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The Effects of Changes in Commodity Export Prices on Money Creation and Real Exchange Rate in Selected African Countries

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Abstract

Changes in the world prices of commodities have macro level effects on Sub Sahara African countries whose economies depend primarily on export revenues. This study analyzed the determinants of money creation and real exchange rate of selected Sub Sahara African countries (Cote d'Ivoire, Gabon, Ghana, Kenya and Nigeria), operating under either a fixed exchange rate system, or a flexible exchange rate system. The empirical results show that both money creation and real exchange rate are determined by changes in factors that are specific to each country's monetary policies and export commodity markets. Money creation is determined by changes in the real money balances, the nominal interest rate, the inflation tax, and the export prices of a country's primary product(s) such as cocoa, coffee, tea, and crude oil. On the other hand, the real exchange rate is determined by changes in factors such as the nominal exchange rate of a domestic currency, the inflation rate, the world inflation rate, the inflation tax, and the world prices of cocoa and crude oil for SSA exporters of these two major commodities. Overall, the selected countries share insightful similarities and differences that have significant policy implications.

Introduction

Most Sub Sahara African (SSA) countries rely on the exports of few primary commodities such as coffee, cocoa, cotton and tea as their main sources of revenues. Thus, changes in export prices may have a significant impact on economic fundamentals such as the real exchange rate and the money creation. During periods of increased

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export activities, their domestic currencies may experience a real appreciation as foreign demand for their commodities rises in response to lower export prices. In contrast, a real depreciation of their domestic currencies may occur during periods of declining exports associated with rising export prices. Moreover, SSA countries whose international reserves increase in response to changes in the export volume and prices of their primary commodities may experience a rise in inflation rate. As a result, their real exchange rate may appreciate due to the inflationary effects of money creation associated with international reserve fluctuations. However, the magnitude of the effects of export price changes on the appreciation or depreciation of the real exchange rate depends in large part on a given country's exchange rate system.

The main purpose of this paper is to analyze empirically the effects of changes in the export prices of primary commodities and other factors on: (a) money creation, and (b) the real exchange rate in selected SSA countries operating under either a fixed or a flexible exchange rate currency system. Empirical evidence on the determinants of money creation and the real exchange rate of SSA countries maybe useful when formulating policies intended to achieve desired domestic economic goals.

Overview of the Relative Significance of Primary Commodities

The trade patterns of SSA countries have been strongly influenced by their colonial ties with Western Europe. For over three quarter of a century, the two major European colonial powers, namely the United Kingdom and France, had monopoly over the imports and exports of most former African territories. Hence, most exports of raw materials and tropical agricultural commodities from colonial African territories went to the United Kingdom and France, which in turn supplied them with manufactured products. Upon gaining independence in the late 1950s and early 1960s, many SSA nations pursued economic development policies by promoting the establishment of import substitution industries and the expansion of their export sectors. However, the pace of industrialization has been quite slow and relatively insignificant for many of SSA nations, as their economies continue to depend on the exports of the same primary commodities as before as independence. Although trade with other western nations,

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mostly members of the European Union, has increased significantly over the past thirty years, France and the United Kingdom remain their major trading partners. Fluctuations in the import demand for primary commodities due to changes in export prices relative to importing nations' economic conditions affect significantly the gross domestic products of SSA countries.

SSA national incomes and fiscal policies are affected by the price movements of their major exports. The influence of movements in commodity prices on export sales, tax revenues, and government expenditures in countries whose economies depend strongly on the export of primary commodities has been documented by several studies (Cuddington, 1992; Bleaney and Greenaway, 1993; Deaton, 1999b; Cashin, McDermott, and Scott, 2002). Deaton (1999b) indicated that primary commodities were accounted, on average, for three-fourth of the total SSA exports in 1997. Hence, during periods of rises in commodity export prices, government revenues increase, either directly from the sale of commodities by state-owned institutions, or indirectly from levying taxes associated with export commodities. Collier and Gunning (1996) pointed out that the commodity exporting countries relying on the windfall gains associated with export price movements to finance government *pro-cyclical expenditure*, rather than imposing a tax on export earnings, may experience large and unsustainable fiscal deficits during periods of commodity price declines. Perhaps, the case of coffee-producing countries such as Kenya and Tanzania, in the late 1970s and early 1980s, and the case of oil-exporting countries such as Nigeria, Mexico and Venezuela, in the late 1970s illustrate quite well the effects of export price booms on expansions which led to sharp increases in domestic and external debt burdens associated with the windfall gains used to fund public sector expenditures that yield very insignificant returns. Moreover, SSA countries may experience the Dutch disease phenomenon, which, as Corden (1984) indicated, is characterized by growing fiscal deficits and a sustained appreciation of the real exchange rate induced by expansionary government spending associated with periodic improvements in the terms of trade.

World price fluctuations may affect the real exchange rates of developing countries, whose economies rely heavily on the export of primary commodities as a

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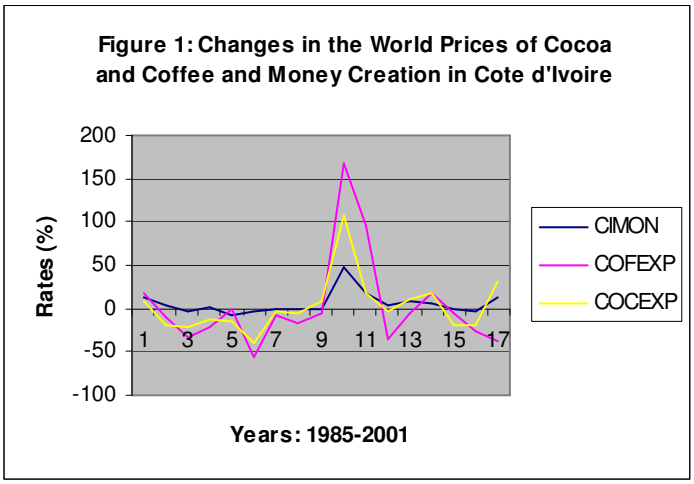
major source of national income and tax revenues. Urutia (1981) and the World Bank (1984) reported that changes in the world prices of primary commodities might affect the real exchange rates of developing countries relying heavily on their exports. These studies found that increases (decreases) in the world price of coffee contributed to the real appreciations (depreciations) of the Columbian peso, which in turn affected the competitiveness of other tradable sectors of the country's economy. Hence, a real appreciation of the Columbian currency resulted into losses of competitiveness or exchange rate, which adversely affected the country's ability to compete in international markets.



