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SOURCES OF TECHNICAL INEFFICIENCY IN COMMERCIAL BANKS' LENDING IN NIGERIA

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***Abstract*—The study assessed sources of technical inefficiency in commercial banks' lending in Nigeria. Yearly time series data that spanned between 1960 and 2008 were used. Stochastic frontier model as well as descriptive statistics was employed as instrument of data analysis. The result revealed that the financial inputs of demand deposits, time savings in both local and foreign currencies and foreign liabilities of the industry significantly influence the industry's lending output. Furthermore, about 24% of the maximum lending capacity of the industry is presently wasted with non performing loan and inflation contributing in a statistically significant manner to lending inefficiency. The study recommends that the unproductiveness associated with capital base of the industry and loan incentive from Central Bank of Nigeria should be addressed in order to shift the lending frontier of the industry**

Keywords - Commercial Banks' lending; technical inefficiency; stochastic frontier model.

I. INTRODUCTION

Based on the assumption that greater financial deepening increases aggregate income and accelerates economic growth, financial development is considered a key component in the process of economic growth.

Moreover, the supply of efficient, sustainable, and broadly-based financial services is important in many sectors of emerging economies most especially the agricultural sector because the high risks and transaction costs in most rural markets for goods, services, assets, and factors of production results to large degrees of market fragmentation (Gonzalez-Vega, 2008). These costs and risks are responsible for low levels of market integration and for a wide dispersion of marginal rates of return on resource use (McKinnon, 1973) with wide gaps separating marginal rates of return available to deficit and surplus units. This signals numerous unexploited opportunities for improving the productivity of available resources. Financial intermediation reduces these gaps and as a result aggregate income increases. Indeed, the supply of formal financial services and poverty are related in complex ways (Gonzalez-Vega, 1998; Zeller *et al*., 1997). Formal financial services, according to Gonzalez-Vega (2008), can release credit constraints and facilitate a fuller exploitation of existing productive opportunities. When this is the case, some households can lift themselves out of poverty. Other times, financial services can assist in household risk management strategies, thereby stabilizing incomes and encouraging productive investment (Zeller and Meyer, 2002; Zeller, 2003). Poverty and/or vulnerability to risk would be alleviated in these cases. Some other times, financial services assist in processes of physical and human capital accumulation and allow households to overcome poverty traps (Maldonado, et al., 2002). However, these outcomes will be realistic and sustainable when financial services in the economy are efficient and sustainable.

Based on the foregoing, the financial sector reform has been implemented in Nigeria. The policy attempts to improve efficiency in the operation of formal financial institutions and harness the advantages associated with transactions that take place through markets and on market terms. Though, to the extent to which the policy has allowed a more favorable environment for financial deepening by creating a broader set of financial organizations (bank and non-bank intermediaries, credit unions and nongovernmental organizations, micro finance institutions), the policy has been successful. However, the successful acceleration of the process of financial deepening will require the closing of inefficiency gaps (the difference between the current rate of financial deepening and the potential/ feasible supply), the insufficiency gap (the difference between potential supply and legitimate demand for financial services), and the feasibility gap -the gap between legitimate demand and unrealistic political expectations or promises (Gonzaleez-Vega (2008)).

Given the de emphasis on state-owned banks and the market incentives associated with financial liberalization in Nigeria, there is the need for commercial banks in the country to be more proactive and efficient to exert the expected leadership role in the financial sector. Therefore this study examined the issue of inefficiency in lending services and its sources in commercial banks in Nigeria.

II. MATERIALS AND METHODS

The estimation of lending efficiency was accomplished with the use of Stochastic Frontier Model. The advantage of the method is that simultaneous estimation of the inefficiency score and identification of factors influencing inefficiency are possible. Moreover, the estimated efficiency scores were described with simple descriptive statistics.

