

**TESTING THE PURCHASING POWER PARITY  
HYPOTHESIS FOR THE NIGERIAN FOREIGN  
EXCHANGE MARKETS**

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## **ABSTRACT**

The authors in their effort at modeling the Nigerian foreign exchange rate discover that so far, studies have concentrated on the Official Market. However, three other Exchange Rate Markets exist. This study investigates the dynamics and behavioural operations on all the various Markets. The Purchasing Power Parity (PPP) hypothesis was tested for each of the Markets and was found to hold in the long run for all the Markets. It has also been established that a valid cointegrating relationship exists between Nigerian and US prices for each Market. The error correction model for each Market was also confirmed to be consistent with the Engle-Granger framework. The Parallel Market emerges as the leading indicator of the exchange rate of the naira. This is because the level of prices in the US appears to be a determining factor of exchange rate at IFEM and Official Market whereas level of prices in BOTH COUNTRIES determined the Parallel Market exchange rate but neither determines at the Bureau de Change rate.

## **I. Introduction**

The justification for the study is amply exemplified by the observation of the Secretary to the Government of the Federation of Nigeria, U.J. Ekaette (2002). According to him, continuous depreciation of the Naira has encouraged currency speculation which unscrupulous individuals would naturally prefer to productive activity, leading to the diversion of invest able funds to non-productive activities. In the same vein, the former Governor of the Central Bank of Nigeria (CBN) J.O Sanusi (2002) stated that the choice of exchange rate regime is a critical issue Suffice it to say that the current high interest rate structure represents the opportunity cost which the economy is paying for a misaligned exchange rate regime, indicative of the structural imbalance in the economy. The ultimate aim of our research is to explain the determinants of the Nigerian real exchange rate and to explore the possibility of convergence of all the exchange rates in the various markets. This paper is divided into six sections. Section II deals with literature review, Section III discusses exchange rate regimes in Nigeria, section IV examines Purchasing Power Parity exchange rate model while section V estimates the model and Section VI gives the conclusion.