Figures 1, 2 and 3 depict the relationship between movement in the world prices of selected primary commodities (expressed in SSA domestic currencies) and money creation in Cote d'Ivoire, Kenya and Nigeria. The growth rate of money in Cote d'Ivoire and Kenya (Figure 1 and 2) is in tandem with the world prices of their major export commodities. Similarly, money growth in Nigeria is fluctuating with changes in the world crude oil prices, but their trend is less consistent. Moreover, the relationship between the real exchange rate and changes in these countries export prices is portrayed in Figures 4, 5 and 6. The real exchange rate and changes in export prices tend to fluctuate in opposite direction in the case of Cote d'Ivoire (cocoa and Coffee) and Kenya

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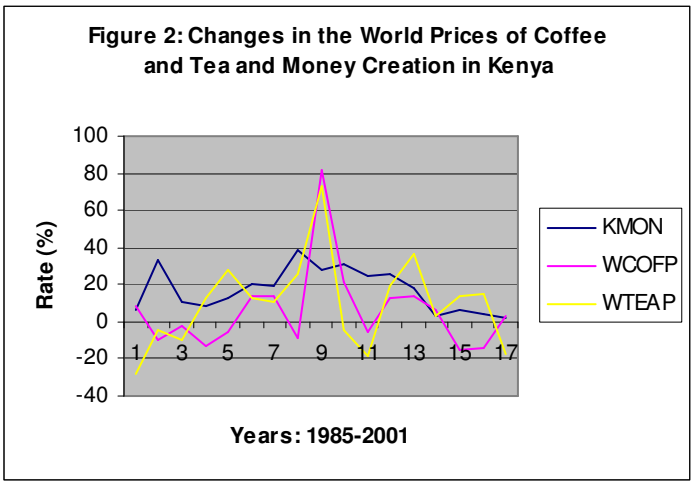
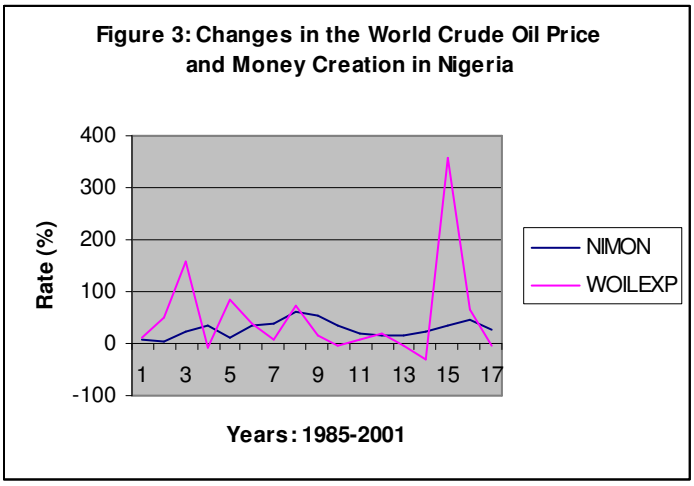
(Figure 4 and 5); however, such a pattern seems inconsistent with crude oil in the case of Nigeria (Figure 6).





Edwards (1986) maintained that the effects of changes in the prices of primary commodities on the real exchange rate are transmitted through two channels. First, an increase in the price of a primary commodity will cause a rise in the disposable income of producers from the exporting nations. Consequently, an income effect will result, characterized by an increase in their demand for tradable and non-tradable goods which

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in turn will cause, not only, a rise in the relative prices of tradable and non-tradable, but also, an appreciation of their real exchange rate.

Second, an exporting country may experience a balance of payment surplus and an accumulation of international reserves associated with an increase in the price of a primary commodity. Unless a country's monetary authorities impound it, the growth in money supply due to an increase in international reserves will cause a rise in inflation, and may result in a real appreciation of its currency.

Figure 4: Changes in the Export Prices of Cocoa and Coffee and the Real Exchange Rate in Cote d'Ivoire

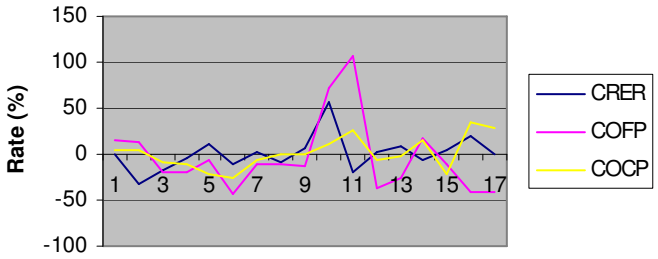
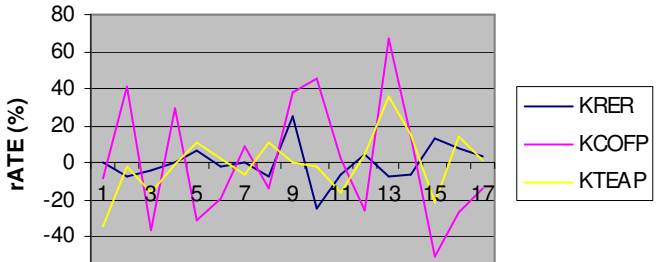


Figure 5: Changes in the Export Prices of Coffee and Tea, and the Real Exchange Rate in Kenya



