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A STATISTICAL ANALYSIS OF FOREIGN EXCHANGE RATE BEHAVIOUR IN NIGERIA'S AUCTION

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OMIC RESEARCH CONSORTIUM

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A statistical analysis of foreign exchange rate behaviour in Nigeria's auction

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I. Introduction

For a developing country like Nigeria, the price of foreign exchange plays a highly siginificant role in the ability of the economy to attain optimal productive capacity. Before the dramatic change in exchange rate management policy in the wake of the economic reform programme that began in July 1986, the supply of foreign exchange to the economy was heavily subsidized through the overvaluation of the domestic currency (the naira). In the years of abundant foreign exchange earnings, for example 1974-1980, the impact of this subsidy was felt mainly on the consumption side. The manufacturing sector, also benefitted, however, but agriculture suffered inadvertently. When the economic crisis started in January 1981, efforts to preserve the subsidy became futile; the subsidy went as economic rent to a handful of opportunists, and the expected benefits of a fixed rate at less than market price were lost to the economy.

Given this situation in the face of rapidly declining foreign exchange earnings, there was every reason for the government to seek to set the price for foreign exchange right and provide incentives for agricultural and manufactured exports.

Since these efforts began, the monetary authorities have had to live, very uncomfortably, with the puzzle surrounding the instability of the exchange rate. What is considered a stable and realistic exchange rate has remained elusive. In the pursuit of realism, the monetary authorities changed the auction system and frequency of bidding in the official foreign exchange market on several occasions before the eventual collapse of the auction system on 5 March 1992. Before this collapse, the following auction systems were tried out :

- Average rate pricing system with weekly bidding
- Marginal rate pricing system with weekly bidding
- Dutch auction system with fortnightly bidding
- Inter-bank system with daily bidding
- Dutch auction system with daily and subsequently weekly bidding

The behaviour of the naira exchange rate under each system was markedly different — volatile in some and fairly stable (but unrealistic) in others.

II. Management of the exchange rate in Nigeria

The concern with exchange rate management policy in Nigeria can be traced back to 1960 when the country became politically independent, even though the Central Bank of Nigeria and the Federal Ministry of Finance had come into being two years earlier. There are a variety of ways and reasons for classifying subsequent developments in Nigeria's exchange rate policy. One classification would put such developments into two phases, namely, a passive phase and an active phase. Yet another binary classification, which is essentially equivalent to the foregoing, is the pre-structural adjustment and post structural adjustment division in exchange rate policy developments. A classification that seems to capture the historical sequence more closely, however, would divide exchange rate management into five periods or stages.

Stage I: Fixed parity between the Nigerian pound and the British pound

In the first period of exchange rate policy in Nigeria, which spanned the year 1960-1967 there was a one-to-one relationship between the Nigerian pound (N£) and the British pound sterling (S£). This fixed parity lasted until the British pound was devalued in 1967. Because of the Nigerian civil war which was going on at the time, the monetary authorities did not consider it expedient to devalue the Nigerian pound in sympathy with the British pound.

Two major reasons accounted for this reluctance. First, a considerable share of the country's resources was being diverted to finance the war. And second, there was the apprehension that devaluation of the Nigerian pound would only raise domestic prices of imports without any appreciable impact on exports, which were still largely primary products. Rather than devalue the Nigerian pound, the monetary authorities decided to quote the Nigerian currency in reference to the US dollar. In addition, they impose severe restrictions on imports as well as strict administrative controls on foreign exchange.

Stage II: Fixed parity between the Nigerian pound and the American dollar

The second period of Nigeria's exchange rate policy lasted from 1967 to 1974. During

this time a fixed parity was maintained with the American dollar. Nigeria abandonded the US dollar and once again kept its currency at par with the British pound following the international fincancial crisis of the early 1970s, which constrained President Nixon to devalue the dollar.

It will be recalled that in 1971 the Bretton Woods (adjustable peg) system collapsed and this gave rise to a new pattern of par value that was established by the Smithsonian Agreement. This also eventally collapsed in March 1973, and led to the emergence of a system of generalized floating of the major currencies of the international financial system. Nigeria did not suddenly float its currency (now the naira) independently in line with the generalized floating that emerged in 1973; rather, it retained the peg to the US dollar. This policy did not last for long, however, because no sooner was the naira pegged to the US dollar than the dollar was devalued.

During this phase of Nigeria's exchange rate policy it became apparent that there were severe drawbacks in pegging the naira to a single currency. One clear case was that the naira had to undergo a de-facto devaluation in sympathy with the dollar following the devaluation of the latter. Initially the devaluation of the naira was thought capable of ensuring stability of the local currency value of exports as well as protecting the local industries from excssive external competition. It soon became clear to the monetary authorities that pegging the naira to the weak US dollar, especially during the first quarter of 1974, worsened Nigeria's inflationary situation. Against this background of mounting inflationary pressures, the policy of pegging the naira to a single currency was abandoned in 1974.

Stage III: Independent exchange rate policy

With the abandonment of the policy of pegging the naira to a single currency, between April 1974 and late 1976, the Nigerian monetary authorities attempted an independent exchange rate management policy that pegged the naira to either the US dollar or British pound sterling, whichever currency was stronger in the foreign exchange market. The main policy objective was to operate an independently managed exchanged system that would influence real economic variables in the economy and bring down the rate of inflation. Consequently, a policy of progressive appreciation of the naira was pursued over the period; this was aided by the concurrent oil boom. Because of the huge earnings from crude petroleum exports during this time Nigeria persistently ran appreciable external surpluses in its balance of payments, which supported the appreciation of the naira.

The appreciation of the naira was, however, guided by:

- changes in Nigeria's external reserves position;
- changes in the balanace of payments; and
- changes in the foreign markets of the currencies of Nigeria's major trading partners, especially the US dollar and the British pound sterling.

Given the circumstances that prevailed from 1974 to 1978, the policy of appreciating

the naira exchange rate was considered appropriate since an over-valued currency was necessary for implementing the import substitution industrialization programme that was being pursued. This policy approach continued through 1976 when the economic fortunes of Nigeria started to wane.

Stage IV: Pegging the naira to an import-weighted basket of currencies

Late in 1976, as a result of the changing fortunes of Nigeria's economy, a policy reversal was effected in the management of the exchange rate. The naira was deliberately depreciated, though this was not systematic. In the effort to realign the exchange rate, the monetary authorities were convinced that a more appropriate way to ensure stability and viability of the naira was to peg it to a basket of currencies. Hence, they adopted a basket comprising the seven currencies of Nigeria's major trading partners. The currencies were the US dollar, the British pound sterling, the German mark, the French franc, the Dutch guilder, the Swiss franc, and the Japanese yen. This import-weighted basket experiment was carried out between 1976 and 1985.

The experiment did lead to considerable stability in the naira exchange rate. However, there was ample evidence following the economic crisis that started in January 1981, and worsened progressively to 1985, that the exchange rate was unviable. Both in nominal and real terms, the naira was grossly over-valued against the US dollar. Toward the end of 1985, as the economic crisis deepened, the federal government was faced with two alternatives in the management of the exchange rate. The first option was to continue the policy of administratively fixing the exchange rate thus intensifying trade and exchange controls. The second choice was to allow the rate to be determined by market forces. The governement chose the second option and this led to the introduction and operation of the second-tier foreign exchange market (SFEM), now foreign exchange market (FEM), in September of 1986.

Stage V: Market determined exchange rate policy

This is the fifth stage in Nigeria's exchange rate management policy. It started off effectively on 26 September 1986, when the country's exchange rate was first determined officially through a public auction in the foreing exchange market. Since then, tremendous progress has been made towards arrriving at a stable and viable exchange rate for the naira. The current exchange rate policy is, indeed, the most significant policy reform in Nigeria's economic adjustment programme. Every effort is therefore being made by the monetary authorities to enusre that this phase in the country's exchange rate management policy generates and establishes a realistic and sustainable rate for the naira. The evidence so far, however has shown that there are still elements of distortion in the exchange rate

that make it difficult to ascertain what path of adjustment leads to stability and realism.

Operation of the foreign exchange market system

Under the market system, two exchange rates prevailed in two markets, described as first-tier and second-tier foreign exchange markets. The first-tier rate applied to debt servicing, payments to international imports for which letters of credit were opened before the commencement of the second-tier market, and disbursements in respect of public sector letters of credit.