## **II. Literature Review**

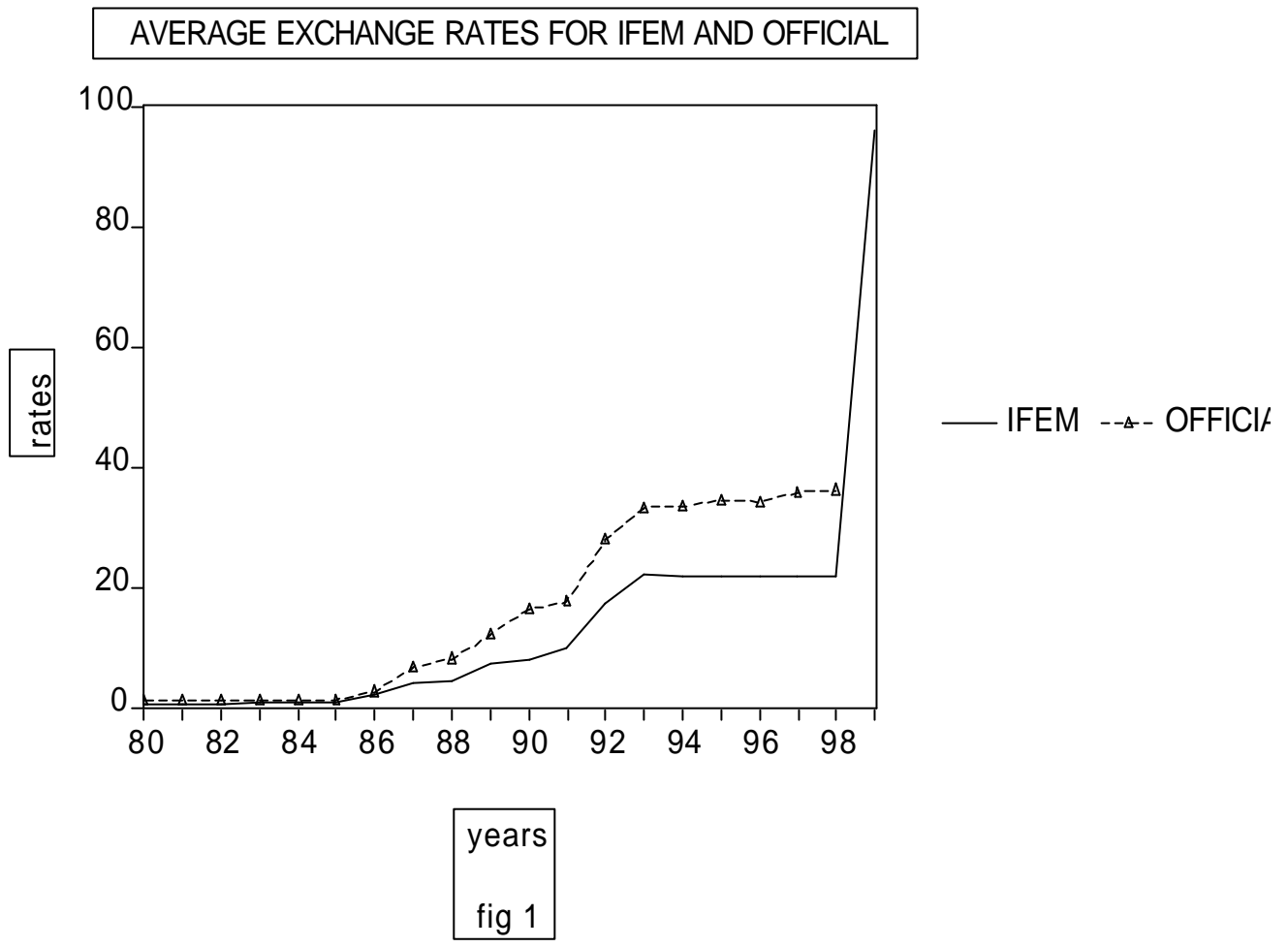
According to Peter Rowland (2003) exchange rate models include (i) a simple random walk model (ii) a random walk model with a variable drift and (iii) monetary models. He concludes that fundamental models might only be a useful tool for forecasting of the exchange rate *in the very long run*. According to Evans and Lyons(29 Jan.2001) macroeconomic models of nominal exchange rates perform poorly. The proportion of monthly exchange rate changes that these models can explain is essentially zero. Robert Lafrance and Simon van Norden (Spring 1995) developed a simple equation with a few key variables accounting for broad movements of the Canada- US real exchange rate over the post-1970 period of floating exchange rates. Finally, E.O.Ojameruaye(1990) reviews the Purchasing Power Parity(PPP) theory of exchange rate and applies the PPP method to

Nigerian data from 1970 to 1988. The paper critically examined the PPP approach to the determination of the realistic exchange rate of the Naira.

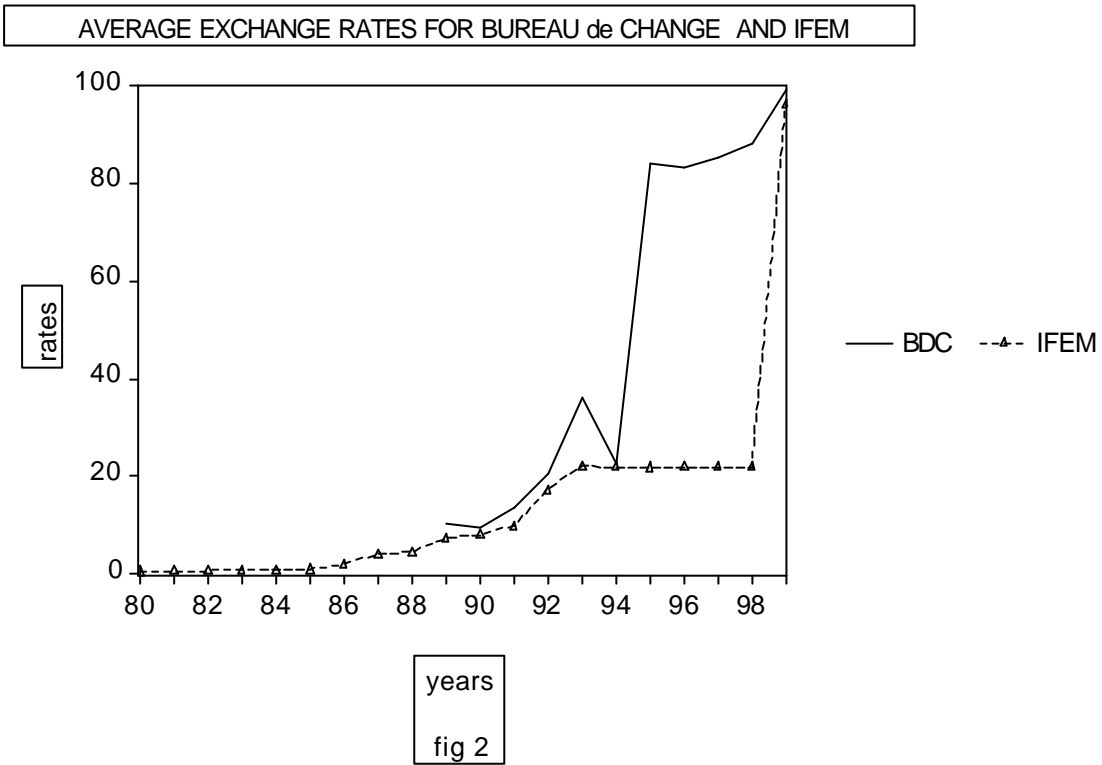
### **III. Exchange Rate Regimes in Nigeria**