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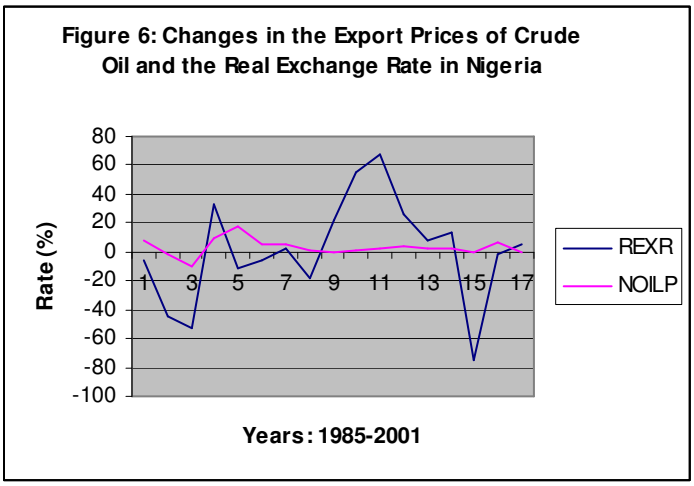

Many SSA countries have used Seignorage as a source of revenue for financing their budget deficits. Evidence of its use as a tool for financing government budget deficit is documented by Adam (1995) in the case of Zambia, and by Agenor (2004) for a number of developing economies, including Kenya and Ghana. However, funding budget deficit through money creation imposes an inflation tax, which may induce an appreciation of the real exchange rate.

The effectiveness of a SSA country's monetary policies to achieve desired domestic objectives depends in part on its exchange rate system. Under a fixed exchange rate regime, monetary reserves are difficult to control over an extended period because any attempt to place limitations upon changes in money reserves the market rate is likely to diverge from the official quoted central bank rate (Lane, 1993). In contrast, a flexible exchange rate regime frees the monetary authorities from any balance of payments constraints, and allows them to focus their demand-management policies toward the achievement of domestic stability, or it increases their degree of control over the money supply and enhances the efficacy of demand-management policies (Artus and Young, 1979).

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Methodology and Data Collection

Edwards (1986) provided empirical evidence of the effects of changes in the export prices of primary commodities on the real exchange rate in developing countries. His model raised criticism over the use of some simplifying assumptions. First, he assumed that the demand for money is a function of income and not the interest rate, because of lack of data on the latter. Second, his empirical analysis focused only on the effects of changes in the export prices of Columbian coffee, ignoring, as one reviewer pointed out the "white stuff: cocaine" whose price is a major determinant of the country's real exchange rate. Third, his paper did not mention how the price paid to farmers was determined. If the price paid to farmers is set below the world price by a marketing board, as has been the case in many developing countries, then this may induce coffee smuggling; therefore, omitting it from the model may affect the value of the real exchange rate depending on its relative significance. These three assumptions may have probably caused model misspecification and measurement errors.

Taking into account some of the review comments and suggestions about Edwards' model, a variant model is developed in this study for a small SSA open economy producing tradable and non-tradable, exporting few primary commodities, and whose government attempts to achieve desirable national goals using either fiscal and/or monetary policies. The fiscal deficit is included in the model as an endogenous variable to capture the effect of public expenditure on money creation. Among the SSA countries selected for this study, some are still operating under a pegging system, while others have shifted away from a fixed to a flexible exchange rate regime. Hence the model consists of a series of equations as followed:

$$Q_{Nt}^{i} = f(P_{Nt}^{i});\ i = 1, 2, 3,\ldots. n \text{ non tradable goods} \quad (1)$$

$$Q_{Tt}^{i} = f(P_{Tt}^{i});\ i = 1,2,3,\ldots\ldots n \text{ tradable goods} \quad (2)$$

$$GDP_t = \sum(Q_{Nt}^{i} P_{Nt}^{i}) + \sum(Q_{Tt}^{i} P_{Tt}^{i}) \quad (3)$$

$$GR_t = T_t GDP_t \quad (4)$$

$$DEFICIT_t\ (SURPLUS_t) = GR_t - GS_t \quad (5)$$

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$$M^s_t = m_t MON_t \quad (6)$$

$$MON_t = R_t + DEFICIT_t \quad (7)$$

$$\Delta M^s_t = m_t(\omega \Delta R_t + \Omega DEFICIT_t) \quad (8)$$

$$\Delta R_t = \theta(\Delta M_t^d - \Delta M_{t-1}) + \Psi \Delta P_{Tt}^i \quad (9)$$

$$(M/P)^d = f(r, Y) \quad (10)$$

$$\Delta M_t^d = \gamma \Delta r_t + \Phi \Delta Y_t \quad (11)$$

$$(M/P)_t^d = (M/P)t^s = (M/P)_t \quad (12)$$

$$\Delta P_t = (1 - \delta)\Delta P_{Nt} + \delta \Delta P_{Tt} \quad (13)$$

$$\Delta P_{Tt}^i = \Delta E_t + \Delta P_{Tt}^{i*} \quad (14)$$

$$\Delta P^i_{Nt} = \Delta P_{Tt} + \lambda(\Delta M_t - \Delta M_t^d) + \rho Y_t \quad (15)$$

$$\Delta Y_t = g_t + \tau(\Delta P_{Tt}^{i*} - \Delta P_{Tt}^*) \quad (16)$$

$$e_t = (E_t \times P_t) / P_{Tt}^* \quad (17)$$

Δ is used here to represent the percentage change in the value of variables in the above equations, whereby:

Q_{Nt}^i = quantity of non-tradable good i produced in period t.

P_{Nt}^i = the domestic price of non-tradable good i produced in period t.

Q_{Tt}^i = quantity of tradable good i produced in period t.

P_{Tt}^i = the domestic price of tradable good i produced in period t.

GDP_t = gross domestic product in period t.

M^s_t = supply of money in period t.

m_t = money multiplier in period t.

MON_t = the stock of high-powered money in period t.

GR_t = government revenues in period t is determined by the product of the average tax rate (T) and the gross domestic product.

GS_t = government spending in period t

T_t = average tax rate in period t.

$DEFICIT_t$ ($SURPLUS_t$) = government revenue minus government spending.

ΔM_t = the rate of growth of nominal money in period t.

$\Delta RGDP_t$ = the rate of change in real gross domestic product in period t.

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ΔR_t = the rate of change of international reserves in the country's currency.

ΔM_t^d = the rate of change of the nominal quantity of money demanded in period t.

Δr_t = the nominal interest rate in period t.