A. *The Stochastic Frontier Model*

The stochastic frontier (Aigner et al. 1977; Battese and Corra, 1977; Meussen and Van den Broeck, 1977) model is one the econometric approaches to technical efficiency measurement. It is motivated by the notion that deviations from the production frontier may not be entirely under the control of the production unit under consideration. Thus, the model allows for technical inefficiency but also acknowledge the fact that random shock outside the control of producers can affect output. An appropriate formulation of a stochastic frontier model in terms of a general production function for a production unit at time (t) can be described as:

$$y_t = f(x_t, \beta) + V_t - U_t = f(x_t, \beta) + \varepsilon_t \qquad (1)$$

where is the scalar of lending output of the industry at time period t; x_t is a vector of K inputs of the industry at time (t); β is a vector of unknown technology of the industry to be estimated; V_t is a two sided random variables which are assumed to be independently and identically distributed as $N(0,\sigma_v^2)$ and independent of U_t which in turn are non negative random variables that account for technical inefficiencies in production and are assumed to be independently distributed as truncations at zero of the $N(m_t, \sigma_u^2)$ distribution.

The mean inefficiency is a deterministic function of p explanatory variables such that: $m_t = Z_t\delta$, where δ is a px1 vector of parameters to be estimated.

Following Battese and Corra (1977) if we allow $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\gamma = \sigma_u^2 / \sigma_u^2 + \sigma_v^2$, the inefficiency, $\square_t$ in equation (1) can then be specified as:

$$U_t = Z_t\delta + W_t \qquad (2)$$

where Wt is defined by the truncation of the normal distribution with mean zero and variance σ_u^2, Thus, the technical inefficiency of the industry at time t is

$$TE_t = \exp(-Ut) = \exp(-Z_t\delta - Wt) \quad (3)$$

In order to achieve this objective, it is necessary to decompose estimates of ε_t into separate estimates V_t of statistical noise and inefficiency $\square_t$ for each time. This requires distributional assumption on the two error components. Though OLS provides consistent estimate of all production parameters except the intercept term, a different estimation techniques are required to obtain a consistent estimate of the intercept and estimate of the technical efficiency of each producer. After the technology parameters, the second step is to obtain an estimate of efficiency. According to Aigner, Lovell and Schimdt (1977), the density function of ε_t is given by:

$$f(\varepsilon_t) = \frac{2}{\sqrt{2\pi(\sigma_u^2+\sigma_v^2)}}\left[1 - F\left\{\varepsilon_t \frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right\}\right] \exp \frac{-1}{2(\sigma_u^2+\sigma_v^2)} \varepsilon_t \qquad (4)$$

,

where F is a standard normal distribution function. Therefore, the likelihood function for a N sample of time is:

$$L(X,\varepsilon_t) = \left[\frac{2}{\sqrt{2\pi\sigma_u^2+\sigma_v^2}}\right]^N \prod_{t=1}^{N}\left[1 - F\left\{\varepsilon_t \frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right\}\right] \exp \frac{-1}{2(\sigma_u^2+\sigma_v^2)} \sum_{t=1}^{N} \varepsilon_t^2 \qquad (5)$$

Consequently, $Ln(L(X,\varepsilon_t))$ the second likelihood function is:

$$NLn(2) - NLn\left\{\sqrt{\sqrt{2\pi}(\sigma_u^2+\sigma_v^2)}\right\} + \sum_{t=1}^{N}\left[1 - F\left\{\varepsilon_t \frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right\}\right] - \frac{-1}{2(\sigma_u^2+\sigma_v^2)} \varepsilon_t \qquad (6)$$

And the conditional distribution of U_t given (Lovell et al. (1982) which contains whatever information yields about is given by

$$\frac{\sigma_u\sigma_v}{\sigma}\left[\frac{\frac{1}{\sqrt{2\pi}} \exp \frac{-1}{2}\left\{\frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right\}^2}{1 - F\left[\varepsilon_t \frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right]} - \varepsilon_t \frac{\sigma_u/\sigma_v}{\sqrt{\sigma_u^2+\sigma_v^2}}\right] \qquad (7)$$

B. *The Estimated Models*

In estimating technology of lending services, the associated technical efficiency and its determinants, lending services by commercial banks was construed as output of financial inputs such as demand deposits; savings and time deposits; foreign liabilities of the industry such as balances held for offices abroad, money at calls with foreign banks, loans and advances from banks outside Nigeria; loans from monetary authorities; and number of employees. Also, following Gonzalez-Vega (2003), the technical efficiency of banking industry is thought to be function of macroeconomic and banking industry specific variables. Thus, the inefficiency model was estimated as a function of a mix of macroeconomic and banking industry variables.