U.J.Ekaette(2002) noted that one major challenge that had confronted this administration since it assumed office in May 1999 was how to quickly put the economy back on the path of sustainable growth. According to him, most of the banks are suspected to have abandoned real banking for “round tripping”(the diversion of official Foreign Exchange(FE) to the Parallel Market). O.O.Soleye(1985) then Honourable Minister of Finance stated that conscious effort aimed at the management of the Nigerian foreign exchange resources began in 1962 with the inception of the EXCHANGE CONTROL ACT which was directed at freeing the management of our FE from its erstwhile colonial pattern. T.Ademola Oyejide(1985) stated that the Nigerian Pound was introduced in 1959.Its external value was fixed at par with the British Pound Sterling which,in turn, defined its United States Dollar(USD) value as \$2 .80. Nigeria joined the International Monetary Fund(IMF) after Independence, and the Nigerian Pound had its parity defined,in June 1962,in terms of Gold at one Nigerian Pound equals 2.48828 grams of fine gold This confirmed its original USD par value. Similarly,the exchange rate of the Nigerian Pound for the British Pound Sterling was determined via its gold parity .However, the sterling was devalued by 14.3 per cent against its gold parity in November,1967. Since Nigeria did not devalue in tandem,the value of the Nigerian Pound became 1.17 British Pounds Sterling.The Naira replaced the Nigerian Pound as Nigeria’s currency in January1973,its par value was set at half that of the pound .Hence the exchange rate became \$1.52 to the naira. The rigid relationship between the USD and the naira was terminated in April 1974;the fixed rate for sterling had been broken earlier in June 1972,when the sterling started to float officially. In February 1978 ,the system of determining the naira exchange rate against a basket of currencies of Nigeria’s main trading partners was finally adopted. According to Ugbebor,the Oil GLUT of 1981 led to a crisis in the Foreign Exchange Market (FEM) in 1982.In December 1983 there was a change in government.With effect

from January 1984 and again in May 1984 additional exchange control measures were introduced. Another change in government took place in August 1985. In September 1986, the Second-Tier Foreign Exchange Market (SFEM) was introduced. Under SFEM, the exchange rate was floated when it became obvious that a rigid or controlled exchange rate would not ensure internal balance. The principles of the Structural Adjustment Programme (SAP) were adopted leading to a market-oriented approach to price determination. The Second-Tier rate was determined by auction at the SFEM using (a) the average rate pricing method, (b) the marginal rate pricing method, (c) the Dutch Auction System (DAS) which was introduced in April 1987, whereby the CBN bought and sold FE in this market and supplied the demand of the authorized dealers in full. The First-Tier rate was still applicable to Debt Service payments, other public sector disbursements and pre-SFEM transactions. The merger of the two markets in July 1987 to form an enlarged FEM was more technical than real. According to Akinmoladun (1990), the gap between the two rates began to grow shortly after. In January 1989, the DAS was re-introduced and the Dual Exchange Rate system FEM merged with the Interbank market to form IFEM. By March 1992 there was a complete floating of the naira. Another change in government in August 1993 ushered in a new fixed exchange rate. In 1995, the Autonomous Foreign Exchange Market (AFEM) was introduced, under a policy which allowed for Central Bank of Nigeria intervention on a predetermined basis instead of arbitrarily. Under AFEM, BUREAUX DE CHANGE would buy and sell from privately-sourced FE at the AFEM rate. The fixed exchange rate was reserved for public sector use. In 1993, the Parallel Market and Bureaux de Change exchange rates were almost double the devalued First-Tier rate for the naira. The authorities saw this as a signal of a depreciation trend which needed correction. This led to a re-introduction of a fixed exchange rate which pegged the naira at ₦21.996 to \$1 in 1994. In January 1997, the naira was formally PEGGED and a pro rata system of FE allocation to end-users was adopted.