In the second-tier market, little or no restriction was placed on the functioning of the market. To ensure equity in the allocation of foreign exchange, banks were initially classified into two categories, namely, big banks and small banks. Each successful big bank could purchase a maximum of 10% and small banks a maximum of 7% of the total foreign exchange allocation. Given this classification, it was clear that not all the authorized dealers would be successful at each bidding session. Consequently, each dealer tried to outbid the others by quoting high rates. Given the limited resources in the market, the resultant high level of excess demand and aggressive posture of the banks, the naira depreciated at the first and second bidding sessions when the average of successful bids was used to determine the exchange rate.

After the second bidding, the marginal rate system was introduced as a mechanism for setting the exchange rate in the belief that it would safeguard against the problem of excessive depreciation. The marginal rate method enabled all successive bids to be settled at the rate quoted by the last successful bank. Efforts at ensuring fairness and viability in the market led to further amendments to the rules. Thus in order to increase the number of successful bids, banks were reclassified into "big", "medium" and "new", with maximum allocations of 5%, 2% and 1.5% respectively.

Although the naira firmed up at the end 1986 relative to its position at the beginning of the second-tier market, the fluctuation from one bidding session to another was large. The Central Bank of Nigeria actually had to intervene on two occassions in order to moderate the amplitude of fluctuation in the exchange rate. The first intervention was the sixth session when the initial foreign exchange supply was increased from $75 million to $86 million in order to arrest the downturn in the rate. The second intervention, at the tenth bidding session was meant to prevent an appreciation of the naira. These auctions tended to stabilize the rate for some time.

During the first three months of 1987, however, the second-tier rate contined to depreciate. It became clear that a change in the modality for determining the exchange rate was necesssary so as to preserve the gains already made. Consequently, the Dutch auction system was introduced in April 1987. Under this system, bids were settled at bid rates in order to check unrealistic bids that had no bearing with actual demand. Under the Dutch auction there were as many rates as there were successful bidders. However, one worrisome development was that the rates diverged widely from one another, implying the existence of distortions in the allocation of resources. Furthermore, after the initial

show of strength, the naira weakened again and by the end of 1987, when it stood at US$1.00 = ₦4.1413, it had depreciated by 19.9%.

Meanwhile, the inter-bank foreign exchange market had become important and added another source of instability to the naira exchange rate. Initially, the inter-bank rate was linked to the second-tier rate but later the link was broken. The banks were then permitted to buy and sell foreign exchange at the rate determined in that market subject only to the condition of a 1% spread between their buying and selling rates.

The inter-bank rate also diverged widely from the first tier market rate, which implied that resources were not being rationally allocated. This caused a lot of concern to the monetary authorities. Data on inter-bank rates showed that in July 1987, the rate stood at US$1 = ₦4.3550 compared with US$1 = ₦3.8081 in the foreign exchange market (Table 1). Although the differential narrowed during 1987, it widened progressively to 38% by April 1988 and by December 1988 stood at 54.8%. By the end of 1988, therefore, it was clear that the multiplicity of rates under the Dutch auction system as well as the large differential between the foreign exchange market and autonomous rates, was exerting undue pressure on the exchange rate and intensifying the problem of resource misallocation. Indeed, by the end of 1988, the naira had depreciated on the FEM from US$1 = ₦1.5691 at the commencement of the second-tier market to ₦5.3530, reflecting a 70.7% depreciation (Table 1). The autonomous rate itself had depreciated from US$1 = ₦3.7375 in July to US$1 = ₦8.2856 at the end of 1988 (54.9%). The rate at the end of 1988 indicated a premium of ₦2.9326 or 54.8% on the FEM rate.

In order to redress the situation and establish a single naira exchange rate, the autonomous market and the official foreign exchange market were merged with effect from January 1989 to form the inter-bank foreign exchange market (IFEM). No distinction was made in the inter-bank market between funds obtained from the Central Bank and those from autonomous sources. The exchange rate was determined by the Central Bank using one or a combination of the following guiding principles:

(a) Weighted average of all quotations submitted by banks (individual bank quotation weighted by amount demanded).
(b) Simple average of all quotations submitted by all banks.
(c) Highest and lowest bank quotes, provided the latter does not depreciate by more than 2% when compared with the rate that emerges in (b) above.
(d) Intelligence report on the exchange rate movements during the previous day in both the inter-bank foreign exchange market and some world financial centres.

Under the inter-bank market, which lasted until 14 December 1990, the monetary authorities succeeded in establishing a single and fairly stable exchange rate for the naira in the official market. This is one measure of success in the operation of the market. However, the weakness of the naira continued to be an issue of concern to the monetary authorities. For example, the exchange rate stood at ₦6.7178 = US$1 during the month of January 1989 but had depreciated to ₦7.5871 by March. The rate strengthened progressively from ₦7.5808 = US$1 in April to ₦7.1388 = US$1 in July 1989, after a US$1 in August compared with ₦7.0389 = US$1 in January 1989.

In order to ensure adequate funding of the foreign exchange market and thereby ease

Table 1: 1986 -1990 naira-dollar exchange rates

Month	SEEM	Parallel market	First-tier rmarket	SEEM	Parallel market	First-tier market	Autonmous	SEEM	1988 Parallel market	Autonomous market
January			1	3.647		2.61		4.1748	4.86	4.449
February			1	3.7014		2.92		4.2611	4.5	4.5488
March			1	3.9218		3.25		4.3169	4.3	4.7214
April			1.02	3.9054		3.44		4.2023	4.3	5.3147
May			1.03	4.1617		3.51		4.1103	5.4	6.1539
June			1.12	4.0506		3.64		4.1913	5.9	6.3597
July			1.27	3.8081		3.8081	4.355	4.6087	6.35	6.2765
August			1.33	4.0809			4.4579	4.583	6.6	6.6427
September	4.6406		1.44	4.2767			4.4934	4.7167	6.2	6.5608
October	4.1203		1.83	4.2767			4.5694	4.7748	7.33	6.0317
November	3.5311		2.29	4.289			4.553	5.1479	7.5	6.4761
December	3.1828		2.59	4.1664			4.5291	5.343	8.35	8.2856
Average	3.8687		1.41	4.018025		3.311157	4.49267	4.5359	5.965833	5.985075
Depreciation/ Appreciation	-45.8024		61.3896	12.4664		31.46188	3.844031	21.86412	41.79641	46.30443

Source: Central Bank of Nigeria.

series of tight monetary policy actions had been taken. The rate averaged n7.2593 = the pressure on the naira, various balance of payments support loans were arranged by the government . These included a World Bank trade policy and export development loan ($452 million). An Organization of Economic Cooperation Fund loan from Japan ($100 million) and a British government loan of $100 million. Another method by which the government has been trying to improve the allocative efficiency of the foreign exchange market has been through the establishment of *bureaux de change*. The aims of the policy have been to allow small dealers in foreign exchange more freedom of action and to enlarge the size of the officially recognized market and so improve macroeconomic management.

Despite these developments, the exchange rate is yet to attain a stable level. In the continued quest for stability and realism to the exchange rate, the monetary authorities on 14 December 1990 abandoned the bidding system and method for determining the exchange rate under the inter-bank market and re-introduced the Dutch auction system with daily bidding sessions. By March 1991 bidding on a daily basis had been replaced by bidding twice weekly. The consequence of the change to the Dutch auction system has been another sudden depreciation of the naira. As at December 1990, the naira was exchanging for the dollar at the rate of ₦8.71: US$1.00 whereas by February 1991 it had depreciated to ₦9.40: US$1.00, reflecting a depreciation of 7.45%.

III. Some issues in the analysis of statistical properties of daily exchange rates

The analysis of the statistical properties of daily exchange rates is important for understanding the possible causes of instabillity or otherwise in a country's market-determined exchange rate management system. In a market system, it is observable that the distribution of daily spot exchange rate changes differs between weekdays and weekends. In Nigeria, a close look at the movement of exchange rates in the parallel market, for instance, shows that there is a tendency for the naira exchange rates to appreciate on Fridays but depreciate on Mondays and Tuesdays.

It has also been observed that the impact of daily and fortnightly biddings in the formal foreign exchange markets differs significiantly in terms of the ruling exchange rates they generate and the rate of change of such exchange rates. Such difference is emphasized, more or less, depending on whether the biddings are done under a Dutch auction system or margianal or average rate pricing systems.

Studies on exchange rate behaviour have in the past tested for types of distribution and "day-of-the-week" effects among others. The "day-of-the-week" effect is usually to ascertain whether the distribution of daily spot exchange rates is different across days of the week. In the literature, there is consensus that the distribution of the daily changes in rates is unimodal and has fatter tails than the normal distribution. See, for instance Burt, Kaen and Booth (1977), Westerfield (1977), Rogalski and Vinso (1978), and Hsieh (1988). It is this second feature of the distribution that has attracted the most attention. Two competing explanations have been advanced to explain the leptokurtosis. One view suggests that the data were independently drawn from a fat tail distribution that remains fixed over time, while the other proposes that the data come from distribution that vary over time.

