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## What Drives the Choice of Exchange Rate Regimes in LDCs? An Empirical Investigation

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### Abstract

The choice of an exchange rate regime is linked, to some extent, to the attainment of specific targets set by the monetary authorities. These targets are usually related to internal and external imbalances. Hence, a correlation between the choice of the exchange rate regime and real output, prices, and balance of payments stabilization is expected. This article aims at examining the choice of the exchange rate regimes in an LDC using multinomial logit and simultaneous limited-independent models based on data from 1960 to 2000. Results show that different variables help to explain the choice of exchange rate regime at different periods of time. These variables are degree of openness, inflation differential, change in foreign reserves, and real and monetary shocks. Results further suggest that domestic monetary disturbances appreciate the real exchange rate and favor a more flexible arrangement, while in the presence of real shocks the balance of payments acts as a shock absorber and a fixed regime becomes more likely.

**Key words:** exchange rates, limited dependent models, logit models.

### I. Introduction

The exchange rate regime is the way a country manages its currency in respect to foreign currencies and the foreign exchange market. This choice is linked, to some extent, to the attainment of specific targets set by the monetary authorities. These targets are usually related to internal and external imbalances. Hence, a correlation between the choice of the exchange rate regime and real output, prices, and balance of payments stabilization is expected. For instance, when the aim of the monetary and fiscal policy is to stabilize the balance of payments, it is desirable to adopt a flexible exchange rate system. This will help overturn any current or capital account disequilibrium. In respect to financial regulation, a fixed exchange rate imposes a degree of financial discipline by discouraging recourse to inflationary finance (León and Oliva, 1999). On the contrary, proponents of exchange rate flexibility argue that the choice of a fixed exchange rate would only cause financial crises and consequently continuous devaluations. However, when the aim is real output stabilization, the role of the exchange rate regime is largely viewed as a shock absorber. That is, the variability of real output is affected by diverse economic instability, and the choice of the exchange rate regime is used to spread these effects. Therefore, the choice of which exchange rate to adopt depends on the nature of the shocks as well as the structural characteristics of the economy such as the degree of openness, degree of capital mobility, degree of wage indexation, and degree of development. In this respect, adjustable peg system, for instance, is based on an assumed par value that defines upper and lower limits of fluctuation from a central exchange rate. Although such upper and lower levels are predefined, they can be altered as the balance of payments position changes. Destabilizing speculation may also affect exchange rate stability, necessitating the alteration of the limits. The crawling peg regime was developed to avoid the problem of relatively large par value changes to correct external imbalances and destabilizing speculation. Under this system, the authorities can undertake programmed or step-devaluation instead of a once and for all approach to alter the par value so as to restore external balance. The managed float involves some form of official intervention to smooth the path of exchange rate when it overshoots the desired level. This is on the contrary of the pure float that allows the market forces of demand and supply to dictate the movements in the exchange rate. For the managed float to operate the system successfully there must be a large pool of reserves to draw from, whenever necessary. Insufficiency of reserves is a major constraint to the successful operation of the

managed float variant and has often resulted in the specification of the bounds within which the managed float system should operate.

The present study investigates the determinants of the choice of the exchange rate regime in Nigeria using data from 1960 to 2000. The use of this approach aims at overcoming the limitations of the cross-section approach. As depicted by León and Oliva (1999), the time series approach is based upon the assumption that the choice of a regime is better explained by the past and present evolution of the economy rather than by certain conditions at a given moment. The cross-section approach is based upon the assumption that policy makers will not change the regime until the long-term benefits would exceed the cost of the switch. This implies that there lies some inertia in regimes that can be better captured by a time series analysis. By using a time series approach, we regard the regime choice as a medium-term decision that marginally depends on short spanned indicators.