Furthermore, in estimating technology of lending by the industry, data obtained were fitted to both Cobb-Douglass and trans-logarithm functional forms with the view to selecting the functional form that best fit the data. Thus, stochastic Cob- Douglass function given by (8) was estimated.

$$Ln(loan)_t = Ln(A) + \beta_1 Ln(Demandep)_t + \beta_2 Ln(Timesav)_t + \beta_3 Ln(Feddep)_t + \beta_4 Ln(CBNloans)_t + \beta_5 Ln(Capital)_t + \beta_6 Ln(Branches)_t + \beta_7 Ln(Forliab)_t + V_t - U_t \qquad (8)$$

where: Ln is the natural logarithm of the corresponding variable; loan is the Demanddep represents total demand deposit of commercial banks, Timesav is the total time savings and foreign currency deposits held by commercial banks in Nigeria, Feddeposit is total federal government deposits in commercial banks, CBNloans is total loans and advances to commercial banks from Central Bank of Nigeria, Branches is the total number of commercial bank branches in Nigeria which serves as proxy for number of employees in period t, and $V_t - U_t$ are as earlier defined.

Similarly, the trans logarithm model given by (9) was estimated.

$$Ln(loan)_t = Ln(A) + \beta_1 Ln(Demandep)_t + \beta_2 Ln(Timesav)_t + \beta_3 Ln(Feddep)_t + \beta_4 Ln(CBNloan)_t + \beta_5 Ln(Capital)_t + \beta_6 Ln(Forliab)_t + \beta_7 Ln(Branches)_t + \beta_8 (Ln(Demanddep))^2_t + \beta_9 (Ln(timesav))^2_t + \beta_{10} (Ln(CBNloan))^2_t + \beta_{11} (Ln(Feddep))^2_t + \beta_{12} (Ln(Capital))^2_t + \beta_{13} (Ln(Branches))^2 t + \beta_{14} (Ln(Forliab))^2_t + \beta_{15} \{Ln(Demandep) * Ln(Timesav) * Ln(CBNloan) * Ln(Branches) * Ln(Forliab)\}_t + V_t - U_t \quad (9)$$

The deterministic inefficiency model simultaneously estimated with (8) and (9) is:

$$U_t = \delta_0 + \delta_1 Ln(REF)_t + \delta_2 Ln(NPL)_t + \delta_3 Ln(RES)_t + \delta_4 (INF)_t + \delta_5 Ln(CONC)_t + \delta_6 (GOVDEF)_t + W_t \quad (10)$$

Where REF is a dummy variable measuring financial sector reform with value of 1 in reform year, and 0 otherwise; NPL is the non performing loan portfolio of the bank; Res is total amount reserved by commercial banks with Central Bank of Nigeria; INF is inflation rate; CONC is the number of commercial banks in the country- this serves as a measure of bank concentration or competitiveness of the industry; GVTDF is the total value of loan to government in (t) period and serve as a measure of government fiscal deficit; and W_t is a deterministic error term.

In choosing the model that best represent the data, the likelihood ratio (LR) test was employed. In its linear form, the test statistic is expressed as:

LR = -2(Log likelihood restricted model- Log likelihood unrestricted model).

Where log likelihood restricted model is the log of the likelihood function of the restricted Cobb-Douglass stochastic frontier model; and, log likelihood unrestricted model is the log likelihood function for the unrestricted trans logarithmic model. The LR statistic has a mixed chi squared distribution with degree of freedom equal to the number of restrictions

C. *Source of data:*

All data for the study were collected from the Statistical Bulletin of the Central bank of Nigeria (CBN). The data spanned between 1960 and 2008. All the data were aggregate, yearly time series data on commercial banking sector and, except data on reform variable, all the data were measured in million Naira.