Few attempts have been made to determine which of the two explanations better characterizes the data. Friedman and Vandersteel (1982) considered three hypotheses, namely:

(1) The data are independent and identically distributed (IID), drawn from a table symmetric paretian distribution.
(2) The data are IID, drawn from a mixture of two normal distributions.
(3) The data are independently drawn from a normal distribution whose mean and variance change over time.

They found evidence in favour of the third hypothesis. Calderon-Rossel and ben-Horim (1982) tested directly for the IID property. They found that they can reject IID for most currencies. They attribtued the rejection to shifts in the means of 9 out of 13

currencies, and to changes in the skewedness in the remaining cases. Hsieh (1988) found that exchange rate changes are not independent and identically distributed. Each day of the week may have a different distribution, but this is not sufficient to explain the rejection of IID; there is little serial correlation in the data and the means and variances change over time.

Our concern in this study is not simply to examine the statistical properties of the exchange rates as they relate to the three hypotheses put forward by Friedman and Vandersteel (1982). Rather, the main thrust of our work is to examine these properties as they contribute to the relative frequency of the depreciation, appreciation or stability of the exchange rates.

IV. The research methodology

Data requirement

The data for the study, which were obtained from the Central Bank of Nigeria (CBN), consist of daily weekly and fortnightly closing bid rates for the following currencies:

- US dollar (US$)
- British pound sterling (S£)
- Japanese yen (yen)
- German mark (DM)
- Dutch guilder (DG)
- French franc (FF)
- Swiss franc (SWF)

The following auction systems with their corresponding frequencies of bidding sessions form the basis of the analysis:

- Average rate system (with a second tier foreign exchange market) - weekly bids
- Marginal rate system (with a second tier foreign exchange market) - weekly bids
- Dutch auction system (with autonomous market) - fortnightly bids
- Inter-bank foreign exchange system - daily bids, but with ruling rates determined by the Central Bank
- Dutch auction system - daily and weekly bids

Determination of the rate of change in exchange rates

Following Hsieh (1988), our study calculated the rate of change for each currency by taking the logarithmic difference between the close of two successive trading days or weeks. Thus, for exchange rate y, the rate of exchange was defined as follows:

$$\text{Exchange rate change } (ERC) = \log (Yt / Yt\text{-}1) \times 100$$

Based on the values obtained for *ERC*, the average or mean rate of change and the variance of the rate of change were obtained.

Determination of the coefficient of variation

For ease of comparison of relative dispersion or variability across currecies, the study calculated the coefficient of variation (*COV*) for each of the currencies over the various phases of the auction system. The *COV* was defined as follows:

$$\text{Coefficient of variation } (COV) = \frac{\text{Variance of } y}{\text{Mean of } y}$$

Measurement of relative stability of exchange rates

In order to verify further the issue of relative stability of the naira-dollar exchange rates under the various auction systems, we look at the behaviour of an index of instability that was derived as follows:

$$\text{Exchange rate instability index (ERI)} = \sqrt{\text{Var}(y)} \times f$$

Where,

$$\text{Var}(y) = \text{The variance of } y$$

$$f = \text{The mean rate of change of } y$$

$$f = \sum_{t=1}^{n} (ERC)_{t/n}$$

One advantage of this index is that it combines the variance of y and its rate of change into a single statistic that reports the extent to which that variable is stable. This avoids the problem of assessing the relative stability of the exchange rate data series using the coefficient of variation (adjusted variance), which does not capture the size of the rate of exchange of that series, or using the variance of the rate of change, which misses the variability in the series.

V. Behaviour of exchange rates in Nigeria's foreign exchange auction

Demand-supply indexes and bids for foreign exchange in the foreign exchange auction

In Nigeria demand and supply indicators as well as bids for foreign exchange in the foreign exchange auction are usually expressed in US dollars the principal currency in this context. Although the demand and sypply situations are expressed in dollars, these indicators are actually an expression of the economy's requirement for, and capacity to generate, foreign exchange. Thus the demand for and supply of currencies such as pound sterling, deutsche mark, Dutch guilder, French franc, Swiss franc and Japanese yen are all measured in US dollar equivalents.

There may be several reasons for the use of the dollar as the lead currency. A major one is that the bulk of foreign exchange supply to the foreign exchange market (FEM) is in dollars (through crude oil export earnings). Moreover, since the 1980s, US dollar assets have constituted the largest componet of Nigeria's external reserves (Table 2). Hence the operations of the auction are conducted in dollars. However, having arrived at the ruling rate for the dollar, the monetary authorities have to determine the exchange rates for the other currencies relative to the dollar in major financial centres in Europe and the United States.

What this implies is that, apart from the US dollar, the naira exchange rate for a currency, say the Japanese yen, is not directly determined in the foreign exchange auction. The movement of exchange rates in the auction is therefore expected to differ across currencies unless exchange rate parities are fixed by countries having convertible currencies. What this suggests in the context of this study is that the analysis of the properties of the exchange rates will inevitably focus more attention on the behaviour of the naira-dollar exchange rate whenever there is need to make a judgement.

Phases in the foreign exchange auction system and macroeconomic policy characteristics

Since the commencement of the public auction for the determination of the exchange rate for the naira vis-a-vis the dollar (and some other major currencies), the value of the

Table 2: Components of Nigeria's external reserves (%)

Component	1970	1971	1972	1973	1974	1975	1976	1977	1978	1989	1990	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Old IMF	15.4	7.9	9.6	10.7	1.1	1.2	1.4	1.3	27.1	7.8	2.6	10	1.8	2.4	6.5	1.1	0.5	0.4	0.5	0.2	0.1
Old Sterling	.	7.9	13.4	9.5	1.1	1.2	1.7	2.2	4.6	2.6	3.6	11.3	2.7	10.2	0.5	0.5	.	.	.	.	.
Assets	75.4	73.9	54	59.1	57.6	33.1	14.7	16.5	14	4.9	22	15.1	18.8	17.3	16.6	7.1	4.9	9.1	5.8	21.0	42.5
Assets	9.2	10.3	23	20.4	38.8	41.8	20.9	15.8	14.6	25.3	23.5	19.7	39	33.9	51.2	58.2	76.2	69.6	66.6	67.3	50.4
Assets	.	.	.	0.3	1.3	12.5	26.6	30.5	14.8	37.1	22.8	13.2	6.3	5.4	6.9	6.2	5.4	5	9.1	29	0.4
French franc	.	.	.	.	0.1	3.9	6	4	5	7.7	6.8	4.5	13.3	1.1	0.2	9.3	3.5	8	5	5.8	5.6
Canadian dollar	.	.	.	.	.	.	15	12.7	2.1	2	1.4	2.1	1	0.9	0.6	0.6	0.3	0.2	0.2	.	.
Japanese yen	.	.	.	.	.	.	7.3	9.2	4.5	5.8	9.1	9.6	0.5	0.3	.	1.3	.	.	.	.	0.1
Swiss franc	.	.	.	.	.	.	1.5	1.9	.	6.4	6.8	9.4	12.8	23.4	12.4	12.5	3.3	2.7	3.4	0.4	.
Belgian franc	.	.	.	.	.	.	3.5	3.9	9.2	0.3	0.8	1.5	3.1	3.8	1.8	0.4	0.2	0.4	0.6	0.1	.
Dutch gilder	.	.	.	.	.	.	1.4	1.4	1.8	2.5	0.6	2.7	1.7	1.9	2	1.9	3.4	2.5	3.7	0.3	.
Others	.	.	.	.	.	.	.	0.6	2.3	2.4	.	0.9	.	.	1.3	0.9	2.3	2.1	5.1	1.1	0.9

Source: Central Bank of Nigeria.

naira and the process by which the value is arrived at have undergone tremendous changes. The value depreciated from a nominal rate of n1.004 to US$1.000 in mid-September 1986 to about ₦9.8662 to $1.000 as at the end of December 1991, and to about ₦18.55 to a dollar through deliberate depricaiton on 5 March 1992 by the federal government. The auction system has equally undergone several changes during this time. Between September 1986 and November 1991, the auction system passed through six major phases (Table 3). A much finer classification may put these phases into seven by splitting the frequency of bidding for the interval from March 1991 to November 1991 into two parts namely, twice weekly in the first instance, and then once weekly.