ΔY_t = the rate of change of real income in period t.

ΔP_{Tt}^i = the rate of change in the domestic price of tradable good i (e.g. coffee, cocoa) in period t.

ΔP_t = the rate of change in the domestic price level in period t.

ΔP_{Nt}^i = the rate of change in the domestic price of non-tradable good i in period t.

E_t = the nominal exchange rate, expressed in units of a foreign country's currency (amount of U.S. dollars in this study) per one unit of a given SSA domestic currency in period t.

P_{Tt}^* = the world price of tradable goods

ΔP_{Tt}^* = the world inflation rate.

ΔP_{Tt}^{i*} = the rate of change in the world price of tradable good i (e.g. coffee, coca) in period t.

X_t = other factors affecting the rate of depreciation of SSA pegged currencies in period t.

e_t = the real exchange rate in period t.

Equation (1) indicates that the supply of non-tradable goods (Q_{Nt}^i) is mainly determined by the prices of non-tradable goods (P_{Nt}^i), and equation (2) indicates that the supply of tradable goods (Q_{Tt}^i) is primarily determined by the prices of tradable goods (P_{Tt}^i). Equation (3) indicates that the gross domestic product (GDP_t) is obtained by summing up the total market values of tradable goods and non-tradable goods in period t. Equation (4) shows that government revenue (GR_t) is obtained by multiplying the average tax rate by the total quantity of tradable and non-tradable goods sold in period t. Government deficit or surplus is determined in equation (5) by the difference between government revenue and spending. Given SSA countries reliance of the exports of few primary commodities as their main sources of national income, it is postulated that government deficits are inversely related to export prices. Thus, in Cote d'Ivoire, Ghana, and Kenya, government deficits were often associated with periods of decline in world

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prices of their major export commodities prices such as coffee, cocoa, and tea. In equation (6), the supply of money is a multiplicative of the money multiplier (m_t) and the stock of high-powered money (MON_t) in period t.

Assuming that changes in the claims on SSA countries' governments by their central banks are those associated with their deficit ($DEFICIT_t$), then, equation (7) postulates that the change in money supply occurs through changes in international reserves and in fiscal deficits. As a tool for financing government deficits in SSA countries, money creation via bonds issued by the central bank may impose an inflation tax on their economies. Equation (8) shows that the change in money supply is related to changes in high-powered money in equation (7) by a multiplicative of the money multiplier.

Equation (9) indicates that the international reserves respond to an excess demand or supply of money and to changes in the price of tradable goods in period t. Borrowing from Edwards (1986), this formulation allows for international reserves shocks to be a source of money creation in the short-run. Equation (10) is a general money demand function stating that the demand for the liquidity of real money balances is a function of the nominal interest rate and income. Equation (11) is a specification of equation (10) indicating that a change in the domestic demand for money (ΔM_t^d) is determined by changes in the nominal interest rate and the level of national income. The growth of domestic demand for money is positively related to the level of national income and inversely related to the nominal interest rate. Equation (12) suggests that the domestic demand for money and the domestic supply of money are in equilibrium with the national stock of money in the long run.

The behavior of the domestic price level is depicted by equation (13), which indicates that its changes are related to changes in the prices of non-tradable goods (P_{Nt}) and to changes in the prices of tradable goods (P_{Tt}). Equation (14) indicates that the change in the domestic price of a tradable good i (e.g. cocoa) is positively related to the change in the nominal exchange rate (ΔE_t) and to the rate of change in the world price of a tradable good i (P_{Tt}^{i*}). The change in the domestic price of non tradable goods (P_{Nt}) is as depicted in equation (15) positively associated with the changes in the domestic price

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of tradable goods, the excess demand or supply of money, and the change in the real income. Equation (16) portrays the rate of growth of real income, which is positively affected by changes in domestic and world coffee price differentials ($\Delta P_{Tt}^{i*} - \Delta P_{Tt}^{*}$) and other factors unrelated to coffee prices (g_t). Equation (17) represents the real exchange rate, which is defined as the product of the nominal exchange rate Et, and the ratio of the world price level to the SSA domestic price level. Where, the U.S. wholesale price index is used as a proxy for P_{Tt}^{*}, and the CPI of the domestic country, used as a proxy for the price of non-tradable goods.

Substituting the expressions in equations (9) and (11) for ΔR_t and ΔM_t^d , the growth of money in period t (ΔM_t) in equation (8) becomes:

$$\Delta M_t = m_t[\omega\theta(\Delta M_t^d - \Delta M_{t-1}) + \Psi\Delta P_{Tt}^i + \Omega DEFICIT_t]$$
$$\Delta M_t = m_t(\omega\theta\Delta M_t^d - \omega\theta\Delta M_{t-1} + \omega\Psi\Delta P_{Tt}^i + \Omega DEFICIT_t)$$
$$\Delta M_t = m_t[\omega\theta(\gamma\Delta r_t + \Phi\Delta Y_t) - \omega\theta\Delta M_{t-1} + \omega\Psi\Delta P_{Tt}^i + \Omega DEFICIT_t]$$
$$\Delta M_t = m_t(\omega\theta\gamma\Delta r_t + \omega\theta\Phi\Delta Y_t - \omega\theta\Delta M_{t-1} + \omega\Psi\Delta P_{Tt}^i + \Omega DEFICIT_t) \quad (18)$$

Substituting the expressions in equation (14) for ΔP_{Tt}^i, equation (18) can be rewritten as followed:

$$\Delta M_t = m_t[\omega\theta\gamma\Delta r_t + \omega\theta\Phi\Delta Y_t - \omega\theta\Delta M_{t-1} + \omega\Psi(\Delta E_t + \Delta P_{Tt}^{i*}) + \Omega DEFICIT_t]$$
$$\Delta M_t = m_t\omega\theta\gamma\Delta r_t + m_t\omega\theta\Phi\Delta Y_t - m_t\omega\theta\Delta M_{t-1} + m_t\omega\Psi(\Delta E_t + \Delta P_{Tt}^{i*})$$
$$+ m_t\Omega DEFICIT_t \quad (19)$$

Equation (19) postulates that the growth of money is positively associated with changes in the interest rate, the real income, the nominal exchange rate, the export prices of tradable goods, government deficit, and negatively related to change in money growth lagged one period. Most SSA countries do not report budget deficit data consistently to the World Bank, and omitting this important variable ($DEFICIT_t$) from the regression would cause missing variable bias. However, this problem could be partly avoided by

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incorporating into equation (19) a monetary variable that would capture the effects of money creation as a tool for financing budget deficits.