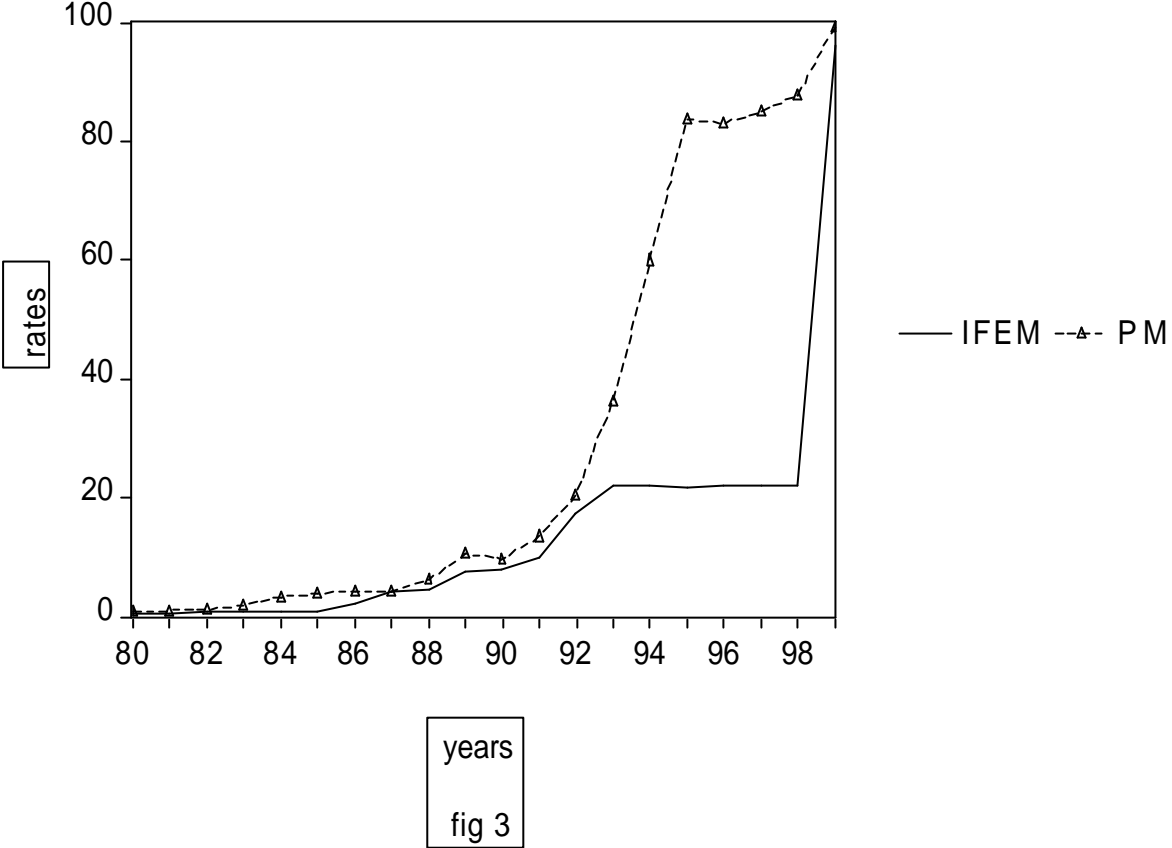


Source: Central Bank of Nigeria, *Nigeria Major Economic and Financial Indicators*, April, 2000.