Table 3: Nigeria's foreign exchange market phases

	Period	Auction system	Frequency of biddings
Phase one	26 Sep 1986 - 2 Oct 1986	Average rate pricing	Weekly
Phase two	2 Oct 1986 - 19 Mar 1987	Marginal rate pricing	Weekly
Phase three	19 Mar 1987 - 12 Dec 1988	Dutch Auction	Fortnightly
Phase four	9 Jan 1989 - 14 Dec 1990	Inter-bank market (with ruling rates determined by the CBN using some guiding principles)	Daily
Phase five	14 Dec 1990 - 19 Mar 1991	Dutch auction	Daily
Phase six	Mar 1991 - Mar 1992	Dutch auction	Weekly

Source: From data obtained from the Central Bank of Nigeria.

Phases one and two: September 1986 - March 1987

The first phase of the auction system lasted only from 26 September 1986 to 2 October 1986 - two auctions. Under this phase, bidding was done weekly and the exchange rate was arrived at through the averaging of all bids submitted. This phase has come to be known as a phase of average rate pricing.

The method of determining the exchange rate under the average rate pricing system was modified after the second auction on 2 October 1986. This modification resulted in the second phase of the auction system, which was based on marginal rate pricing principle. The frequency of bidding was retained however. This phase of the auction system lasted until 19 March 1987.

The first and second phases of the auction system, fell within the period in which Nigeria began a major reform programme. The macroeconomic policies of the government continued the National Economic Recovery Programme that had taken off in October 1985. There was upward adjustment in customs and excise tariffs and a ban was placed on the importation of specific commodities, including vegetable oils, commercial day-old chicks, etc. Non-statutory transfers to all economic and quasi-

Table 4: Federal government budget deficits (1986-1990)

Year	Deficit (₦bn)	GDP at Current prices (₦bn)	Total expenditure (₦bn)	Deficit as % of GDP	Deficit as % of total expenditure
1986	8.25	73.06	16.22	11.29	50.86
1987	5.89	108.88	22.02	5.41	26.75
1988	12.16	145.23	27.75	8.37	43.82
1989	15.27	196.16	41.03	7.78	37.22
1990	23.36	239.79	64.15	9.74	382.00

economic parastatals were reduced by about 50% and subsidy on petroleum products, excepting household kerosene, was cut to about 20%. The fiscal measures led to a 25.5% reduction in the fiscal deficit by the end of 1986.

Monetary and credit policies adopted in 1986 were aimed at reducing excess demand and liquidity in the economy. Overall net domestic credit was expected to increase by 5% and 6% in 1986 and 1987, repectively.

In actual performance, however, the governtment budget experienced a deficit of about 11.3% in 1986 — which was substantially above the 3% envisaged for the structural adjustment programme (SAP) and 5.4% in 1987 (Table 4). Bank credit to the economy rose by 12.7% between 1985 and 1986 instead of the 8.7% allowed by the programme. The corrresponding figures for 1987 and 1988 were 14.3% and 36.2% increases as compared with 6.0% and 8.1% projected for the SAP.

The depreciation experienced in the dollar exchange rate during the first phase could have been caused partly by the inability of the government to mainatain fiscal and monetary targets, while the appreciation in the second phase could be assumed to have resulted from the massive reduction in fiscal deficits from 11.3% of GDP to 5.4% in 1987, even though there was considerable overshooting of the credit target.

Phase three : March 1987 - December 1988

The period 19 March 1987 and 12 December 1988 marked the third phase in the exchange rate management. During this phase, the Dutch auction was adopted and the frequency of bidding was changed from once weekly to once fortnightly.

The massive deprectiation experienced by the dollar exchange rate over this phase can be traced to the liberal policies the government pursued, especially in 1988. In 1988, the government implemented a reflationary programme to increase the level of economic activity, which had reached a very low ebb during the second phase of the auction system. The reflationary budget raised the deficit from 5.4% in 1987 to about 8.4% in 1988. The specific fiscal measures designed to reflate the economy consisted of the following:

- Provision of a reflationary package of ₦2.5 billion in addition to the built-in deficit of ₦6 billion, thus raising the overall budget deficit to ₦8.5 billion
- Exemption from taxation of all investment income earned outside Nigeria and repariated to Nigeria through official channels.
- Adopttion of lower company tax rates for three years for small and medium-size companies (annual turnover of less than ₦500,000) engaged in manufacturing,agricultural production or mining.
- Revocation of the wage freeze and restoration of the right to collective bargaining, including the adoption of enchanced wages/salaries and fringe benefits package in the public sector.
- Prescription of an additional 5% capital tax allowance for qualified expenditure on plant construction and agricultural production.

These fiscal measures coupled with the tremendous increase in credit from a target of 8.1% to 36.2% could have exerted substantial pressure on the exchange rate, which reached the highest level of depreciation over all the six phases.

Phase four : January 1989 - December 1990

The fourth phase in the auction system spanned about two years, 9 January 1989 to 14 December 1990. This phase introduced the inter-bank foreign exchange market system with daily biddings for foreign exchange by commercial banks.

During this phase, the dollar exchange rate experienced about 18.9% depreciation. This was clearly an "improvement" on the 24.9% experienced during the third phase. There are at least two major policy factors that contributed to the reduction of the pressure on the naira. The first is the marginal reduction in the budget deficit from 8.4% in 1988 to 7.8% in 1989. But the impact of this benefit was later wiped out by the 9.7% deficit incurred in 1990 budget. The second major factor was the directive in 1989 that all federal and state government establishments should move all their accounts from commercial banks to the Central Bank.

Other monetary policy measures adopted in 1989 included:

- Continued deregulation of interest rates, which raised the CBN rediscount rate to 13.25%.
- Increase in the cash reserve ratio by 1%.
- Increase in the statutory minimum liquidity ratio from 27.5% to 30%.

Growth in aggregated credit, targeted at 9.5% actually declined by 14.1% by the end of the year. However, money supply which was expected to grow at 14%, shot up by 21.5%.

The rather high level of depreciation of the dollar exchange rate during this phase may have been caused by the increased budget deficit experienced in 1990 and the enormous increase in money supply. The increase in money supply projected at 13.0% rose as far as 44.9% by the end of the year, while the aggregate credit target, set at 13.5% stood at 17.1% at the end of 1990.

Phase five December 1990 - March 1991

Between 14 December 1990 and mid-March 1991, the Dutch auction was once again introduced, but with daily biddings. This marked the fifth phase of auction system.

This phase fell into the first quarter of 1991 and the macroeconomic policies of the government were just being implemented. A modest budget surplus of ₦0.1million was expected and the growth in aggregated bank credit was pegged at 10.6% with all creidt going to the private sector. Money supply was also expected to grow at 14.6%. The very low level of depreciation of the dollar exchange rate (3.62%) could have resulted from the fact that the economy was yet to feel the impact of public sector expenditure prgorammes and policies whose implementation had just commenced. Probably such impacts start appearing on the economy when spending agencies of the government receive the first allocation of their respective budgets and when the implementation of new policy directives has actually taken off. For instance, the impact of the slash of lending rates to a maximum of 21% in January 1991 is not likely to show up in the demand for credit until later in the year.

Phase six: March - December 1991

From mid-March 1991 to early March 1992, the naira exchange rate was determined by means of the Dutch auction, but the frequency of bidding was changed from daily to weekly. The auction system was thus in its sixth phase before its collapse on 5 March 1992.

The increase deprectiation and variability experienced in the dollar exchange rate over this phase could have been the result of pressure on the naira arising from the huge budget deficit that the government ran instead of the expected surplus (Table 5) and the inability to mainatain set targets in the area of monetary and credit policy.

The movements in the principal exchange rate since commencement of the market-determined exchange rate management system in the country could, therefore, have been influenced substantially by the type of macroeconomic policies the government pursued over the various phases of the auction system. In the next section, we take up the analysis of the effects that, together with the policy characteristics, could exert more extensive impact on the variability of the naira exchange rate.

Behaviour of the naira - dollar exchange rate under the auction system

Performance of the exchange rate under each phase

The shortest phase in the auction system was the first one, while the longest was the

Table 5: 1991 budget performance (₦bn)

Items	1991 approved budget	1991 budget out-run	Difference
Retained revenue	38.766	27.575	-11.191
Recurrent expenditure	12.334	12.484	0.15
Capital (treasury component)	9.69	9.943	0.253
Debt service	16.642	24.588	7.943
Total expenditure	38.666	47.012	8.246
Surplus deficit	0.100	-19.437	-19.537

Source: National Planning Commission.