The worsening of the terms of trade of SSA economies with the industrialized nations, due to declines in the export prices of their primary commodities, along with rising government expenditures, have contributed to their severe and chronic budget deficits. Most SSA countries lack well-developed institutions to collect revenue from sources such as sales taxes, income taxes, and property taxes. Overburdened by foreign debts and faced with limited ability to borrow from the public or from abroad, many SSA countries relied on seignorage as a means of financing their deficits. The amount of nominal money (ΔM_t) created by a government is primarily determined by the intended amount of goods and services or revenue in real terms generated by that base money creation. This process, known as seignorage, is derived through the process of total differentiation, by decomposing the change in real money balance into two separate effects as followed:

$$\Delta(M_t/P_t) = \Delta M_t/P_{t-1} - (\Delta P_t/P_{t-1})(M/P_{t-1}) \quad (20)$$

Where, the first term of equation (20) representing the change in real money balance is decomposed into two separate effects. The first expression represents the real value of the current change in nominal money balances (deflated by the domestic price level lagged one period). The second expression, which represents the revenue from the inflation tax ($INFTAX_t$), captures the effects of expansionary monetary policies associated with fiscal deficits.

Substituting the expressions in equation (20), then equation (19) can be rewritten as followed:

$$\Delta M_t = m_t\omega\theta\gamma\Delta r_t + m_t\omega\theta\Phi\Delta Y_t - m_t\omega\theta\Delta M_{t-1} + \Delta(M_t/P_t) + m_t\Omega\, INFTAX_t + m_t\omega\Psi(\Delta E_t + \Delta P_{Tt}{}^{i^*}) \quad (21)$$

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Following the analytical framework developed by Meltzer (1993), the real exchange rate equation is expressed as followed:

$$RER_t = RER_{t-1} + (1-\beta)X_t + u_t \quad (22)$$

The actual real exchange rate (RER_t) consists of the weighted average of the lagged dependent variable (RER_{t-1}) and the vector X, which represents the real money balances (M_t/P_t); where, M_t and P_t are, as pointed out above, the stock of money and the domestic price level in period t, respectively

In equation (22), the term u_t is described as a random term and a transitory component that accounts for the effects of omitted variables on the dependent variable. Hence, other variables identified earlier in this study provide a ground for considering the following extended model:

$$\Delta RER_t = \Delta RER_{t-1} + \Delta EXR1 + (1-\beta)\Delta M_t/P_{t-1} - (\Delta P_t/P_{t-1})(M/P_{t-1}) + \Delta P_t + \Delta P_{Tt}^{*} + \Delta r_t + \Delta P_{Tt}^{i*} + \varepsilon_t \quad (23)$$

For the empirical analysis, the money growth equation (21) and the real exchange rate equation (23) are specified respectively as followed:

$$\Delta M_t = a_0 - a_1\Delta M_{t-1} - a_2\Delta r_t + a_3\Delta RMON_t + a_4\Delta INFTAX_t + a_5(\Delta E_t + \Delta P_{Tt}^{i*}) + a_6 DUM_t + \varepsilon_t \quad (24)$$

$$\Delta RER_t = b_0 + b_1\Delta RER_{t-1} + b_2\Delta EXR1 + b_3\Delta INFTAX_t + b_4\Delta P_t + b_5\Delta P_{Tt}^{*} + b_6\Delta r_t + b_7\Delta P_t^{i*} + \varepsilon_t \quad (25)$$

Where, in equation (24), $a_1 = m_t\omega\theta\gamma$; $a_2 = m_t\,\omega\theta\Phi$; $a_3 = m_t\omega\theta$; $a_4 = m_t\omega\Psi$; $a_5 = m_t\Omega$. The change in real income (using the real gross domestic product or the gross national income as a proxy) and the change domestic rate of inflation are represented by ΔY_t and $\Delta(\log P_t)$, respectively. The change in inflation tax is represented by $\Delta INFTAX_t$,

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the change in real interest rate by Δr_t, and the change in real money balances by $\Delta RMON_t$. A dummy variable (DUM_t) is included in equation (25) to capture the effects of structural adjustment policies and changes in exchange rate policies; taking a value of 0 for years before, and a value of 1 for years after a given policy went into effect. The change in export price of the ith primary commodity converted in national currency from the U.S. dollar, using the nominal exchange rate, is represented by $\Delta(E_t + P_{Tt}^{i*})$. The expected signs of their coefficients are as followed: $a_1<0$; $a_2>0$; $a_3<0$; $a_4>0$; $a_5<0$. The estimated coefficient of the dummy variable (a_6) can take on either a positive or a negative sign. On the other hand, in equation (25) the expected signs of the estimated coefficients for the determinants of the change in the real exchange rate are as followed: $b_{1>0;}$ $b_2>0$; $b_3<0$; $b_4<0$; $b_5>0$; $b_6<0$; $b_7<0$; $b_8<0$; $b_9<0$. The error term ε_t is included in the regression to account for omitted variables.

Five SSA countries were selected for this study: Cote d'Ivoire, Gabon, Ghana, Kenya, and Nigeria. As members of the franc zone, Cote d'Ivoire and Gabon, whose common currency (the cfa) has been pegged to the French franc since 1948, are still operating on a fixed exchange rate regime. On the other hand, Ghana, Kenya, and Nigeria, whose respective currencies were pegged either to the British pound or to the U.S. dollar, have been operating on a flexible exchanged rate since in the early 1980s. The variable $\Delta(E_t + P_{Tt}^{i*})$ in equation (24) represents the world price of primary commodity i exported by a given SSA country. Hence, the following acronyms were used for $\Delta(E_t + P_{Tt}^{i*})$:

- World price of coffee in a given SSA country's local currency: $\Delta WCOFPEX_t$.
- World price of cocoa in a given SSA country's local currency: $\Delta WCOCPEX_t$.
- World price of tea in a given SSA country's local currency: $\Delta WTEAPEX_t$.
- World price of crude oil in a given SSA country's local currency: $\Delta WOILEX_t$.

