# EMPIRICAL ANALYSIS OF THE PORTFOLIO STRUCTURE OF A LEADING COMMERCIAL BANK IN NIGERIA

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*An attempt is made in this paper to empirically analyze the portfolio structure of United Bank for Africa (UBA), which is a leading Commercial bank in Nigeria in terms of total deposit, capital base and branch network. Three major determinants of the structure identified in the study are rate of returns, total deposit and gross domestic product. Regression results show that impacts of the determinants were generally satisfactory, except for rate of returns. The predictions are also quite impressive and useful for policy formulation on portfolio management in the bank.*

## INTRODUCTION

Commercial bank is a financial institution where money and other valuables are kept for safe custody. The money kept with the bank is referred to as deposit and the depositor is entitled to his money when he is in need of it. But experience has shown that all depositors do not withdraw their money all at the same time. So, it becomes possible to keep some proportion of the deposit to meet the withdrawal needs of depositors while the excess can be given out as loans and also invested in securities. It is the distribution of total deposit of the bank into cash reserves, loans and investments that constitute bank portfolio. The issue before management is what proportions of the total deposit should be held as cash reserves, loans and investments, taking into consideration the need to maximize profit and ensure adequate liquidity for the depositors.

Portfolio management is one of the most challenging aspects of bank management. It is not simply a distribution of bank's funds, but a distribution which must meet two important but conflicting objectives of profitability and liquidity. This is clearly indicated by Crosse and Hempel (1988) who argue that the primary aim of bank's portfolio policy is to obtain maximum return with minimum exposure to risk. In addition, they maintain that banks must be sufficiently liquid in order to meet not only the legal reserve requirement but also the net withdrawal of funds by depositors.

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In order to fully understand bank portfolio behaviour, there is need to adopt both theoretical and empirical methods of analysis. This study therefore uses both methods to analyze the portfolio structure of United Bank for Africa (UBA) which is one of the leading commercial banks in Nigeria in terms of total deposit, capital base and branch network. The study covers the period 1980 – 2000, with relevant data obtained from the publications of the bank and other sources such as Central Bank of Nigeria, Federal Office of Statistics in Nigeria, and International Monetary Fund.

**Statement of problem**

Banks seek to maintain optimum portfolio structure at any given point in time. The desired holding or demand for any asset class in the portfolio is determined, among other things, by rate of returns, total deposit and level of economic activities (gross domestic product). If desired holding deviates from actual, the bank is expected to adjust its portfolio until it approaches the desired level. The bank, therefore, is always in a process of portfolio adjustment as a result of changes in the determinants. It is the impact of these determinants on each asset class of the portfolio that this study attempts to estimate and analyze; for the purpose of providing useful policy information to the management of UBA.

**Portfolio determination : A review of pioneering studies**

The literature on portfolio determination is quite extensive. There is the proposition which states that the portfolio maximizing agent evaluates its performance in terms of expected utility from its assets (Bernoulli, 1954). This proposition is explicit in Bernoulli's classical work on portfolio structure which he based on the principle of expected utility maximization. In his opinion, the value of an asset in a portfolio depends on its utility and not on its price. The Bernoulli rule for asset selection in a portfolio has however been severely criticized largely because his expected utility principle was derived from assumptions rather than real life behaviour. The criticism may not blur the proposition because an earlier study by Neumann and Morgenstern (1947) derived the expected utility principle directly from a set of individual behaviours. In other words, they showed that utility index can be constructed to predict asset choice under conditions of risk. A rational investor who conforms to the Neumann and Morgenstern axiom will attempt to maximize his expected utility from the asset selection in his portfolio.

In literature, there are other principles of portfolio selection which are not based on the expected utility hypothesis but on the comparison of means and variances of the probability distribution of returns. Notable among these are the works of Markowitz (1952) and Tobin (1958). The basic elements of Markowitz theory of portfolio selection are set out in terms of expected returns and variances of returns from securities. He started by rejecting the hypothesis of

portfolio selection based solely on maximum expected returns, on the grounds that it does not explicitly take diversification into consideration. He pointed out that portfolio with maximum expected returns is not necessarily the one with minimum variance which is the relevant measure of risk associated with securities. He went on to demonstrate how the investor can arrive at an efficient portfolio from a knowledge of expected returns and variances for every asset. In this approach the investor is assumed to have subjective probability distribution of his expected returns which is described by its mean and standard deviation. With his subjective evaluation of the mean and standard deviation, the investor diversifies his portfolio in order to get an efficient set that will maximize his expected returns. The work of Tobin on portfolio selection is in many ways similar to Markowitz's, but with important differences. Both theories are based on the principle of expected returns, but Tobin assumes only two assets (risky and riskless) in a portfolio. He expressed the expected utility of the investor as a function of expected returns and risk, which clearly shows that the investor has an objective function and a constraint. The problem of the investor is therefore how to maximize his utility subject to the constraint imposed by the market. Underlying Tobin's approach, like Markowitz, is the contention that well diversified portfolio can reduce risk and optimize returns. The classic works of Markowitz and Tobin were followed by other studies which attempted to elaborate on the problem of portfolio selection.