## II. Review of the Literature

The issue of exchange rate has been prevalent in the literature. Many economists have shown the important role played by real exchange rate in facilitating the adjustment process in low-income economies. Some of these studies include Edwards (1994), Elbadawi (1989), and Kiguel, (1992). Edwards (1994) argues that, in the short run, real exchange rate responds to both real and monetary disturbances and that in the short run, inconsistently expansive macroeconomic policies will generate a situation of real exchange rate misalignment. In a similar context, Elbadawi and Soto (1994) illustrate that under a pegged nominal exchange rate; expansionary fiscal and monetary policies may cause a persistent real overvaluation. These studies conclude that a proper alignment of the real exchange rate is a major determinant of economic performance. In addition, severe macroeconomic disequilibria and balance of payment crises in the developing countries are often cited as the direct consequence of real exchange rate misalignment (Edwards, 1994 and Dornbush, 1982). A study by the World Bank (1984) reveals that overvalued exchange rates in African countries lead to dramatic collapse of the agricultural sectors. This is because overvalued exchange rates undermine overall export and agricultural performance. Kiguel (1992) argues that the exchange rate regime has limited impact on the real exchange rate and only affects it in the short run due to rigidities in domestic prices and wages. In his study, Calvo et al. (1995) argued that the steady state real exchange rate is independent of permanent changes in monetary policy. They argue that this result depends on the fact that there is no direct steady state link in the theory between inflation and the real exchange rate so that monetary shocks are related to real exchange rate misalignment. Asea and Reinhart (1995) focus on the effects of capital inflows on the real exchange rate and interest rate differentials and on monetary policy responses. In fact, this is a phenomenon that has been quite common in the economies in Latin America and Asia. Aghevli et al. (1991), state that the choice of exchange rate regime is dependent on several other factors. These factors include the objectives pursued by the policy makers, the sources of the shocks hitting the economy and the structural characteristics of the economy. The basic argument is that, regardless of the objectives that determine the exchange rate regime, the authorities are presumed to adjust their domestic macroeconomic policies, particularly monetary and fiscal policies, to fit the chosen exchange rate policy. The exchange rate regime consecutively determines the flexibility of the monetary policy pursued.

Various exchange rate regimes have been reviewed in the literature. These include the extreme regimes, i.e. the fixed exchange rates, free float and intermediate regimes such as adjustable or crawling peg and target zones/crawling bands. Many empirical studies assert that small open economies are better served under a fixed exchange rate regime (Nnanna, 2000). Flood et al. (1989) suggest that the less diversified a country's export and production structure, the better for that economy to adopt a flexible exchange rate. Nnanna (2000) maintains that, while fixed exchange rate regime may provide price stability, it undermines policy flexibility which can have serious implications for internal and external balances. The effect of random shocks on the domestic economy is another major concern regarding the choice of an exchange rate regime. Nnanna (2000) argues that the optimal regime is the one that ensures macro economic stability.

### III. Empirical Analysis

The model for this study draws heavily from that of León and Oliva (1999). The model is a multinomial qualitative response model. This is used since the choice of the exchange rate regime is of a discrete form. The model incorporates a dependent variable  $y_t$ , such that:

$y_t = 0$  if the country has a fixed exchange rate regime at time  $t$

$y_t = 1$  if the country has a managed exchange rate regime at time  $t$

$y_t = 2$  if the country has a flexible exchange rate regime at time  $t$

In line with the above definition, the study, using a time series approach, investigates the determinants of the choice of Exchange rate regime. From the literature, some of the variables that affect the decision of a specific exchange rate system include:

- i. Monetary shocks (MS), defined as the 12-months-average standard deviation of the residuals from an ARMA (3-6,1) specification for the seasonally adjusted percentage change of money (M1). To avoid simultaneity problems, the paper considered the one-period lagged MS as an explanatory variable. The fitted ARMA was obtained using an iterative cycle of identification, estimation, and diagnostic checking of the variable.
- ii. Real shocks (RS), defined as the 12-months-average standard deviation of the residuals from an ARMA (1,1) specification for the percentage change in manufacturing production. The fitted ARMA was obtained using an iterative cycle of identification, estimation, and diagnostic checking of the variable.
- iii. Inflation differential (ID), defined as the difference between domestic and international inflation. International inflation was based on the definition from the IFS, IMF.
- iv. Foreign reserves constraints (FR), defined as the average change in international reserves during the previous 12 months.
- v. Openness (OPEN), defined as the ratio of trade (exports plus imports) divided by manufacturing production (The manufacturing production index is used as a proxy for total output).