Empirical Results

The OLS results from estimating equations (24) and (25), using macroeconomic data collected from the World Bank and the International Financial Statistics series for

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Table 1: OLS Estimates of the Determinants of Money Growth in Selected SSA Countries, 1972-2001 Period**.**

Statistical Descriptions	Cote d'Ivoire N=31	Gabon N=23	Ghana N=31	Kenya N=30	Nigeria N=30
Constant	0.3682 (3.6629)	12.7384** (5.9513)	28.2380** (12.0692)	-10.6388* (1.6874)	1.9968 (3.6105)
ΔM_{t-1}	0.2184* (0.0717)	0.0416 (0.0584)	-0.0396 (0.1585)	-0.1109*** (0.0640)	1.2474* (0.1795)
$\Delta M_t/P_{t-1}$	9.1917*** (1.5736)	60.9976* (5.1471)	0.7089* (0.1636)	1.0221* (0.0472)	0.0184 (0.1049)
Δr_t	-0.1813 (0.3878)	-1.4500** (0.6658)	0.1837 (0.3838)	0.2602* (0.0841)	-0.2773 (0.4264)
$\Delta INFTAX_t$	-0.899E-03 (0.0421)	-0.1783 (0.1545)	0.6069E-05 (0.118E-04)	0.2474* (0.1606)	0.2878E-03* (0.391E-04)
$\Delta WCOFEXP_t$	0.0736** (0.0296)	-	-	0.0307** (1.5135)	-
$\Delta WCOCEXP_t$	0.1433* (0.0471)	-	0.0301 (0.1198)	-	-
$\Delta WTEAEXP_t$	-	-	-	0.0311** (0.0147)	-
$\Delta WOILEX_t$	-	0.2265** (0.0894)	-	-	0.0815 (0.1083)
DUM	-	-	-	5.8971* (1.4483)	6.4433 (5.6079)
Adjusted R^2	0.9142	0.9239	0.3423	0.9599	0.9150
DW	2.0279	1.9696	1.8959	1.2548	1.4018

Note: Numbers in parenthesis represent standard errors. Statistically significant coefficients at the (*) 1%, (**) 5%, and (***) 10% levels, respectively.

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the 1972-2001 period (1995=100), are reported in Tables 1 and 2. Overall, the coefficients of determination are relatively high, perhaps reflecting the goodness of fit of both models and power to explain the proportion of the total variations observed in each dependent variable. Given the presence of lagged dependent variables in the equations as regressors, the Durbin-Watson statistic is not a valid test for serial correlation. Thus, both the Durbin-h test and the Breusch-Godfrey test were conducted with results indicating no presence of serial correlation. Moreover, the Jarque-Bera statistics have relatively high p-values, which imply normally distributed residuals.

The estimated coefficients provide some insight about the behavior of each country's money growth. The percentage change in nominal money growth lagged one period (ΔM_{t-1}) is statistically significant for Cote d'Ivoire, Kenya, and Nigeria, thus indicating a persistent effect of their money growth at time t that can be attributed to the various sources of money creation in previous periods. The positive sign of the estimated coefficient for Cote d'Ivoire and Nigeria, and the negative coefficient for Kenya suggest that the direction of change of the nominal money growth at period t depends on the size of the lagged effect of the various sources of money creation and the fiscal and monetary policies intended to achieve desired economic objectives in period t-1. Thus, the positive sign of the coefficient for Cote d'Ivoire means that an increase in money creation in the previous period, given its existing economic conditions as well as its fiscal and monetary policies, is associated with a percentage increase in the nominal money growth in the present period. In this case, the nominal money growth is related, not only to the persisting lag-effect of money creation, but also to government policies designed to keep the economy expanding. The government may attempt to contain inflation from rising by reducing the money supply. In contrast, the negative sign of the coefficient for Ghana implies that the government will respond to an increase in money creation in period t_{-1} by reducing money supply in order to contain the rate of inflation from rising in period t.

The nominal interest rate (Δr_t) is inversely related to the percentage change in money growth for both countries operating under a pegging system; however, its coefficient estimate is statistically significant only in the case of Gabon. Among the three countries under flexible exchange rate, only Kenya has a statistically significant

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coefficient; but its positive sign is inconsistent with theory. Overall, these results imply that, as an opportunity cost of holding money, the interest rate is relatively insignificant. In most SSA countries, the commercial financial markets are still underdeveloped, due in large part to the low personal saving, the limited private domestic investment and foreign direct investment, and weak linkages between domestic and international financial markets. Therefore, the ability of SSA monetary authorities, namely central banks, to influence their domestic economies through monetary policies is relatively insignificant.

Inflation tax ($\Delta INFTAX_t$) is negatively related to money creation for both countries on a fixed exchange rate system and positive for all three countries on a flexible exchange rate system. However, its estimated coefficient is statistically significant for Kenya and Nigeria, which implies that printing money as a way to finance government spending, while contributing to money growth, has inflationary consequences.

Evidence of short-run increases in money creation associated with rises in the prices of primary commodities is provided by the positive and statistically significant estimated coefficients of coffee, cocoa, tea, and oil. The estimated coefficient of coffee ($\Delta WCOFEXP_t$) is positive and statistically significant at the 5% level for both Cote d'Ivoire and Ghana. In addition, the estimated coefficient of cocoa ($\Delta WCOCEXP_t$) for Cote d'Ivoire and the estimated coefficient of oil price ($\Delta WOILEX_t$) for Gabon are both positive and statistically significant; the former at the 1% level and the latter 5% level. These results support the hypothesis that higher prices of primary commodities are monetized by countries' central bank through the accumulation of international reserves. The estimated coefficient of tea for Kenya is also statistically significant, but, its sign is, contrary to expectation, negative; which raises concern over price distortion due to control of producers' prices by marketing boards. The coefficient of the dummy variable included in the model, to capture the effects of post 1982 Kenyan structural adjustment policies, is positive and statistically significant, perhaps indicating their partial contribution to the changes in money creation.

