in prices will, respectively, under-value (over-value) the real exchange rate. With a floating exchange rate, the domestic price changes will lead to movements in the exchange rate. Due to the existence of lags, uncertainty as to the permanence of policy changes, credibility effects, and so on, the above adjustments will not occur smoothly in practice. The above effects, however, are relatively consistent over the medium terms (Johnson 1973: Ch.9; Sachs and Larrain 1993:299-301; and Rogoff 1996).

[5]. Maciejewski (1983); Helmers, (1988).

[6]. Prices are typically misaligned in two ways. In static terms, the comparative costs of production and distribution at the existing real exchange rate are "too high" in that the underlying economic "absorption" generates a balance of payments deficit, which cannot be financed. In dynamic terms, some behavior emerges (such as persistent deficit financing), which tends to raise the rate of overall domestic inflation above the corresponding rates in the country's main trading partners. In the former case, the real over-valuation can be corrected by a devaluation, which leads to "expenditure-switching" and "demand-reduction. " In the latter case, the real over-valuation requires a change in the behavior that leads to excess money creation combined with a floating exchange rate, or a pre-determined, credible "tablita" which regularly offsets the effects of the higher rate of domestic inflation.

[7]. Here, and throughout the paper, the exchange rate E_t is defined as units of Kenyan Shillings per British Pound. Thus, an increase in E_t will correspond to depreciation of the domestic currency price.

[8]. The average population growth rate for the period 1990-96 was 2.7%.

[9]. The choice of the United Kingdom as a representative for the World in this open economy model for Kenya is consistent with the fact that the U.K. is Kenya's major trading partner.

[10]. In a two lag setting:

$$yr_t = c_1 + \beta_{11} yr_{t-1} + \beta_{12} yr_{t-2} + \beta_{13}er_{t-1} + \beta_{14}er_{t-2} + u_1$$
$$er_t = c_2 + \beta_{21} yr_{t-1} + \beta_{22} yr_{t-2} + \beta_{23}er_{t-1} + \beta_{24}er_{t-2} + u_2,$$

the Johansen test shows that there is a cointegration relationship between the two series at 5% significance level. The normalized cointegrating coefficients are:

er	yr	c
1.00	-0.72	5.12
	(0.14)	

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