The Capital Asset Pricing Model (CAPM) which was developed independently by Sharpe (1964) and Linter (1965), and extended by Mossin (1966) and Fama (1970), has its foundation in the expected utility hypothesis. The model explains an efficient portfolio in terms of risk and returns on various combinations of asset. The locus of these alternative combinations is the capital market line (CML), and the maximum utility to the investor is at the point where the utility curve showing different portfolios is tangential to the CML. It is only at this point the investor maintains an optimum portfolio.

Empirical investigations which followed the pioneering theoretical works have been quite revealing. Brecching and Clayton (1965) undertook an important empirical study on the portfolio behaviour of selected commercial banks in Britain and found that a rise in bond rate had negative impact on the proportion of bond investment in bank portfolio. Treasury bill rate was however observed to be positively related to investment in bills. These empirical findings were in support of the theoretical arguments posited by the authors. A similar study was carried out in United States of America by Russel (1964) to ascertain the factors influencing portfolio adjustments of commercial banks. His major finding showed that the rate of returns had a positive impact on the proportion of

asset in the portfolio. In Nigeria, Ojo (1976) carried out a study on the determinants of demand and supply of commercial bank loans and found gross domestic product (GDP) to be the major determinant. Ajayi (1978) did a more elaborate work by grouping bank assets into two categories of liquid investments and loans. He must have reasoned that long-term investments are of less importance for the purpose of his study, since banks in Nigeria allocate a very small proportion of their funds to such investments. Using quarterly data, he estimated demand functions for treasury bills and loans and found that total deposit has positive and significant impact on demand for liquid investments in the portfolio. The pioneering efforts in portfolio analysis in Nigeria by Ojo and Ajayi stimulated several researchers who have also made meaningful contributions to the growing literature on portfolio determination in Nigeria. The most recent amongst them are Udegbunam (1991), Olisambu (1991), Alabi (1994) and Ogbodo (1997).

**Model Specification**

For the purpose of this study the bank portfolio is structured into three classes of asset viz:

(a) Cash asset (C)

(b) Investment asset (I)

(c) Loans and advances (L)

The demand for each class of asset depends on the following determinants;

(i) Rate of returns (R )

(ii) Total bank deposit (D)

(iii) Gross domestic product (Y)

The level of each asset class ($A_{it}$) in the portfolio at a given time is linearly related to the determinants as follows;

$$A_{it} = a_o + a_1R_t + a_2D_t + a_3Y_t + u_t \quad \text{.....(1)}$$

Where;

$A_{it}$ = actual level of i class of asset (i = 1, 2, 3)

t = time subscript

$a_o$ = autonomous level of the asset class

$a_1$ = impact of rate of returns on the asset class

$a_2$ = impact of total deposit on the asset class

$a_3$ = impact of gross domestic product on the asset class

$u_t$ = error term ( Guassian White noise).

Due to habit, inertia and rigidity which create lags in response, the current level of asset in the portfolio at any given period may only represent a partial adjustment. The partial adjustment as well as adaptive expectation are therefore built into the equation, following a previous study (Edo, 1995). The resulting equation is stated hereunder;

$$A_{it} = a_0 + a_1R_t + a_2D_t + a_3Y_t + a_4A_{it-1} + u_t \quad \text{..... (2)}$$

Where;

$A_{it-1}$ = lag variable

$a_4$ = coefficient of lag variable

The coefficients $a_1$, $a_2$ and $a_3$ measure the respective impacts of rate of returns, total deposit and gross domestic product on each asset class in the bank's portfolio, while $a_4$ represents the impact of the lag variable. Equation (2) may be

decomposed into three to yield the functions for individual asset class viz;

$$C_t = a_0 + a_1R_t + a_2D_t + a_3Y_t + a_4C_{t-1} + u_t \quad \text{(3a)}$$

$$I_t = a_0 + a_1R_t + a_2D_t + a_3Y_t + a_4I_{t-1} + u_t \quad \text{(3b)}$$

$$L_t = a_0 + a_1R_t + a_2D_t + a_3Y_t + a_4L_{t-1} + u_t \quad \text{(3c)}$$

Where;

$C_t$ = Cash asset in period t

$I_t$ = Investment asset in period t

$L_t$ = Loans and advances in period t.