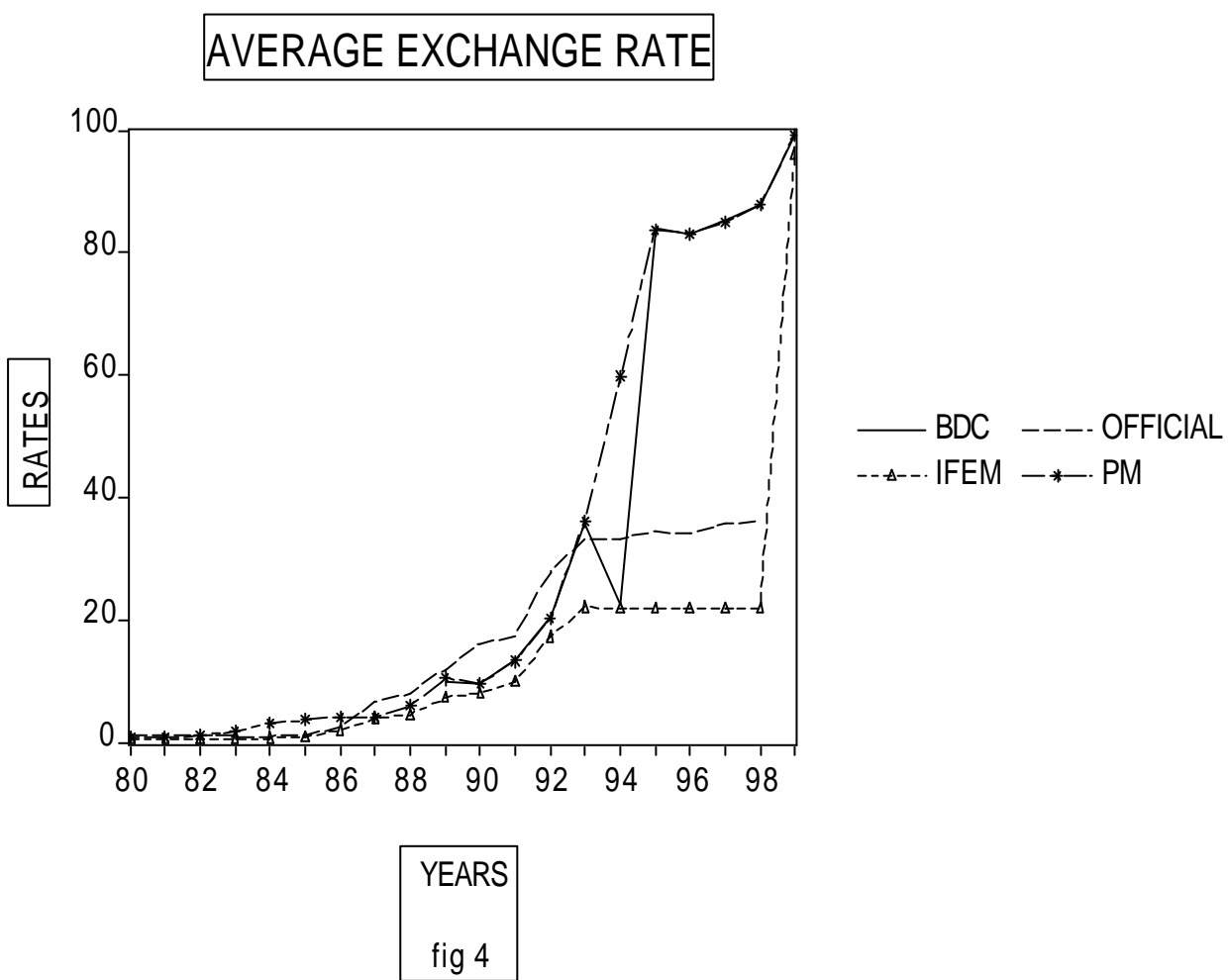


Source: Central Bank of Nigeria, *Nigeria Major Economic and Financial Indicators*, April, 2000.

AVERAGE EXCHANGE RATES FOR IFEM AND PARALLEL MARKET



Source: Central Bank of Nigeria, Nigeria Major Economic and Financial Indicators, April, 2000.



Source: Central Bank of Nigeria, *Nigeria Major Economic and Financial Indicators*, April, 2000.