Table 6: Summary of naira-dollar exchange rate index

Auction system	Frequency of biddings	Mean exchange rate ₦	Variable of exchange rate	Mean rate of change %	Variance of rate of change %	Rate of dep/app %	COV	Insta-bility index %
Average rate pricing	Weekly	4.8379	0.0486	1.9808	3.9235	8.7182	0.0100	0.3103
Marginal rate pricing	Weekly	3.7159	0.1773	-0.2615	27.1493	-25.8200	0.0477	
Dutch auction	Fortnightly	4.2970	0.1320	0.3148	4.2216	24.8963	0.0307	
Inter-bank market	Daily	7.7308	0.1116	0.0185	0.0234	18.8873		
Dutch auction	Daily	9.1696	0.1604	0.0299	1.1168	3.6231		
Dutch auction	Weekly	10.0668	0.7467	0.1139	0.0975	10.8813		

Source: Computed from data obtained from Central Bank of Nigeria
Note: 1. Figure in absolute terms.
2. Coefficient of variation.

fourth. The mean value of the exchange rate was highest under the last phase (Dutch auction with weekly biddings) and was lowest under the second (marginal rate pricing with weekly biddings), during which the exchange rate appreciated substantially (25.8%) (Table 6). From the mean value of the rates of change, the exchange rate moved least under the inter-bank market (phase four). It had a mean of change of 0.0185% and a

variability index of 0.0234. The index of instability, which synthesizes the effects of the variance in the exchange rate and the rate of change of the exchange rate, reported an index of 0.0454 for the inter-bank market. This ranks this phase as most stable. This phase was followed closely by the results of the indexes recoreded for phase five (Dutch auction with daily biddings). Under this phase the exchange rate had a mean rate of change of 0.0299% and a variability index of 1.1168. Its instability index is 0.0693.

Ruling out phase one, since this marks the period during which the first shock was introduced into exchange rate management policy in the country, it is obvious from Table 6 that exchange rate movement was most volatile under phase six (Dutch auction, weekly bids), followed by phase two (marginal rate pricing) and phase three (Dutch auction with fortnightly bids). With respect to the rate of depreciation or appreciation, the exchange rate was relatively more stable under the Dutch auction with daily bids (phase five). It depreciated most substantially under phase three — Dutch auction with fortnightly bids. It was only phase two, marginal rate pricing, that generated appreciation in the exchange rate.

From the point of view of the naira-dollar exchange rate behaviour, the results indicate that a stable and realistic exchange rate for the Nigerian naira is more likely to be generated through the inter-bank market and Dutch auction with daily biddings.

Relative dispersion of exchange rate bids across buyers in the foreign exchange market

In the first phase of the auction system which spanned the period 26 September - 10 October 1986, there was a wide gap between the highest and lowest bid rates submitted by dealers operating in the market. The highest bid rate in the first auction was ₦5.1250 to US$1, while the lowest rate quoted was ₦2.5000. Out of a total of 34 banks participating in the auction, only 16 were successful. Since no bank was disqualified, it means 18 banks quoted rates that were far below the average rate of ₦4.6406 at which the Central Bank sold foreign exchange to the authorized dealers. Thus, about 50% of buyers during the first auction submitted bids that fell on both sides of the average. The distribution of bid rates under the first auction was normal.

During the second auction, which marked the end of the first phase, the gap between the highest and lowest bid rates was maintained. The rates stood at ₦5.5999 and ₦3.0000. The average rate at which authorized dealers bought foreign exchange from the Central Bank was ₦5.0839. Only 13 of the 38 dealers were successful. Thus, 25, representing over 70% of bidders, submitted bids that were much lower than the average rate at which the CBN sold foreign exchange to the dealers. There was, therefore, a very heavy concentration of bids below the average, indicating negative skewedness in the distributiion of bid rates quoted by buyers.

The change to the marginal rate pricing system (i.e., phase two), may have been necessitated by the need to increase the access of a much larger percentage of buyers to foreign exchange. During this phase, the rate at which the Central Bank sold foreign

exchange to dealers fell considerably. The highest bid rate also fell significantly, thus reducing the gap between the highest and lowest. The near convergence of rates under this phase increased the number of successful banks in the auctions. On the average the highest bid rate was 4.2395 while the lowest was 3.4343, and about 25% of buyers submitted bids that fell below the marginal rates set by the CBN. Therefore, the distribution of the bids was postively skewed.

From the second to the sixth phases of the auction system, the gap between the highest and lowest bid rates narrowed considerably and the number of successful banks in the auction came close to 100%. There was, therefore, increased concentration of biddings around the rates at which the Central Bank sold foreign exchange to authorized dealers (Table 7).

Table 7: Dispersal of biddings in the foreign exchange market

Auction system	Average highest bid rate	Average lowest bid rate	Average FEM rate	Average number of participating banks	Average number of participating banks
Average rate pricing	5.36245	2.75	4.86225	36	14
Marginal rate pricing	4.23956	3.43433	3.65217	39	34
Dutch auction	4.4354	4.23153	4.31839	48	43
Inter-bank market	7.874398	7.494794	7.786987	86	86
Dutch auction	9.2404	8.970145	9.14854	107	104
Dutch auction	10.49323	9.864037	9.96878	111	107

Behaviour of exchange rates for other currencies

The analysis above relates to the behaviour of the rate of change of the lead currency, i.e., the US dollar. For the other five currencies, consistent data were available for only four of the six phases of the auction system. These phases are the Dutch auction with fortnightly biddings (phase three), inter-bank with daily biddings (phase four), Dutch auction with daily biddings (phase five) and Dutch auction with weekly biddings (phase six). The dollar is also included in this analysis for ease of comparison. Its indexes may not correspond with those in Table 6, however, because of the data gap experienced for some of the currencies. The summary indexes for each of the four phases for all the currencies are reported in Tables 8 - 11. The summary indexes compare mean values and variability of the rates of change and the rates of depreciation or appreciation of exchange rates for all currencies during each of the four phases of the auction system.

Summary indexes for Dutch auction (fortnightly biddings) 1988

Over this phase of the auction system, the naira exchange rate for the British pound sterling (S£) fluctuated most; it had a mean rate of change of 0.9312%, a vairiance of 7.1016 and a rate of depreciation of 22.6872% (Table 8). Its coefficient of variation stood at 0.078 while the exchange rate index of instability was 0.775. This was followed by the exchange rate for the dollar, which had an instability index of 0.2619. The exchange rate for the yen was most stable. This is clearly indicated by the coefficient of variation and instability index.

Table 8: Summary indexes for Dutch auction (fortnightly biddings) 23 June 1988 - 8 December 1988

Currency	Variation of exchange rate	Mean exchange rate (₦)	Mean change (%)	Variation of change (%)	Rate of depreciation/ appreciation (%)	COV	Instability index (%)
US dollar	0.087747	4.785383	0.7816	1.7962	19.4246	0.018336	0.261884
British pound	0.645165	8.2962	0.9312	7.1016	22.6872	0.077766	0.775098
German mark	0.049636	2.638383	0.8225	2.9331	20.3297	0.018813	0.202053
Swiss franc	0.067301	3.144308	0.0768	3.1489	19.1257	0.021404	0.071894
French franc	0.003946	0.775941	0.7951	2.7089	19.7237	0.005085	0.056013
Dutch gilder	0.039176	2.33875	0.8232	2.92	20.3442	0.016751	0.179582
Japenese yen	0.000048	0.035191	0.9287	2.9141	22.6328	0.001364	0.006677

Source: Computed from data obtained from Centrald Bank of Nigeria.

Summary indexes for inter-bank market (daily biddings) 9 January 1989 - 14 December 1990

Under the inter-bank market, the dollar exchange rate performed most remarkably well (Table 9). With a mean rate of change of 0.0234%, a variability index of 0.0305 and a rate of deprecitaion of 1.8873%, the naira exchange rate could be taken to have attained a reasonably stable level. The coeffiecient of variation and the index of instability, however, place the performance of the dollar next to the yen, which most studies have confirmed to be most stable. But there is more to it than meets the eye. If the variability index is an indication of the extent to which the rate of change in the exchange rate is generated by a stochastic process (which the auction system is expected to be), then a variability index of 0.0305 suggests an auction system that was controlled by the monetary authorities.

Table 9: Summary index for inter-bank foreign exchange market **9 January 1989 - 14 December 1990**

Currency	Variation of exchange rate	Mean exchange rate (₦)	Mean change (%)	Variation of change	Rate of depreciation/ appreciation (%)	COV	Instability index (%)
US dollar	1.130323	7.707596	0.0234	0.0305	1.8873	0.016908	0.055223
British pound	2.225706	13.15465	0.0337	0.1369	26.0022	0.169195	0.273873
German mark	0.367032	4.448585	0.0467	10.079	34.1312	0.082505	0.130921
Swiss franc	0.556702	5.15046	0.0471	10.079	43.1312	0.108088	0.161928
French franc	0.081178	1.334631	-0.1292	13.808	43.3903	0.060824	0.102411*
Dutch gilder	0.309482	3.9331169	0.0686	2.4752	45.842	0.078685	0.145707
Japenese yen	0.000016	0.054175	0.019	0.2113	15.6279	0.000295	0.000551

Source: Computed from data obtained from Central Bank of Nigeria.
Notes: 1. Coefficient of variation. 2. Measured in absolute terms.