Thus, (3a) – (3c) constitute single equations model for explaining the portfolio structure of the bank, with all the variables expressed in logarithm. The rate of returns on cash asset is proxied by discount rate on treasury bills which is the closest asset to cash in terms of liquidity. The discount rate is however taken as opportunity cost of holding cash asset. The a priori expectations (expected signs) of the coefficients in the model are negative or positive for autonomous term ($a_0 > 0$, $a_0 < 0$ ), positive for rate of returns on asset except cash ($a_1 > 0$ for investment and loans, $a_1 < 0$ for cash only), positive for total deposit ($a_2 > 0$), positive for gross domestic product ($a_3 > 0$) and positive for lagged asset class ($a_4 > 0$).

## Estimation and Analysis of Results

The model which consists of equations for the three asset classes of the portfolio is estimated for United Bank for Africa (UBA) using the single equation estimation technique of Ordinary Least Squares (OLS) contained in the PC – GIVE Computer Software (Hendry, 1989). The estimation is considerable departure from a previous study (Iyare and Edo, 1992) in which only investment asset was estimated. The structure of UBA portfolio and the impacts of its determinants are shown in the estimation results reported in table1.

**Table I**

**Estimation Results of UBA Asset Equations**

| Asset class | Coefficient of Determinants | | | | | Other Indiees | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $a_0$ | $a_1$ | $a_2$ | $a_3$ | $a_4$ | $R^2$ | F | Durbin's h-statistic | SEE |
| $C_t$ | -0.04 (-1.89) | 0.06 (0.39) | 1.72 (4.21) | 3.44 (6.49) | 2.13 (3.23) | 0.97 | 77.93 | -1.01 | 0.03 |
| $I_t$ | -0.25 (-2.06) | 2.18 (5.11) | 0.11 (2.08) | 2.12 (2.43) | 0.22 (2.27) | 0.82 | 26.54 | 1.04 | 0.006 |
| $L_t$ | 0.88 (1.56) | -0.92 (-3.15) | 0.05 (2.07) | 1.03 (3.34) | 1.05 (3.71) | 0.93 | 41.36 | -1.02 | 0.009 |

**Note:** t–values are in parenthesis under the coefficients.

**Source:** Computer estimation

In table I, the cash asset equation has $R^2$ of 0.97 which is quite good. This indicates that the estimated equation explains 97 percent of the variation in cash holding of UBA for the period under consideration. In other words, the explanatory power of the equation is strong. The relationship between cash asset of the bank and its determinants is indicated to be stable by the F-value of 77.93 which is significant at the 1 percent level. We have to therefore accept the hypothesis of significant linear relationship between portfolio cash and its determinants in UBA. The coefficients of total deposit and gross domestic product have the expected signs, and are both significant at the 1 percent level. This result suggests that the amount of cash in the portfolio increased with total deposits and gross domestic product. This is expected since large proportion of deposits are on current accounts which are often erratic and unstable and therefore requires a sizeable cash reserve. A related reason for holding sizeable amount of cash is the fact that the opportunity for profitable investment is seriously limited. The positive relationship between cash and gross domestic product can be explained by the fact that increase in economic activities results in higher cash flows into the banking system. Contrary to expectation, rate of returns did not have the correct sign and is not significant at the .5 percent level. This perhaps follows from another hypothesis which states that commercial banks are expected to increase their cash holding as discount rate increases, to avoid liquidity problem. The coefficient of lagged cash asset is positive and significant at the 1 percent level, which is an evidence in support of the hypothesis that past cash holding has a positive impact on current cash holding and that commercial banks adjust their portfolio from period to period in an attempt to attain desired level.

The investment asset equation results are also interesting. The $R^2$ of 0.82 suggests a good fit which indicates that 82 percent of the systematic variation in investment was accounted for by the determinants during the period. The F-value of 26.54 also suggests a stable linear relationship between the determinants and investment asset. All coefficients in the equation have the predicted signs and are significant at the 5 percent level. The results clearly show that all the determinants made considerable impact on the investment asset in UBA portfolio during the period.

The loans and advances equation also performed impressively well. The $R^2$ of 0.93 again suggest a very good fit indicating that 93 percent of variation in loans and advances was explained by the equation during the period. The F-value of 41.36 passes the significance test at the 1 percent level suggesting a stable linear relationship for the equation. The coefficients of total deposit and gross domestic product have the expected signs and are significant at the 5 percent level. The coefficient of rate of returns does not have the correct sign, a situation which could be explained by an alternative

hypothesis which states that commercial banks are expected to increase cash holding as lending rate on loans and advances decline.