Table 2 shows the regression results of the real exchange rate which is expressed as the nominal exchange rate adjusted for price level difference between a SSA country and foreign countries (e.g. the U.S.). As pointed out above, in calculating each SSA

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country's real exchange rate, the U.S. wholesale price index was used as a proxy for the world price of tradable goods (P_{Tt}^{*}). Ghana, Kenya, and Nigeria, whose currencies were all pegged to the British pound in the past, have been operating on a flexible exchange rate system since the early 1980s. A dummy variable was included in the model to capture the effect of the shift of their exchange rate systems from a pegging system to a flexible exchange rate system; but, its estimated coefficient is statistically insignificant, and contributed very little to improving the overall statistical results. Consequently, the dummy variable was dropped from their regression equation. Overall, the coefficients of determination, along with the other basic statistics, reflect the goodness of fit of the model as well as its explanatory power about the changes in the dependent variable. The non-significance of the coefficient of the change in the lagged real exchange rate (ΔRER_{t-1}) implies a lack of persisting effect on the real exchange rate in period t.

The nominal exchange rate (EXR_t), expressed as the price of a given SSA country's currency in terms of U.S dollars (e.g. the dollar price of the Naira), is positively related to the real exchange rate. The estimated coefficient of the nominal exchange rate (ΔEXR_t) is statistically significant at the 1% level for all five SSA countries. Cote d'Ivoire and Gabon, whose common currency (the CFA) has been pegged to the French franc since 1948, have maintained a fixed exchange rate during the entire study period. Therefore, the effects of changes in the nominal exchange rate of the CFA on these two countries' real exchange rate really reflect the movements of the French franc against the U.S. dollar. Thus, a 10% nominal devaluation of the CFA in period t, due to a depreciation of the French franc against the U.S. dollar, is associated with a decrease in the real exchange rate of the CFA by about 10.92% for Cote d'Ivoire and 10.85% for Gabon, meaning that their products domestic are now cheaper relative to comparable products from foreign countries.

Changes in the nominal exchange rates of Ghana, Kenya, and Nigeria, which have been operating under a flexible exchange rate system throughout most of the study period, really reflect movements of their domestic currencies against the U.S. dollar.

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Table 2: OLS Estimates of the Determinants of the Real Exchange Rate in Selected SSA Countries, 1972-2001 Period

Statistical Descriptions	Cote D'Ivoire N=31	Gabon N=23	Ghana N=23	Kenya N=29	Nigeria N=29
Constant	0.3827 (1.9595)	4.6572*** (2.3643)	3.2745 (6.1330)	5.6998*** (3.0787)	8.5450* (2.7361)
ΔRER_{t-1}	-0.0317 (0.0304)	-0.0152 (0.0268)	-0.0048 (0.0406)	-0.021E-03 (0.0024)	0.0312 (0.0247)
ΔEXR_t	1.0919* (0.0390)	1.0847* (0.0298)	1.4056* (0.0635)	1.0862* (0.0036)	1.1556* (0.0398)
ΔCPI_t	1.3377* (0.2775)	0.5637*** (0.2932)	0.9514* (0.1716)	0.7313* (0.1115)	0.8122* (0.0368)
$\Delta WINFLA_t$	-1.4592* (0.2217)	-0.8349* (0.1464)	-0.6921 (0.6212)	-1.2959* (0.2756)	-1.8015* (0.3279)
$\Delta INFLATAX_t$	-0.0069*** (0.0034)	-0.0044* (0.0010)	0.6090E-04 (0.645E-04)	-0.0047*** (0.0026)	-0.312E-03 (0.428E-03)
ΔRIR_t	0.3550 (0.2107)	-0.3447 (0.2692)	0.3356** (0.1629)	-0.0468 (0.1127)	0.0025 (0.0129)
$\Delta WPCOC_t$	-0.0508** (0.0222)	-	-0.1150*** (0.0578)	-	-
$\Delta WPCOF_t$	0.0244 (0.0191)	-	-	-0.0111 (0.0319)	-
$\Delta WPTEA_t$	-	-	-	-0.0112 (0.0468)	-
$\Delta WPOIL_t$	-	-0.0513* (0.0119)	-	-	-0.1795** (0.0661)
Adjusted-R^2	0.9757	0.9881	0.9541	0.9998	0.9849
DW	1.2380	1.9877	1.7855	2.4186	1.9156

Note: Numbers in parenthesis represent standard errors. Statistically significant coefficients at the (*) 1%, (**) 5%, and (***) 10% level, respectively. $\Delta WPCOC_t$: change in the world price of cocoa. $\Delta WPCOF_t$: change in the world price of coffee. $\Delta WPTEA_t$: change in the world price of tea. $\Delta WPOIL1_t$: change in the world price of crude oil.

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Holding other factors constant, a nominal depreciation of the Ghanaian Cedi by 10% is associated with a decrease in its real exchange rate by about 14%, thus making domestic goods now 14% cheaper as compared to competing foreign goods. Moreover, a 10% depreciation of the nominal exchange rate of the Kenyan Shilling is associated with a decrease in the real exchange rate of Kenya by 10.86%. The Nigerian Naira has depreciated significantly against the U.S. dollar. Similarly, a 10% nominal depreciation of the Naira, holding other factors unchanged, is correlated with a decrease in Nigeria's real exchange rate by about 11.55%, which makes its domestic products cheaper relative to foreign products.