III. RESULTS AND DISCUSSION

The result (Table 1 and 2) revealed that commercial banks' lending in Nigeria is influenced by level of demand deposits in the industry's possession, amount the industry holds as time savings in both local and foreign currencies, the level of federal government deposits in the bank's possession, level of its foreign liabilities and its number of employees. However, the capital base of the industry as well as level of loans from Central Bank of Nigeria had no significant statistical influence on the industry's lending. Also, while the amount held as time savings in local and foreign currencies is most influential on the industry's lending services, increases in number of employees associated with increases in number of branches had negative influence on the industry's lending. The study further revealed that about 24% of the optimal lending capacity of the industry is presently wasted with increases in inflation and level of bad loans positively influencing lending inefficiency. However, increases in commercial banks' concentration were found to increase lending efficiency. Overall, the result implies that the lending services of the industry could be expanded by addressing the unproductiveness associated with its capital base and loans incentive from Nigerian monetary authority while its optimal lending capacity could be reached through strict inflation control, better risk asset management as the industry is given better opportunity to be more open.

IV. CONCLUSION AND RECOMMENDATION

The study concludes that: demand deposits, time savings held in local and foreign currencies and foreign liabilities of commercial banking industry in Nigeria positively influence the industry's lending with the amount held as time savings being the most productive input in loan creation; lending operation of commercial banks is characterized by a reasonable level of technical inefficiencies with non-performing loans and inflation being significantly responsible. The study recommends that the unproductiveness associated with the capital of the industry and loan incentive from Central Bank of Nigeria should be addressed as a way of making financial sector reform more effective on credit delivery in Nigeria.

TABLE I. MAXIMUM LIKELIHOOD ESTIMATE OF STOCHASTIC FRONTIER MODEL OF COMMERCIAL BANKS' LENDING IN NIGERIA (1960-2008)

Variable	**Cobb-Douglass Model**		**Trans logarithm Model**	
	Coefficient	**t value**	**Coefficient**	**t value**
Constant	3.31***	4.51	-0.36	-0.38
Ln(Demandep)	0.48***	3.38	-0.79	-1.06
Ln(Timesav)	0.62***	2.78	1.38**	1.78
Ln(Feddep)	0.06***	2.81	-0.03	-0.45
Ln(CBNloans)	0.01	0.36	-0.07	-1.38
Ln(Capital)	0.00	0.03	-0.04	-0.14
Ln(Forliab)	0.19***	6.30	0.02	0.15
Ln(Branches)	-0.66***	3.35	0.61	2.63
$(Ln(Demandep))^2$	-	-	0.07	1.45
$(Ln(Timesav))^2$	-	-	-0.04	-0.67
$(Ln(Feddep))^2$	-	-	0.02	3.45
$(Ln(CBNloan))^2$	-	-	0.02**	1.73

$(Ln(Capital))^2$	-	-	-0.02	-0.84
$(Ln(Forliab))^2$	-	-	0.02	1.20
$(Ln(Branches))^2$	-	-	-0.05***	-4.78
Interaction term†	-	-	-0.00***	-5.08
INEFFICIENCY MODEL				
Constant	1.70	1.05	0.19	0.19
REF	-0.10	-0.15	0.43	0.45
Ln(NPL)	0.11**	2.04	0.05***	3.46
Ln(RES)	0.12	1.07	0.03	0.63
Ln(INF)	0.58**	2.00	0.09	0.95
Ln(CONC)	-1.39***	2.76	-0.30	-1.10
Ln (GOVDEF)	0.05	0.38	0.03	0.21
σ^2	0.29	2.01	0.12	5.32
Λ	0.99	55.90	0.89	4.07
Log likelihood value	10.90		6.75	
LR	-8.24			

† –Implies (Ln(Demandep) * Ln(timesav) * Ln(Feddep) * Ln(CBNloan) * Ln(Capital) * Ln(Branches) * Ln(Forliab))

***(**) significant at 1%(5%)

Source: Data analysis, 2010

TABLE II. DESCRIPTIVE STATISTICS OF TECHNICAL EFFICIENCY OF COMMERCIAL BANKS IN LENDING IN NIGERIA (1960- 2008)

Static	Score
Mean	0.76
Median	0.87
Standard Deviation	0.24
Skewness	-1.36
Kurtosis	0.79
Minimum	0.12
Maximum	0.97

Source: Data analysis, 2010

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