Table 10: Summary index for Dutch auction with daily biddings 14 December 1990 - March 1991

Currency	Variation of exchange rate	Mean exchange rate (₦)	Mean change (%)	Variation of change	Rate of depreciation/ appreciation (%)	COV	Instability index (%)
US dollar	0.139281	9.144045	0.334225	0.50889	14.26561	0.015232	0.215757
British pound	0.67324	17.68496	0.276082	0.269961	11.93901	0.038069	0.431126
German mark	0.063799	6.10956	0.247669	0.428571	10.77918	0.010442	0.125702
Swiss franc	0.087987	7.163935	0.211593	0.398157	9.284537	0.012282	0.136446
French franc	0.005537	1.79755	0.244098	0.38736	10.63234	0.00308	0.036764
Dutch gilder	0.052198	5.42022	0.251573	0.430227	10.93944	0.00963	0.114593
Japenese yen	0.00001	0.068645	0.274757	0.367901	11.88525	0.000146	0.001658

Source: Computed from data obtained from Central Bank of Nigeria.
Note: 1. Coefficient of variation. 2. Measured in absolute terms.

The pound sterling (S£) exhibited the greatest variability over the period. It had an instability index of 0.2739 and a coefficient of variation of 0.1692. The DM and DG moved in the same direction with about the same magnitude of change, variance and depreciation. In relative terms, however, the DG experienced the largest rate of change and depreciation in its exchange rate —0.0686% and 45.842%, repectively.

Summary indexes for Dutch auction (daily biddings) 14 December 1990 -March 1991

During this brief phase of about three months of daily biddings under the Dutch auction system, the variability of the dollar exchange rate was relatively higher than that experienced by all other currencies except the pound sterling. The pound sterling had an instability index of 0.4311 and a coefficient of variation of 0.0381. These indexes are more than twice those recorded by the dollar exchange rate — 0.02158 and 0.0152, respectively. With the exception of the Japanese yen and French franc, the variability in the exchange rate for the other currencies as measured by the instability index ranged between 0.1146 for the DG and 0.1364 for the SwF. The yen maintained its relative stability in comparison with the other currencies, and was followed by the French franc. Apart from the dollar exchange rate, which experienced a much higher level of depreciation, the depreciation rate for all other currencies was about 10%.

Summary indexes for Dutch auction (weekly biddings) March 1991 -October 1991

Table 11 presents summary indexes for the last phase before the collapse of the auction system. This phase started in mid-March 1991. The Japanese yen and the US dollar had the lowest rate of change and variability index, as well as a low rate of depreciation. The other five currencies experienced negative rates of change that translated into fairly high rates of appreciation. With the exception of the FF , which had 0.0438, the variability of the naira exchange rates for the other currencies as measured by the instability index ranged between 0.1326 for DG and 0.4223 for the S£.

Given that the dollar is the pinicipal currency in the auction, its behaviour seems to represent more closely the nature of the demand and supply situations in the foreign exchange market. The appreciation experienced by the other currencies is more of a reflection of movements in the exchange rates in international foreign exchange markets.

Performance of exchange rates across the various phases of the auction system

Tables 12 - 16 present comparative indexes for all the currencies across four phases of the auction system. The idea is to enable one to reach a preliminary conclusion as to which phase of the auction system would be more likely to generate relatively reasonable indexes, particularly for the dollar exchange rate, in the long run. Within the context of our analysis the desirable auction system should be the one that generates the lowest rate of change and variability of exchange rate changes as well as the lowest rate of

Table 11: Summary indexes for Dutch auction with weekly biddings March 1991 - October 1991

Currency	Variation of exchange rate	Mean exchange rate (₦)	Mean change (%)	Variation of change	Rate of depreciation/ appreciation (%)	COV	Instability index (%)
US dollar	0.776406	10.07229	0.011384	1.584369	0.809269	0.077083	0.094012
British pound	1.742647	17.25808	-0.10235	2.550665	-7.57919	0.100976	0.422306
German mark	0.221434	5.86167	-0.10186	2.699515	-7.7542	0.0037777	0.150184
Swiss franc	0.22588	6.807796	-0.10862	2.278305	-8.06145	0.03318	0.156629
French franc	0.018302	1.727022	-0.10486	2.639913	-7.77208	0.010597	0.043805
Dutch gilder	0.172866	5.203206	-0.10169	2.757701	-7.52872	0.033223	0.132584
Japenese yen	0.000043	0.00734	0.034033	1.87239	2.4	0.000586	0.00121

Source: Computed from data obtained from Central Bank of Nigeria.
Notes: 1. Coefficient of variation. 2. Measured in absolute terms.

depreciation. Also, it should have the lowest coeffiecient of variation and exchange rate index of instability. From all indications, it seems that the path to a stable and sustainable exchange rate based on the dollar exchange rate, is more likely to be traced by the inter-bank market and Dutch auction with daily biddings.

With respect to the other currencies, the relative stability of the exchange rates for the yen and French franc is an indication that the Japanese and French monetary authoritites may have fixed their respective exchange rates.

From the foregoing analysis of the behaviour of the naira exchange rate for all the currrencies, it is certain that a wide variation exists in cross-currency performance with respect to the variance of exchange rate, the size of the mean rate of change, the sizes of the coefficient of variation and instability index, and the rate of depreciation or appreciation. This rather enormous variability in cross-currency performance tends to show that exchange rate movements for some of the currencies are influenced by factors outside the Nigerian economy. The case of the Japanese yen and French franc appears well established.

Even though cross-currency variability in performance indexes is an issue of concern in this study, the marked difference in the behaviour of each currency from one auction system to the other is of greater consequence in the management of the market-determined exchange rates in Nigeria. While the coefficient of variation in the exchange rates for the dollar shows that variability is about the same across the phases of the auction system, the exchange rate instability index, which combines variance with rate of change, shows that the various phases of the auction system did not generate uniform levels of instability. The absence of cross-phasal uniformity is equally shown by the mean rate of change, the variance of the rate of change and, very importantly, the rate of depreciation/appreciation. These differ markedly from one phase to the other in the auction system.

The cross-phasal variability in the rate of change and depreciation (appreciaton) of the dollar exchange rate may be due to the inability of the government to maintain fiscal

Table 12: Summary of naira exchange rate indexes: all currencies mean rate of change

Currency	Dutch auction (fortnightly)	Inter-bank (daily)	Dutch auction (daily)	Dutch auction (weekly)
US dollar	0.781647	0.02343	0.334224	0.011383
British pound	0.931239	0.033706	0.276082	-0.10234
German mark	0.82253	0.046732	0.247668	-0.10186
Swiss franc	0.768247	0.047068	0.211593	-0.10861
French franc	0.795104	-0.12915	0.244097	-0.10485
Dutch gilder	0.823188	0.068643	0.251572	-0.10169
Japanese yen	0.928692	0.01902	0.274756	0.034032

Table 13: Summary of naira exchange rate indexes: All currencies variance of rate of change

Currency	Dutch auction (fortnightly)	Inter-bank (daily)	Dutch auction (daily)	Dutch auction (weekly)
US dollar	1.796156	0.030478	0.050889	1.584368
British pound	7.101576	0.136856	0.269964	2.550665
German mark	2.933069	10.07898	0.42857	2.699514
Swiss franc	3.148895	10.07898	0.398156	2.278305
French franc	2.708947	13.80804	0.8736	2.639913
Dutch gilder	2.919999	2.475151	0.430227	2.7577
Japanese yen	2.914055	0.211274	0.3679	1.872389

Table 14: Summary of naira exchange rate indexes: All currencies rate of depreciation/appreciation

Currency	Dutch auction (fortnightly)	Inter-bank (daily)	Dutch auction (daily)	Dutch auction (Weekly)
US dollar	19.42462	1.88732	14.26561	0.809269
British pound	22.68721	26.00216	11.939	-7.57919
German mark	20.32972	34.12121	10.77917	-7.57919
Swiss franc	19.12574	34.13121	9.284536	-8.06145
French franc	19.72368	34.39034	10.63233	-7.77207
Dutch gilder	20.3442	45.84202	10.93944	-7.52872
Japanese yen	22.63279	15.6279	11.88524	2.4