In spite of all these efforts, the trend has been woeful. In 1962: ₦1 ~ £1, 1996: ₦130 ~ £1 and in 2002: ₦200 ~ £1. Since currency conversion involves the fixing of a price or value for the currency that is being bought, it is equivalent, in terms of international trade, to the worth of one currency in terms of another. The future however, is bright as Nigeria hopes to increase her oil production from the current 2.2 million barrels per day to 4 million bpd by 2007. Moreover, revenue from natural gas is expected to hit the 60 billion US dollar mark by 2010. *A mathematical model is therefore, desirable.*

#### IV. Exchange Rate Models

A random Walk with a Variable Drift

A random walk with a variable drift is defined as

$$s_t = u_t + s_{t-1} + e_t \quad (1)$$

where

$$u_t = u_{t-1} + v_t \quad (2)$$

The error terms,  $e_t$  and  $v_t$  are white noise processes and should be independent and normally distributed. The term  $U_t$  defines the drift, and  $S_t$  is the exchange rate. If  $u_t$  would be a time-independent constant, we would have a normal random walk with a drift. We have seen earlier that a structural monetary model is preferable to this.

The Purchasing Power Parity (PPP) Hypothesis

Two alternative forms of PPP have evolved over time, *absolute* PPP and *relative* PPP. The absolute PPP hypothesis states that the exchange rate between the currencies of two countries should equal the ratio of the price levels of the two countries. In logarithmic form this is written as

$$s = p - p^* \quad (3)$$

where  $s$  is the nominal exchange rate measured in units of domestic currency per unit of foreign currency,  $p$  is the domestic price level, and  $p^*$  is the foreign price level, all variables in logarithms.

The relative PPP hypothesis, on the other hand, states that the exchange rate should be proportionate to the ratio of the price level, which, again in logarithmic form, is stated as

$$s = k + p - p^* \quad (4)$$

where  $k$  is a constant parameter. Since information on national price levels normally is

available in the form of price indices rather than absolute price levels, absolute PPP may be difficult to test empirically. We will, for this, reason use relative PPP for the study in this paper, in line with earlier empirical studies.

The PPP hypothesis does not make any general assertion about the direction of causality between the variables. It only states the relationship. Causality between prices and the exchange rate might well run in both directions. The exchange rate may respond to a change in the ratio of the national price levels, while rate depreciation might feed inflation. When it comes to purchasing power parity, this has been tested in a large number of studies, and empirical evidence strongly confirms that the PPP is not a valid hypothesis about the relationship between nominal exchange rates and national price levels in the short term. The main theoretical argument against the validity of long-term PPP comes from the structural models of inflation. In the long-term PPP has, nevertheless, received considerable empirical support.

## V. Estimation of the PPP Model.

### ANALYSING THE LONG-TERM COINTEGRATING RELATIONSHIPS

We start this section by testing the time series data for unit roots. The tests are summarized in tables 1-3.

Table 1.

Unit Root Test for The Time series.  
(All test regressions include an intercept term)

Variable	Level	First Difference	Second Difference	Order of integration
IFEM	ADF(8)=-1.6152	ADF(7)=-0.1509	ADF(0)=-3.0702**	2
Bureau de Change	ADF(3)=-1.1629	ADF(0)=-4.9122*		1
Official	ADF(5)=-5.1595*			0
Parallel Market	ADF(8)=0.107855	ADF(0)=-3.0606**		1
U.S. Consumer prices	ADF(0)=4.0619**			0
Nigeria Consumer Prices	ADF(6)=-0.0062	ADF(6)=-1.4240	ADF(0)=-3.7954**	2

Table 2.

Unit Root Test for The Time series.  
(All test regressions include Trend and intercept terms)

Variable	Level	First Difference	Second Difference	Order of integration
IFEM	ADF(8)=-1.9911	ADF(7)=-0.3641	ADF(6)=0.3211	
Bureau de Change	ADF(3)=-0.2556	ADF(0)=-4.8761**		1
Official	ADF(6)=-1.2582	ADF(4)=-4.4849**		1
Parallel Market	ADF(7)=-3.5974***			0
U.S. Consumer prices	ADF(6)=-1.2150	ADF(0)=-4.7201*		1
Nigeria Consumer Prices	ADF(6)=-1.3294	ADF(6)=-0.1211	ADF(0)=-3.7993**	2

Table 3.

Unit Root Test for The Time series.

(Test Regressions contains neither intercept term nor Trend nor both)

Variable	Level	First Difference	Second Difference	Order of integration
IFEM	ADF(8)=0.5433	ADF(7)=-0.6946	ADF(0)=-3.1382*	2
Bureau de Change	ADF(3)=0.6502	ADF(0)=-3.4633*		1
Official	ADF(6)=-0.2195	ADF(6)=-3.4789*		1
Parallel Market	ADF(0)=2.7644*			0
U.S. Consumer prices	ADF(0)=7.9912*			0
Nigeria Consumer Prices	ADF(0)=5.5974*			0

Note: The Augmented Dickey-Fuller test is used to test for unit roots. The value in parentheses is the order of the lag used, which is decided by using the Schwartz criteria. The symbols ‘\*\*\*’ and ‘\*’ indicate significance at the 5 and 1 percent respectively.