The exchange rate regime equation thus, takes the form:

$$y_t = f(ID_t, FR_t, OPEN_t, MS_{t-1}, RS_t). \quad (1)$$

From the specification above, the major rationale for considering a given exchange rate regime is related to the shocks that affect output variability and subsequently make the economy unstable, while the restrictions for a fixed exchange rate system come from the balance of payments side. In addition, the purchasing power of parity and the fact that the nominal exchange rate can be used as an anchor are implicit with the incorporation of the inflation differential variable. A structural characteristic of the economy, common in the exchange rate regime literature, is captured by the openness variable. The econometric estimation of equation (1) requires a definition of the probabilities of choosing any of the three alternatives in a binary form:

$$\text{Log}(P_{jt}/P_{2t}) = \beta X_t + u_t \quad (2)$$

with:  $j = 0, 1$  and  $t = 1, \dots, N$ . As usual,  $X_t$  represents a matrix of independent variables and  $\beta$  a vector of coefficients. Assuming a logistic cumulative distribution for the error term:

$$P_{2t} = 1 / (1 + \exp(\beta' X_t) + \exp(\beta' X_t)), \quad (3)$$

$$P_{jt} = \exp(\beta' X_t) / (1 + \exp(\beta' X_t) + \exp(\beta' X_t)). \quad (3')$$

The estimation requires the maximization, with respect to  $\beta$  of the likelihood function:

$$L = \prod_{t \in \theta_0} P_{0t} \prod_{t \in \theta_1} P_{1t} \prod_{t \in \theta_2} P_{2t} \quad (4)$$

here  $\theta_j = \{\text{the } j\text{-th response is observed}\}$  with  $j = 0, 1, 2$ . The results from the multinomial logit estimation are summarized in Table 1.

The result shows that most of the variables were significant in explaining the choice of the exchange rate regime, given the value of their t-statistics. More so, the value of the Madalla's pseudo-R square, which was 61, suggests that the regression has an apposite fit. With respect to the predicted outcomes, 71% of the cases are correctly predicted as a fixed exchange rate regime. The accuracy rate for the managed exchange rate regime was 68% while that of the flexible exchange rate regime was exactly 72% of the cases.

Table 1

## Multinomial Logit Estimation: Fixed and Managed versus Flexible

Variable	Compare	Estimate	T-Value	
Constant	0/2	-9.18	-3.41*	
	1/2	-1.23	-0.71	
Inflation differential (ID)	0/2	0.91	3.01*	
	1/2	0.98	3.11*	
Foreign reserves constraint (FR)	0/2	0.00	-0.26	
	1/2	-0.01	-1.96**	
Openness (OPEN)	0/2	8.35	5.01*	
	1/2	-3.42	-2.08*	
Monetary shock 1 lag (MS(-1))	0/2	-1.08	-3.92*	
	1/2	-0.11	-1.01	
Real shock (RS)	0/2	1.42	3.84*	
	1/2	1.31	4.02*	
Observed and Predicted Outcomes				
Observed	Predicted			
Reg = 0	Reg = 0	Reg = 1	Reg = 2	Total
	71	21	9	101
Reg = 1	8	68	11	87
Reg = 2	0	6	76	82
Total	79	95	96	270
-2 Log Likelihood for full model 105.32				
Percent Correctly Predicted 72.10				
Madalla's pseudo R-square 0.61				

Note: \* significant at 1% level;  
 \*\* significant at 5% level.

Furthermore, to recover the estimates and t-statistics for the fixed against the managed exchange rate regime choice, the variance-covariance coefficient matrix was derived. This was done using the specification below:

$$\text{Log}(P_{0t}/P_{2t}) - \text{Log}(P_{1t}/P_{2t}) = \text{Log}(P_{0t}/P_{1t}).$$

From the table, inflation differential (ID) coefficient estimate was significant relative to the flexible exchange rate regime. Also, the slope of the estimates indicates that the bigger the inflation differential is the greater the probability of a using or operating a less flexible exchange rate regime is. This implies that Nigeria tends to use the flexible exchange rate to stabilize prices especially when it was inherent that relative to international inflation, domestic inflation remains high.

Similar to the findings of Fischer (1976) and Aizenman and Frenkel (1982), the effect of the disturbances shows clear-cut results whichever the choice is. This signifies the probability that the monetary authorities preferred a more flexible exchange rate regime when monetary shocks (MS) dominate. It is important at this stage to note that a loss on the purchasing power of the domestic currency could be more obvious before the presence of monetary shocks, thus the regime tends to be

less interfering. More so, inasmuch as the monetary shocks could be caused by changes in the flow of international reserves, there could be some degree of collinearity. In the face of domestic real shocks (RS), the choice of a fixed exchange rate regime becomes apparent. This is evident given the positive slope of the estimate as well as the fact that it was significant when all the three regimes are compared against each other. Consequently, it can also be argued that the probability of a less flexible exchange rate regime is greater when there are capital controls. Though this may be controversial, a further empirical test could be carried out to ascertain whether it is true or not.