In all the equations, the Durbin's h and SEE values indicate some auto-correlation and serial errors respectively, but not serious to the extent of biasing the results. The results could therefore be seen to be highly reliable.

**Predictions**

The model of asset structure which contains three equations were estimated using data for the period 1980 – 2000. Predictions for the three portfolio assets are based on the estimated single equations. The analysis is done by using the estimation results to extrapolate values from one year to the other and observing the prediction errors as well as the Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE). The predictions for each asset class are shown in tables 2 – 4.

Table II shows the predictions from the cash asset equation. It is observed that cash asset exhibits oscillatory trend in actual and predicted values. The prediction errors also exhibit oscillation in absolute values. The accuracy of prediction of the cash asset is approximated by the MAE which is less than 2 percent, indicating that actual and predicted values of cash asset were not significantly different during the period. Again, the RMSE which is small and insignificant further confirms that the actual and predicted values are not significantly different. The observation period, 1980 – 2000, is considered long enough for purpose of policy making. The policy implication here is therefore quite clear, in the sense that future changes in cash asset would depend largely on changes in total deposit and gross domestic product.

Table III shows the prediction for investment asset which is similar in some respects to the prediction for cash asset in table 2. The MAE is also less than 2 percent for period, while the RMSE is small and insignificant. Here again, investment asset would in future depend on total deposit, and gross domestic product, as well as rate of returns. It is also observed in this table that the log values of investment asset over the period are in most cases smaller than the log values of cash asset, an indication that UBA held large cash asset relative to investment asset during the period.

Table IV reports the prediction for loans/advances which exhibits a somewhat different result. It shows that the MAE is greater than 2 percent, but since it is still less than 5 percent, it follows that the prediction is good and useful for policy making, which is further confirmed by the insignificant value of the RMSE. The actual and predicted values of loans/advances were therefore not considerably different during the period. As in the previous case of cash asset, future changes in loans/advances would also depend largely on changes in total deposit and gross domestic product.

Finally, both estimation results and predictions yielded far-reaching and impressive results that would be useful

for policy making to improve performance of UBA portfolio, and indeed, the portfolio of other commercial banks.

**Table II**

**Actual and Predicted Values of Cash Asset in UBA Portfolio (in log)**

| Year | Actual | Predicted | Prediction Error |
|---|---|---|---|
| 1980 | 3.01 | 3.07 | 0.06 |
| 1981 | 3.26 | 3.27 | 0.01 |
| 1982 | 4.05 | 4.07 | 0.02 |
| 1983 | 3.32 | 3.37 | 0.05 |
| 1984 | 3.86 | 3.83 | -0.03 |
| 1985 | 3.27 | 3.19 | -0.08 |
| 1986 | 4.66 | 4.70 | 0.04 |
| 1987 | 4.81 | 4.82 | 0.01 |
| 1988 | 5.04 | 4.98 | -0.06 |
| 1989 | 5.63 | 5.66 | 0.03 |
| 1990 | 4.19 | 4.17 | -0.02 |
| 1991 | 4.74 | 4.73 | -0.01 |
| 1992 | 3.88 | 3.93 | 0.05 |
| 1993 | 3.22 | 3.14 | -0.08 |
| 1994 | 4.06 | 3.97 | -0.09 |
| 1995 | 3.96 | 3.98 | 0.02 |
| 1996 | 2.28 | 2.19 | -0.09 |
| 1997 | 3.29 | 3.19 | -0.10 |
| 1998 | 4.38 | 4.41 | 0.03 |
| 1999 | 5.04 | 4.99 | -0.05 |
| 2000 | 5.13 | 5.14 | 0.01 |
| | | MAE | 0.013 |
| | | RMSE | 0.006 |

**Note:** Positive error = over-prediction, Negative error = under-prediction,
MAE = Mean Absolute Error, RMSE = Root Mean Squared Error.