To investigate the existence of a cointegrating vector, we estimate the logarithmic form of the relative PPP hypothesis as stated by equation (4), i.e,

$$S = b_1 + b_2P + b_3P^* + e$$

(Exchange rate)                      (Nigeria CPI)                      (US CPI)

For relative PPP to be valid,  $b_2$  should be positive and approximately equal to one,  $b_3$  should be negative and approximately to one. The parameter  $b_1$  depends on the level of the price indices, i.e, what year is used as base for calculating the indices.

The results of regressions are presented in table 4.

Table 4.

Equation 1	LIFEM = -33.3406 – 0.0007LNCPI + 7.2596 LUSCPI (0.0005) (0.9981) (0.0015) R <sup>2</sup> =0.9308; Adjusted R <sup>2</sup> =0.9227; ADF(0)=-2.7184* F-statistic = 114.3567 Prob(F-statistic) =0.00000
Equation 2	LBDC = -8.0971 + 0.779767LNCPI + 1.250277LUSCPI (0.6175) (0.0479) (0.7355) R <sup>2</sup> =0.9395; Adjusted R <sup>2</sup> =0.9244; ADF(0)=-3.7955* F-statistic = 62.1471 Prob(F-statistic) =0.000013
Equation 3	LOF = -30.40075 + 0.000251LNCPI + 6.742359 LUSCPI (0.0031) (0.9994) (0.0067) R <sup>2</sup> =0.898353; Adjusted R <sup>2</sup> =0.885647; ADF(0)=-2.263216** F-statistic = 70.70337 Prob(F-statistic) =0.00000
Equation 4	LPM = -17.22590 + 0.621351LNCPI + 3.318472 LUSCPI (0.0001) (0.0001) (0.0001) R <sup>2</sup> =0.987519; Adjusted R <sup>2</sup> =0.986051; ADF(0)=-2.376966** F-statistic = 672.5520 Prob(F-statistic) =0.00000

Note: The probability values are given in parentheses below the parameter estimates. The Augmented Dickey-Fuller statistic tests the null hypothesis that the residuals are integrated of order one and, thereby, non-stationary. The value in parenthesis shows the order of the lag used or the augmented Dickey-Fuller test. The symbols '\*' and '\*\*' indicate significance at 1% and 5% levels respectively.

The parameter estimates of  $b_1$  are negative in the regressions. The estimates are also significantly different from zero in all except the second equation (LBDC). We have a valid cointegrating relationship since the residuals are stationary as shown by the augmented Dickey-Fuller test thus suggesting that the PPP hypothesis did not hold in the strong sense between Nigeria and United States during the period under study. From equation 1 level of prices in US appears to be a determining factor of exchange rate at IFEM and Official Market (see equations 1 and 3). However Level of prices in both countries determined the Parallel Market exchange rate but neither determines the Bureau de Change rate.

#### ESTIMATING THE ERROR CORRECTION MODELS.

We now proceed with the third step in the Engle-Granger methodology, the estimation of the error correction model. We shall estimate four different error correction models. In all cases we are using the cointegrating relationship estimated for the unrestricted PPP model, i.e. the results in table 2. We are, consequently, estimating the VARs using the residuals from the regressions in table 4. The four error correction models that we estimated can be stated as

$$\Delta LIFEM_T = \sum_{l=1}^K g_1^l \Delta LIFEM_{T-l} + \sum_{l=1}^K g_2^l \Delta LNCPI_{T-l} + \sum_{l=1}^K g_3^l \Delta LUSCPI_{T-l} + aZ_{T-1} + e_T \quad 13.1$$

$$\Delta LBDC_T = \sum_{l=1}^K d_1^l \Delta LBDC_{T-l} + \sum_{l=1}^K d_2^l \Delta LNCPI_{T-l} + \sum_{l=1}^K d_3^l \Delta LUSCPI_{T-l} + \mathbf{b}Z_{T-1} + \mathbf{e}_T \quad 13.2$$