The domestic rate of inflation (ΔCPI_t) at time t is, as expected, positively related to the change in real exchange rate, and its estimated coefficient is statistically significant at the 1% level for Cote d'Ivoire, Ghana, Kenya and Nigeria, and at the 10% level for Gabon. Other things being equal, a 1% increase in the domestic inflation rate is associated with a real exchange rate increase by about 1.34%, 0.56%, 0.95%, 0.73%, 0.81% for Cote d'Ivoire, Gabon, Ghana, Kenya, and Nigeria, respectively. Depending on the magnitude of change in the world price level, such increases in these countries domestic price levels will make their domestic products relatively more expensive. In contrast, the world inflation rate ($\Delta WINFLA_t$) at time t is, as expected, negatively related to the real exchange rate. Its coefficient estimate is statistically significant at the 1% level for Cote d'Ivoire, Gabon, Kenya, and Nigeria, but insignificant for Ghana. Thus, a 1% increase in the world inflation rate, while other factors remaining the same, would be related to a real exchange rate decrease by about 1.46%, 0.83%, 1.30%, and 1.80% for Cote d'Ivoire, Gabon, Kenya, and Nigeria, respectively. Such decreases make their domestic goods cheaper relative to competing foreign goods.

The inflation tax variable ($\Delta INFLATAX_t$) is, not only negative, but also statistically different from zero at the 1% level for both Cote d'Ivoire and Gabon and at the 10% level for Kenya. These countries expansionary monetary policies have an undesirable consequence far beyond the reduction of the value of money in the hands of the public. The ensuing inflation tax results in an appreciation of their real exchange rates. Hence, a 10% nominal money growth is associated with a real exchange rate

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appreciation of 0.070%, 0.044%, 0.050%, for Cote d'Ivoire, Gabon, and Kenya, respectively. Their products become relatively more expensive compared to foreign competing goods. The non-statistical significance of the estimated coefficient of inflation tax for Ghana and Nigeria implies that real market forces essentially determine their real exchange rates under the flexible exchange rate system.

The relationship between the real interest rate (ΔRIR_t) and the real exchange rate is positive with a statistically significant estimated coefficient at the 5% level for Ghana. Other things being equal, an increase in the domestic real interest rate of Ghana by 1%, while inducing a capital inflow and an appreciation of their nominal exchange rates, is associated with a real exchange rate increase by about 0.33. Such a rise makes Ghana's products, cocoa in particular, more expensive relative to foreign competing products. The non-statistical significance of the estimated coefficient for the other SSA countries is a common trend that reflects the relative underdevelopment of SSA financial markets characterized by their limited ability to attract foreign direct investment and the low domestic private capital investment level that is inherent to the small size of their economies. Therefore, the interest rate changes in SSA countries may not reflect the macroeconomic fundamentals the monetary authorities in advanced economies (e.g. the U.S) rely on to determine the appropriate changes needed to achieve desirable ends such as lowering their interest rates to encourage borrowing for investment spending during periods of recession.

Table 2 also shows evidence of the effects of changes in the world prices of cocoa and oil on the real exchange rates of SSA exporters of these commodities. The estimated coefficient of change in world cocoa price ($\Delta WPCOC_t$) is, as expected, negative, and statistically significant at the 5% and 10% levels for Cote d'Ivoire and Ghana, respectively. Other things equal, a 10% increase in the world cocoa price yields a real exchange rate decrease by about 0.51% for Cote d'Ivoire and 1.20% for Ghana, thus making their domestic products cheaper relative to foreign products. Similarly, the estimated coefficient of the change in world oil price ($\Delta WPOIL_t$) is negative and statistically significant at the 1% level for Gabon and at the 5% level for Nigeria. Hence, a 10% rise in world price yields a real exchange rate decrease by 0.50% for Gabon and by

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about 1.80% for Nigeria. These results suggest that, as the world prices of these export commodities rise relative to the export prices of Gabon and Nigeria, their real exchange rates decrease, thereby, making their products relatively cheaper compared to other foreign competing goods.

Conclusion

SSA economies have been essentially dependent on the exports of one or two primary commodities (e.g. coca, coffee, crude oil) as major sources of national revenues. Therefore, changes in the world prices of these export commodities have significant impacts on their macroeconomic fundamentals such as the money creation and the real exchange rate. This paper analyzed the effects of factors that determine the money creation and the real exchange rate in selected SSA countries (Cote d'Ivoire, Gabon, Ghana, Kenya and Nigeria) using World Bank data for the 1970-2001 period. Results from OLS techniques indicate that the determinants of money creation are specific to each country's macroeconomic conditions relative to its monetary policies intended to achieve desired goals. Changes in the money creation were significantly determined by both the nominal money balances (ΔM_{t-1}) and the inflation tax ($\Delta INFLATAX_t$) in the case of Kenya and Nigeria. On the other hand, changes in the real money balances ($\Delta M_t/P_{t-1}$) for all selected SSA countries except Nigeria, and changes in the nominal rate of interest (Δr_t) for Gabon and Kenya were significant factors in explaining the changes in money creation. The effects of changes in the export prices of commodities on money creation is evidenced by the positive and statistically significant coefficients of the world prices of cocoa and coffee for Cote d'Ivoire, crude oil for Gabon, coffee and tea in the case of Kenya.

The empirical results of the real exchange rate equation provide some insightful similarities among the selected SSA counties. Regardless of the exchange rate system used, the real exchange rate is positively and significantly related to the nominal depreciations (devaluations of the nominal exchange rates of SSA currencies pegged to the French franc) of their domestic currencies, which implies relatively cheaper SSA

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export products abroad. The domestic rate of inflation (ΔCPI_t) is positively and significantly associated with the real exchange rate; indicating that a rise in inflation would make SSA export products more expensive relative to foreign competing goods. In contrast, the estimated coefficient of the world inflation rate ($\Delta WINFLA_t$) is negatively related to the real exchange rate. Therefore, an increase in the world inflation at a rate faster than domestic SSA price levels would reduce their real exchange rates; thus, making their exports less expensive abroad. The coefficient of inflation tax ($\Delta INFLATAX_t$) is negatively and statistically significant for Cote d'Ivoire, Gabon, and Kenya, perhaps indicating that expansionary monetary policies intended to finance deficits affect the real exchange. Finally, changes in the world prices of cocoa ($\Delta WPCOC_t$) and crude oil ($\Delta WPOIL_t$) are negatively related to the real exchange rates of SSA countries exporting these commodities; notably, Cote d'Ivoire, Ghana, Gabon and Nigeria.

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