**Source:** Computer estimation.

**Table III**

**Actual and Predicted Values of Investment Asset in UBA Portfolio (in log).**

| Year | Actual | Predicted | Prediction Error |
|---|---|---|---|
| 1980 | 1.68 | 1.76 | 0.08 |
| 1981 | 1.71 | 1.65 | -0.06 |
| 1982 | 2.08 | 2.15 | 0.07 |
| 1983 | 2.26 | 2.31 | 0.05 |
| 1984 | 2.68 | 2.64 | -0.04 |
| 1985 | 3.34 | 3.40 | 0.06 |
| 1986 | 3.26 | 3.31 | 0.05 |
| 1987 | 3.14 | 3.11 | -0.03 |
| 1988 | 3.28 | 3.23 | -0.05 |
| 1989 | 2.61 | 2.65 | 0.04 |
| 1990 | 3.37 | 3.42 | 0.05 |
| 1991 | 3.31 | 3.30 | -0.01 |
| 1992 | 2.61 | 2.59 | -0.02 |
| 1993 | 2.48 | 2.56 | 0.08 |
| 1994 | 2.13 | 2.16 | 0.03 |
| 1995 | 3.36 | 3.35 | -0.01 |
| 1996 | 2.17 | 2.21 | 0.04 |
| 1997 | 3.22 | 3.24 | 0.02 |
| 1998 | 2.55 | 2.54 | -0.01 |
| 1999 | 2.59 | 2.62 | 0.03 |
| 2000 | 3.06 | 3.10 | 0.04 |
| | | MAE | 0.019 |
| | | RMSE | 0.008 |

**Note:** Positive error = over-prediction, Negative error = under-prediction,
MAE = Mean Absolute Error, RMSE = Root Mean Squared Error.

**Source:** Computer estimation.

**Table IV**

**Actual and Predicted Values of Loans/ Advances in UBA Portfolio (in log).**

| Year | Actual | Predicted | Prediction Error |
|---|---|---|---|
| 1980 | 3.89 | 3.82 | -0.07 |
| 1981 | 3.92 | 3.97 | 0.05 |
| 1982 | 3.63 | 3.65 | 0.02 |
| 1983 | 3.56 | 3.55 | -0.01 |
| 1984 | 3.68 | 3.72 | 0.04 |
| 1985 | 2.34 | 2.40 | 0.06 |
| 1986 | 2.65 | 2.63 | -0.02 |
| 1987 | 3.78 | 3.75 | -0.03 |
| 1988 | 5.13 | 5.22 | 0.09 |
| 1989 | 5.24 | 5.32 | 0.08 |
| 1990 | 5.19 | 5.22 | 0.03 |
| 1991 | 4.33 | 4.31 | -0.02 |
| 1992 | 4.81 | 4.82 | 0.01 |
| 1993 | 3.37 | 3.42 | 0.05 |
| 1994 | 3.48 | 3.57 | 0.09 |
| 1995 | 4.92 | 4.90 | -0.02 |
| 1996 | 3.91 | 3.92 | 0.01 |
| 1997 | 4.05 | 4.08 | 0.03 |
| 1998 | 4.42 | 4.47 | 0.05 |
| 1999 | 4.81 | 4.80 | -0.01 |
| 2000 | 4.35 | 4.39 | 0.04 |
| | | MAE | 0.022 |
| | | RMSE | 0.009 |

**Note:** Positive error = over-prediction, Negative error = under-prediction,

MAE = Mean Absolute Error, RMSE = Root Mean Squared Error.

**Source:** Computer estimation.

## Summary and conclusion

In this paper, attempt has been made to theoretically and empirically analyze the structure of UBA portfolio and the impact of its determinants within the period 1980 – 2000. The portfolio is structured into cash asset, investment asset and loans/advances, while the determinants are identified as rate of returns, total deposit and gross domestic product. In the theoretical framework, a model is specified and subsequently estimated to explain the impact of the determinants on each asset class of the portfolio. Estimation of the model yielded interesting results which indicate, firstly, that rate of returns is an important determinant of investment asset, but a poor determinant of cash asset and loans/advances. Secondly, the performance of total deposit as a determinant is quite impressive because it satisfies the expectation that it must increase in the same direction with all asset classes. This is not surprising as total deposit constitute the bedrock of bank's operations. Thirdly, the performance of gross domestic product as a determinant is also good. The results reveal that it increased and boosted all the asset classes of the portfolio, which is consistent with economic reality and expectation of the model.

To enhance the policy significance of the study, predictions of the model were evaluated and discovered to be impressive for the period. The policy implication of the predictions is quite obvious, and that is, for any class of

asset to change substantially in future, significant changes must also occur in total deposit and gross domestic product. The management of UBA therefore needs to put in place policies that would attract more deposit as this may be the only viable option to boost its portfolio structure. It may not be able to influence gross domestic product which is under the control of extraneous forces.

Finally, the general result from this study is clearly robust and impressive, and we need to emphasize that though it is peculiar to United Bank for Africa, the policy implication is relevant to the entire banking sector in Nigeria.

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