Table 15: Summary of naira exchange rate indexes: All currencies exchange rate instability index

Currency	Dutch auction (fortnightly)	Inter-bank (daily)	Dutch auction (daily)	Dutch auction (weekly)
US dollar	0.2619	0.0552	0.2158	0.094
British pound	0.7751	0.2739	0.4311	0.4223
German mark	0.2021	0.1309	0.1257	0.1502
Swiss franc	0.0719	0.1619	0.1364	0.1566
French franc	0.056	-0.1024	0.0368	0.0438
Dutch gilder	0.1796	0.1457	0.1146	0.1326
Japanese yen	0.0067	0.0006	0.0017	0.0012

Table 16: Summary of naira exchange rate indexes: All currencies coefficient of variation

Currency	Dutch auction (fortnightly)	Inter-bank (daily)	Dutch auction (daily)	Dutch auction (weekly)
US dollar	0.0183	0.0169	0.0152	0.0771
British pound	0.0778	0.1692	0.0381	0.101
German mark	0.0188	0.0825	0.0104	0.0378
Swiss franc	0.0214	0.1081	0.0123	0.0332
French franc	0.0051	0.0608	0.0031	0.0106
Dutch gilder	0.0168	0.0787	0.0096	0.0332
Japanese yen	0.0014	0.0003	0.0001	0.0006

discipline and keep to monetary targets. It could equally be the result of day-of-the-week or month-of-the-year, auction system, and frequency of bidding effects. The potential impacts of such effects are examined in the next section.

VI. Analysis of effects

Given the concern for the non-uniformity in the rate of change and depreciation of the naira-dollar exchange rate, this tudy examined the potential impact of the following effects as they relate to the relative frequency of the deprication of the exchange rate:

- Auction system effect
- Frequency of bidding effect
- Auction system cum frequency of bidding effect
- Month-of-the-year effect
- Day-of-the-week-effect

With respect to the auction system, the six approaches that were tried out before the collapse of the bidding system in March 1992 were grouped into four phases, namely, average rate pricing, marginal rate pricing, Dutch auction and inter-bank market phases. This grouping aimed to eliminate duplication of the Dutch auction system which could be differentiated by means of frequency of bidding (see Table 3). For frequency of bidding, the analysis was based on all three varieties used — weekly, fortnightly and daily biddings. For the combined effect of auction system and frequency of bidding, all six phases of the auction system in Table 3 formed the basis of analysis.

In examining month-of-the-year effect, data for the period 1986-1991 (Table 17) were used, while for the day-of-the-week effect, daily exchange rate data for January - December 1990 were used. The data traversed sections of the two main phases in the auction system that featured daily biddings, the inter-bank and Dutch auction. All analyses were done using the chi-square and, where applicable, the moment coefficients of skewedness and kurtosis.

Auction system effect

In Table 18, we report the results for the first three effects. The null hypothesis against which the chi-square test was performed was that the depreciation occurring in each of the phases of the four auction systems was independant of these auction systems. The result in the table shows that at the 1% level of significance, this hypothesis is rejected. The level of depreciation the naira-dollar exchange rate experienced before March 1992 was significantly influenced by the auction systems the monetary authorities adopted.

Table 17: Monthly naira-dollar exchange rate movements; January - December

Month	1986	1987	1988	1989	1990	1991
January		2.71	4.18	7.75	7.87	9.33
February		3.08	4.27	7.39	7.9	9.52
March		3.48	4.32	7.59	7.94	9.98
April		3.48	4.21	7.58	7.94	0.95
May		3.51	4.11	7.51	7.94	9.25
June		3.73	4.2	7.35	7.95	10.03
July		3.81	4.61	7.2	7.94	10.6
August		4	4.49	7.26	7.96	11.62
September	4.62	4.21	4.72	7.35	7.98	9.96
October	4.12	4.28	4.78	7.4	8.01	9.86
November	3.54	4.3	5.15	7.51	8.32	9.86
December	3.19	4.17	5.36	7.63	8.71	9.87

Number of annual biddings in the foreign exchange market.

Frequency of bidding effect

Results of the chi-square analysis for frequency of bidding are also reported in Table 18. The evidence shows that fortnightly, weekly and daily frequencies of bidding do not generate uniform levels of depreciation. The null hypothesis of uniform depreciation is rejected even at the 1% level. The depreciation experienced in the naira-dollar exchange rate is not independent of the frequency of bidding in the auctions. The impact of the frequency of bidding is less than half of the effect associated with the auction system.

Auction system cum frequency of bidding effect

The combined effect of auction systems cum frequency of bidding generate a much higher value for the chi-square (see Table 18). This shows that the rate of depreciation is accelerated when the naira-dollar exchange rate is determined through an auction system and frequency of bidding, which are prone to depreciation. Expectedly, the effect of the auction systems cum frequency of bidding is greater than that of each taken singly. There is, therefore, evidence of mismatch of auction system and frequency of bidding, which contributed to the rapid depreciation of the naira. The auction system together with the corresponding bidding frequencies generated rates of depreciation that are significantly different at the 1% level.

Table 18: Auction system and frequency of bidding effect on depreciation/appreciation

Auction system bidding frequency	Chi-square coefficient	Critical values (1%)	(5%)	(10%)	D.F.
Auction system	121.038	11.34	7.815	6.251	3
Frequency of bidding	54.354	9.21	5.991	4.605	2
Auction system and frequency of bidding	128.673	15.09	11.07	9.236	5

Month-of-the-year effect and nature of distribution of exchange rate changes

As part of the analysis of effects, this study examined the average of depreciation and the nature of the distribution of the exchange rate changes for each month of the year for the period September 1986 - December 1991. The results of the analysis are reported in Table 19.

A close look at the average rate of depreciation shows that there is a fairly uniform rate of depreciation and exchange rate changes across the months of the year. The highest depreciation seems occurred in December (21.46%), while the lowest rates were experienced in October (17.845%). The gap between the two is less than 4 percentage points. In the content of our analysis, this is negligible.

This observation is supported by the result of the chi-square test for the relationship between month of the year and rate of depreciation. A coefficient of 0.6132 was obtained, which is far lower than the critical value of 5.578 at the 10% level. We cannnot, therefore, reject the hypothesis that, generally, the depreciation the naira-dollar exchange rate experiences on a monthly basis is independant of the month of the year. In other words, the month of the year does not seem to exert significant effect on either the rate of depreciation or the change in the exchange rate.

Given the empirical evidence, however, the data in the table also point to a fact that has been observed with respect to exchange rate behaviour in Nigeria. That is the exchange rate tends to depreciate more in December and January than all other months, which the results in Table 19 confirm a relatively higher level of depreciation also tends to occur about the middle of the year. The results point to the month of July.

The distribution of the rate of change shows positive skewedness in all cases. The peaks of the distribution as measured by the coefficient of kurtosis show that the months of January, and July-December exhibited platykurtic distribution, which suggests greater dispersion of the rate of change, while the months of February-June showed leptokurtosis in their distribution. The February-June distribution, therefore, indicates greater peakedness or less variability in the exchange rate changes. The exchange rate changes are therefore not normally distributed.

Table 19: Month-of-the-year effect and the nature of distribution of the rate of exchange rate changes 1986 - 1990

Month	Average rate of depreciation	Average rate of exchange rate changes	Nature of distribution		
			Skewedness		Kurtosis
January	21.28589	7.638211	1.510002	-0.03186	Positive, platykurtic
February	20.65866	7.17532	1.721716	0.004226	Positive, leptokurtic
March	18.89488	6.518969	2.021696	0.145588	Positive, leptokurtic
April	18.71854	6.565209	2.121878	0.194962	Positive, leptokurtic
May	16.48668	6.100275	2.087568	0.17713	Positive, leptokurtic
June	17.93409	6.524655	2.030566	0.154634	Positive, leptokurtic
July	21.01425	7.333039	0.781204	-0.43415	Positive, platykurtic
August	18.884	6.608528	1.569723	-0.01202	Positive, playtkurtic
September	18.16454	4.702369	0.800164	-0.40475	Positive, platykurtic
October	17.84504	5.772881	1.662168	-0.02013	Positive, platykurtic
November	19.31359	7.449067	0.120842	-0.74227	Positive, platykurtic
December	21.46121	8.741283	0.222483	-1.03816	Positive, platykurtic

Chi-square coefficient for month-of-the year effect on depreciation: 0.613207
Critical values: 3.053 (1%), 4.575 (5%), 5.578 (10%).