$$\Delta LOF_T = \sum_{l=1}^K f_1^l \Delta LOF_{T-l} + \sum_{l=1}^K f_2^l \Delta LNCPI_{T-l} + \sum_{l=1}^K f_3^l \Delta LUSCPI_{T-l} + \mathbf{p}Z_{T-1} + \mathbf{e}_T \quad 13.3$$

$$\Delta LPM_T = \sum_{l=1}^K t_1^l \Delta LPM_{T-l} + \sum_{l=1}^K t_2^l \Delta LNCPI_{T-l} + \sum_{l=1}^K t_3^l \Delta LUSCPI_{T-l} + \mathbf{I}Z_{T-1} + \mathbf{e}_T \quad 13.4$$

where  $\gamma^j, \alpha, \delta^l, \beta, \phi^l, \pi, \tau^l$  and  $\lambda$  are parameters to be estimated,  $k$  is the maximum distributed lag length,  $\Delta$  is the difference operator and  $\mathbf{e}_t$  is independent and identically distributed error terms. The parameter estimates of  $\alpha, \beta, \pi$  and  $\lambda$  should be negative and between zero and minus one. The maximum lag length  $k$  was chosen to be long enough for the error terms to be normally distributed and not serially correlated.

Table 5.

Parameter estimates of  $\alpha, \beta, \pi$  and  $\lambda$   
(Maximum lag length  $k=1$ )

Equation for variable			
Equation13.1	$\Delta LIFEM$	$\Delta LNCPI$	$\Delta LUSCPI$
$\alpha$	0.973108	-0.055507	0.008750
t-statistic	(6.67786)	(-0.56168)	(0.75037)
Equation13.2	$\Delta LBDC$	$\Delta LNCPI$	$\Delta LUSCPI$
$\beta$	1.227167	0.221829	-0.006648
t-statistic	(4.19521)	(0.67040)	(0.53506)
Equation13.3	$\Delta LOF$	$\Delta LNCPI$	$\Delta LUSCPI$
$\pi$	0.751736	-0.130029	0.020743
t-statistic	(3.11895)	(-0.88073)	(1.24119)
Equation13.4	$\Delta LPM$	$\Delta LNCPI$	$\Delta LUSCPI$
$\lambda$	0.999134	0.455293	0.042934
t-statistic	(2.92836)	(1.65985)	(1.62234)

Only the equations for  $\Delta LIFEM$  are stated by equation13.1. The other equations, i.e., the equations for  $\Delta LNCPI$  and  $\Delta LUSCPI$  can easily be derived from these equations. The arrangement is similar for  $\Delta LBDC, \Delta LOF$  and  $\Delta LPM$ . For the error correction models stated by equations 13.1 - 13.4 to be valid with the Engle-Granger framework, the exchange rate (IFEM, BDC, OFFICIAL and PM) has to be exogenous while all other variables should be endogenous. That this is the case is shown by the fact that the parameters of  $\alpha, \beta, \pi$  and  $\lambda$  are significant in the equations for  $\Delta LIFEM, \Delta LBDC, \Delta LOF$  and  $\Delta LPM$  as indicated by the t-statistics. We now have models for each of the four markets that build on the long-term cointegrating relationship. The short-term dynamics are, however, represented by different error correction models, based on variables derived from the hypothesis.

## **VII. Conclusion**

The Parallel Market emerges as the leading indicator of the exchange rate of the Naira. A divergence between the Official and Parallel Market exchange rates induces, in the short term, speculative activities which are inimical to the effectiveness of foreign exchange policy. Therefore, the informal sector of the economy must be carried along by the Federal Government of Nigeria in order to avoid undue short falls in foreign exchange earnings. This is because low foreign exchange reserves and exchange rate instability affect each other, both ways. The Federal Government must adopt BOIT- Build up, Operate, Invest and Transfer excess unexpected ( e.g., World-wide upsurge in crude oil prices) windfalls in foreign exchange earnings into viable ventures leading to rapid, sustainable and healthy economic growth.

A convergence of the exchange rates at all the markets is achievable so that an equilibrium exchange rate could be targeted. The Central Bank of Nigeria must be empowered to say 'NO' to any request by any government in power to finance her spending through either 'Ways and Means' advances or sale of treasury bills. These as well as intervention measures, including the curbing of excessive borrowing and capital flight, might lead to the cancellation of some of the debt owed to foreign countries with the crippling interest accruing over decades.

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