It is important to point out that the effect of inflation differential and monetary shocks have the opposite sign on the exchange rate regime when comparing both fixed and managed against flexible. This can be linked to the relationship between inflation differential, the monetary shock and the exchange rate regime in Nigeria. Over time as the inflation differential increases, the role of the exchange rate as a nominal anchor, moving the latter to a regime with higher degree of intervention in order to control balance of payments crises and shock variability due to capital flows, becomes essential. The occurrence in the 1980s partially confirms this, this is because in the early 1980s, despite the increase in inflation and the shocks that existed, Nigeria still maintained a fixed exchange rate regime, this was in existence until 1986 when the Structural Adjustment Programme (SAP) ushered in a flexible exchange rate regime.

With respect to foreign reserves (FR), the change was significant only when comparing managed and flexible exchange rate regimes. It also had a negative slope that implies that incessant change in foreign reserves demands a more flexible exchange rate regime to avoid balance of payments crisis or a severe monetization. But this also depends on whether the country loses or gains more reserves. For the fixed and managed regimes it was not significant. The degree of openness (OPEN), though had a vague estimate, was significant. In terms of comparison between fixed and flexible exchange rate regimes, the estimation shows evidence of a direct relationship between openness and a fixed regime. This means that the regime was used to aid the channeling abroad of domestic shocks. However, when the managed and flexible regimes are compared together, a more flexible system was opted for, this was to enhance the insulating properties of the exchange rate regime.

The Hausman test was also performed to verify whether the independence of irrelevant alternatives is a problem for the multinomial estimation. The Hausman's  $S$  statistic is defined as:

$$S = (\beta_d - \beta_c)'(V_d - V_c)^{-1}(\beta_d - \beta_c) \quad (5)$$

with a Chi-squared distribution and  $V_c - V_d$  degrees of freedom; where  $\beta_c$  is the vector of coefficients from the full choice set (that is, multinomial),  $\beta_d$  is the vector of coefficients from the restricted choice set (i.e. binomial);  $V_c$  and  $V_d$  are their respective variance-covariance matrices. Based on regressions from Table 1, the value of the  $S$  statistic was equal to 235.18, allowing for the rejection of the null hypothesis of dependence of irrelevant alternatives.

In our bid to avoid simultaneity between the exchange rate regimes and the monetary shocks, a simultaneous limited-dependent model was estimated. This assumes that a number of economic variables (including the monetary shocks) determine the exchange rate regime. Subsequently, this variable, in turn, acts as one of the determinants of the monetary shocks. However, given the nature of the variables involved, one of the endogenous variables (exchange rate regime) is limited, while the other (monetary shock) is continuous. Thus the estimation of the model differs from standard simultaneous models. Based on equation (1), the complete structural simultaneous equation model is specified, in line with the study of León and Oliva (1999), as:

$$\begin{aligned} \text{Log}(P_{jt}/P_{2t}) &= \gamma_1 MS_t + \beta_1 X_{1t} + u_{1t}, \\ MS_t &= \gamma_2 y_t + \beta_2 X_{2t} + v_{2t}. \end{aligned} \quad (6)$$

The reduce form of the model is:

$$\begin{aligned} \text{Log}(P_{jt}/P_{2t}) &= \pi_1 X_t + u_{1t}, \\ MS_t &= \pi_2 X_t + v_{2t}, \end{aligned} \quad (7)$$

where  $X_t$  includes all the exogenous variables in  $X_{1t}$  and  $X_{2t}$ . The two-stage least square estimation technique was adopted in estimating the model. This was in line with the method

suggested by Nelson and Olson (1974) and applied to exchange rate regimes by Savvides (1990). Just like León and Oliva (1999), we first estimated the reduced form of the model by applying maximum likelihood to each equation in (7), from where we obtained the instruments  $y_t^{\wedge}$  and  $MS_t^{\wedge}$ . Later the corresponding instrument replaced the endogenous variables on the right hand side of the structural model, and then the parameters of the model in equation 6 were estimated by applying maximum likelihood to each equation individually. The result is presented in Tables 2 and 3 below.