Day-of-the-week effect and nature of distribution of exchange rate changes

The final effect that was examined in this study concerns the impact of the day of the week on depreciation, and the nature of the distribution of exchange rates changes for each of the week. Like the analysis above day-of-the-week tests were carried out to see whether nor not the IID properties of the daily exchange rates can be confirmed or rejected. Results of the test are reported in Table 20.

Looking closely at the average rate of depreciation and rate of exchange rate changes for each day of the week, we observed that the naira-dollar exchange rate tends to depreciate more on Mondays and Thursdays. It appreciates on Tuesday, Wednesday and Fridays. This trend is also noticeable in the average rate of exchange rate changes for each of the week. This rules out indentical rates of depreciation across days of the week. The highest depreciation seems to occur on Thursdays (0.3716%), while the highest appreciation appears to take place on Wednesdays (0.0588%).

The rejection of identical rates depreciation is confirmed by the result of the chi-square test for the relationship between the day-of-the-week and the rate of depreciation. The empirical investigation turned out a chi-square coeffieient of 52.027, which is considerably higher than the critical value of 13.28 (1% level of significance). We therefore reject the hypothesis that, generally, the depreciation the naira-dollar exchange rate experiences on a daily basis is independent of the day of the week in which foreign

Table 20: Day-of-the-week effect and the nature of distribution of the rate of exchange rate changes 1986 - 1990

Day	Average rate of depreciation	Average rate of exchange rate changes	Nature of distribution		
			Skewedness		Kurtosis
Monday	0.269542	0.120042	29.57145	28.37688	Positive, Leptokurtic
Tuesday	0.098607	0.042926	10.77053	11.85152	Positive, Leptokurtic
Wednesday	0.058776	0.025547	2.817027	2.769936	Positive, Leptokurtic
Thursday	0.371648	0.165299	20.5572	21.351	Positive, Leptokurtic
Friday	0.068634	0.02986	0.253696	0.253696	Positive, Leptokurtic

Chi-square coefficient for day of the week effect on depreciation: 52.02736
Critical values: 13.28 (1%), 9.488 (5%), 7.779 (10%).

exchange transactions are carried out. In other words, in assessing factors that lead to the depreciation of the naira-dollar exchange rate, there is need to adjust the exchange rate data series for the impact exerted by the day of the week.

VII. Summary and conclusion

Exchange rate management policy in Nigeria has passed through five major stages, the current one of which is characterized by market-determined exchange rate management. The current system, which began on 29 September 1986, constitutes a fundamental aspect of the country's economic reform programme. Since the onset of this approach, one major problem that has confronted the Nigerian monetary authorities has been the marked instability in the principal exchange rate — the naira-dollar rate. The instability has mainly featured depreciation of the rate.

In the effort to establish a stable and variable exchange rate for the naira, the monetary authorities experimented with four auction systems and six frequencies of bidding between September 1986 and March 1992 before the collapse of the bidding system. The behaviour of the dollar exchange rate differs significantly over these auction systems and bidding frequencies. This applies equally to the other six currencies used for the study. We found, however, that the dollar exchange rate was relatively stable under the inter-bank (IFEM) and Dutch auction systems with daily frequencies of bidding. The Japanese yen and French franc were most stable throughout all phases of the auction system. This gives the impression that the Japanese and French monetary authorities must have fixed their exchange rates. The British pound sterling exhibited greater characteristics of instability.

In the attempt to explain some of the possible causes of the instability, particularly in the principal currency, our study looked at the macroeconomic policy characteristics of all six phases of the auction system between September 26 1986 and December 1991. We found the fiscal and monetary discipline was lacking on the part of the government, but this does not sufficiently account for the steep depreciation the naira has experienced. We therefore examined the impact of the five major factors on the rate. These are the auction systems, effect frequency of bidding effect, auction system cum frequency of bidding effect, month-of-the-year effect, and day-of-the-week effect.

For the auction system effect, we found that the level of depreciation the naira-dollar exchange rate experienced was significantly influenced by the type of auction system the monetary authorities adopted. We also found that frequency of bidding exerted some influence on the rate of depreciation. The joint impact of both the auction system and frequency of bidding was much larger on the rate of depreciation when compared with their individual influences. On the month-of-the-year effect and the nature of the distribution of exchange rate changes, we found that the highest level of depreciation tends to occur in December and January, but generally the depreciation the dollar exchange

rate experiences is not significantly dependant on the month of the year, and the exchange rate changes are not normally distributed.

Finally, with respect to the day-of-the-week effect and nature of distribution of exchange rate changes, it was found that the depreciation that occurs in the daily biddings is not independent of the day of the week. The dollar exchange rate tends to appreciate on Tuesdays, Wednesdays and Fridays. The highest depreciation seems to occur on Thursdays, while the highest appreciation appears to take place on Wednesdays.

Given these findings we wish to conclude that to adequately account for the instability of the naira exchange rates, it is desirable to look at properties of the processes that generate the exchange rates, effects from day of the week and the macroeconomic policy environment among other factors. The search for the relative significance of these factors in the movement of the exchange rate over the time will be left for the second phase for this research.

VIII. Policy implications

The policy implications that come out of this study are threefold. These are as follows:

1. The monetary authorites should adopt one mechanism for determining the exchange rate, having tried out six pricing/bidding systems. Frequent changes in the auction system and frequencies of bidding should be avoided. Besides, given the time series properties of the exchange rate data, it is not unlikely that the exchange rate will not return to its equilibrium level once disturbed.
2. A perfectly stable exchange rate under the market-determined exchange rate management system cannot be achieved, because of the response of month-of-the-year and the day-of-the-week effects. This means that not all variations in the exchange can be eliminated. The monetary authorities should estimate the size of these effects and make allowance for them when determining the bounds over which the exchange rate may not be allowed to vary, once a particular method for determining the rate has been established.
3. The federal government should reduce its fiscal deficit so that effective monetary restraint can be exercised by the Central Bank. It is common knowledge that a larger part of the excess fiscal burden of government operations is borne by the monetary sector.

References

Boothe, P. and D. Glassman. 1985. *"The statistical distribution of exchange rates: empirical evidence and economic implications"*". Unpublished Manuscript (U.S.A, Alberta: Department of Economics, University of Alberta).

Burt, J., F. R. Kaen and G. G. Booth. 1977. "Foreign market efficiency under flexible exchange rates", *Journal of Finance*. vol. 32. pp. 1325 - 1330.

Calderon - Rosell, J. R. and M. Ben-Horim. 1982. "The behaviour of foreign exchange rates" *Journal of International Business Studies*. vol. 13. 1982. pp. 99 - 111.

Elbadawi I. A.1991. *"The black market for foreign exchange and macroeconomic management in Sudan"* . Mimeo (U.S.A.; Washington: The World Bank, May).

French K. R. 1980. "Stock returns and the weekend effect". *Journal of Financial Economics*, vol. 8. pp. 55 - 69.

Friedman, D. S. Vandersteel. 1982. "Short-run fluctuations in foreign exchange rates". *Journal of International Economics*. vol. 13. pp. 171 - 186.

Gibbons, M. R. and P. Hess. 1981. "Days of the week effects and asset returns". *Journal of Business*. vol. 54. pp. 579 -596

Hsieh, D. A. 1988. "The statistical properties of daily foreign exchange rates: 1974 - 1983". *Journal of International Economics*. vol. 24. pp. 129 - 145.

Hogg, R. V. and A. T. Craig. 1970. *"Introduction to Mathematical Statistics"*. (New York: macmillan).

Keim, D. B. and R.F Stambaugh. 1984. "A further investigation of the weekend effect in stock returns", *Journal of Finance*. vol. 39. pp. 819 - 837.

Messe, R. A. and A. K. Rose. 1991. *"An empirical assessment of nonlinearities in models of exchange rate determination"*. The Review of Economic Studies. vol. 58 (3). no. 195.

National Bureau of Economic Research Inc. 1991. *"Pitfalls and opportunities: What macroeconomists should know about Unit Roots"*. Unpublished Manuscript (U.S.A., Cambridge Massachusetts).

Omoruyi, S. E. 1989. *"Structural adjustment and national development; Deriving a fair and viable exchange rate for the Naira"*. Central Bank of Nigeria, Economic and Financial Review. September. pp. 29 - 34.

Stock, J. H. and M. Watson. 1988. *"Variable trends in economic time series"*. Journal of Economics Perspectives. vol. 2. pp. 297 - 232.

United Bank of Africa. 1992. *Monthly Business & Economic Digest*. (Nigeria: Lagos, March).

Westerfield, J. M. 1977. "An examination of foreign exchange risk under fixed and floating rate regimes". *Journal of International Economics*. vol. 7. pp. 181 - 200.

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