Table 2

Simultaneous Equations Model: Fixed and Crawling versus Flexible

Continuous variable: Monetary shock (MS) Variable	Estimate	T-Value
Constant	-0.71	-2.06*
Inflation differential (ID)	0.04	1.02
Foreign reserves constraint (FR)	0.00	-1.41
Openness (OPEN)	0.68	2.11*
Monetary shock 1 lag (MS(-1))	1.03	5.15*
Predicted exchange rate regime (yE)	0.31	1.89***
Real shock (RS)	0.13	2.81*
R <sup>2</sup> 0.89		
Durbin Watson 1.97		
F-Statistics 204.01		

Note: \* significant at 1% level;  
\*\*\* significant at 10% level.

The table shows that on the overall, the model was significant. This is manifest given the value of the F-statistics, which were 204.01. Also, the value of the coefficient of determination ( $R^2$ ), which is 0.89 shows that all the explanatory variables can explain 89% of the changes in the use of the various exchange rate regimes. Moreover, the value of the Durbin Watson statistics, which stood at 1.97, indicates the absence of autocorrelation in the model. The forecasted exchange rate regime (yE) in the MS equation had a positive slope and was significant at 10% level while the coefficient for the forecasted monetary shock (MSE) in the limited dependent variable equation had a negative slope for all the compared regimes but was only significant at 5% for the fixed versus flexible exchange rate regimes. This result was similar to that obtained earlier when the lag of MS was used to eliminate the problem of simultaneity.

Table 3

Simultaneous Equations Model: Fixed and Crawling versus Flexible

Limited dependent variable: Exchange rate regime (y) Variable	Compare	Estimate	T-Value
Constant	0/2	-14.01	-4.01*
	1/2	-1.02	-1.04
Inflation differential (ID)	0/2	1.01	3.31*
	1/2	0.71	3.14*
Foreign reserves constraint (FR)	0/2	0.00	-0.73
	1/2	-0.01	-3.14*
Openness (OPEN)	0/2	8.01	5.62*
	1/2	-5.13	-2.24*
Predicted monetary shock (MSE)	0/2	-1.41	-5.02
	1/2	-0.22	-1.01
Real shock (RS)	0/2	1.54	3.91*
	1/2	1.33	4.22*



Table 3 (continuous)

Observed and Predicted Outcomes				
Observed	Predicted			
	Reg = 0	Reg = 1	Reg = 2	Total
Reg = 0	78	6	4	88
Reg = 1	4	38	16	58
Reg = 2	2	26	63	91
Total	84	70	83	237
-2.00 Log Likelihood for full model 165.24				
Percent Correctly Predicted 85.04				
Madalla's pseudo R-square 0.73				

Note: \* significant at 1% level.

The result, similar to our earlier findings in this paper, also shows that most of all of the variables help to explain the choice of the exchange rate regime. This can be seen from the value of their t-statistics. The model had an appropriate fit given the value of the Madalla's pseudo-R square. Concerning the predicted outcomes, 78% of the cases are correctly predicted as a fixed exchange rate regime. The prediction accuracy rate was 38% for the managed exchange rate regime while that of the flexible exchange rate regime was 63%. The simultaneous equation approach seems to be more accurate in estimating the probability of alternative exchange rate regimes. But it has a main limitation in that the statistical properties of polychotomous simultaneous equations models are not well known, (León and Oliva, 1999). The standard deviation thus, obtained cannot be used to perform tests on the estimated coefficients because the asymptotic covariance matrix for the multinomial logit cannot be computed. Hence, León and Oliva, (1999) warned that the results obtained using the simultaneous equation model have to be taken with caution.

#### IV. Conclusion

This study examined the choice of the exchange rate regimes in Nigeria using multinomial logit and simultaneous limited-independent models based on data from 1960 to 2000. Strong evidence emerged that different variables ranging from characteristics of the economy (degree of openness) and macroeconomic performance (inflation differential, change in foreign reserves) to real and monetary shocks help to explain the choice of exchange rate regime at different periods of time. Results further indicate that domestic monetary disturbances appreciated the real exchange rate and favored a more flexible arrangement, while in the presence of real shocks the balance of payments acted as a shock absorber and a fixed regime was more likely. This was evident in Nigeria in the early 1980s, though at that period the naira seemed to be overvalued. However, it is necessary to recall that the estimates are depicted in terms of probabilities. Hence, the results should be interpreted with caution

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