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MODELING COMMERCIAL BANKS' KEY DRIVERS FOR FUND MOBILIZATION IN NIGERIA USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

This study explores the core role driving the willingness of commercial banks to mobilise funds for economic development based on the Multilayer Perceptron (MLP) of the artificial neural network (ANN) technique. This approach allows for a nuanced understanding of interdependencies that traditional linear models may overlook, making it particularly suited for analyzing intricate financial systems in emerging economies like Nigeria. This study is critically supported by the Financial Intermediation Theory, which explains the role of financial institutions as intermediaries that facilitate the flow of funds from savers to borrowers. Data used for the analysis and prediction is purposively obtained from 10 commercial banks in Nigeria. The results show that financial institutions are mostly driven to mobilize funds because of their commitment to ensuring an adequate flow of money to serve the deficit sectors of the economy compared to any other underlying reasons. The prediction performs optimally with an r^2 value of 86.5% with a cubic predictability model of $\mathbf{0.328}\boldsymbol{Q} + \mathbf{0.63}\boldsymbol{R} + \mathbf{0.363}\boldsymbol{S} - \mathbf{0.361}\boldsymbol{T} - \mathbf{0.41} = \mathbf{0.568}\boldsymbol{P}$, and the Sum of Square Error (SSE) of 0.002 is minimal based on practice. This study is significant as it could enable financial institutions to make future role predictions relating to this concept in Nigerian settings or other settings analogous to Nigeria using the derived ANN model. These insights provide a basis for banks in Nigeria and similar economies to make strategic financial decisions, supporting the application of ANN models to predict and enhance financial institutions' roles in economic development.

Keywords: *Artificial Neural Network; Commercial banks; Economic development; Multilayer Perceptron; Nigeria.*

INTRODUCTION

Commercial banks mobilize financial resources to support economic development, especially in emerging economies like Nigeria. Financial institutions, particularly commercial banks, serve as intermediaries that channel funds from surplus units (savers) to deficit units (borrowers), facilitating economic growth (Olufemi *et al*., 2024). This study applies ANN particularly the Multilayer Perceptron (MLP) model, to investigate the factors driving fund mobilization efforts in Nigerian commercial banks. ANNs are computational models that mirror certain aspects of biological neural systems, offering robust predictive power for complex and non-linear relationships (Vijh *et al.,* 2020). The MLP, a feed-forward neural network, is well-suited for studying variables with hidden and interdependent relationships, as it maps weighted inputs to outputs through activation functions across multiple layers (Khan *et al.,* 2011; Mfetoum *et al.,* 2024).

To assess commercial banks' propensity to mobilize funds, this study considers four primary functions as variables: (1) ensuring fund flow to deficit sectors, (2) efficient allocation of savings, (3) provision of short-term financing, and (4) credit creation. Financial institutions are often called upon to support deficit sectors by directing funds toward areas of the economy with limited financial resources. Almansoori and Nobanee (2021) argue that this function is indispensable for achieving balanced economic growth, as it addresses liquidity gaps and fosters capital formation. Shahabadi and Jafari (2017) similarly posit that capital market resources channeled to deficit sectors significantly contribute to resilience and stability, enabling sustainable economic growth. The allocation of savings is another core function of banks that supports economic development. By identifying and funding entrepreneurs and productive ventures, banks ensure that savings are channeled into activities with high economic impact (Njoroge, 2024). This function is essential in emerging economies, where investment opportunities often lack adequate funding. Banks play a critical role in providing short-term financing, allowing businesses to manage working capital needs and address short-term liquidity issues. Venkatesan (2012) noted that short-term financing is crucial for maintaining business continuity, especially in sectors susceptible to cash flow fluctuations. Subbiah and Alagarsamy (2017) emphasize that financing is particularly beneficial for small and medium enterprises (SMEs), which drive economic growth but frequently lack access to long-term funding. On the other hand, credit creation is a fundamental banking activity that stimulates economic activity by increasing the money supply available for loans. Khan *et al.* (2011) explain that through credit creation, banks facilitate the financing of productive ventures, thereby increasing economic output and supporting job creation. In the Nigerian context, Onoh and Iheanacho (2017) underscore the importance of credit creation, noting that it helps bridge the gap between supply and demand in the financial sector, enabling more extensive economic participation.

ANNs, particularly the MLP model, are gaining attention for their adaptability and accuracy in financial contexts where traditional models may fall short (Pattnaik *et al.,* 2024). For instance, Mihaylova (2019) highlights the utility of ANN models in finance, emphasizing their ability to handle complex interdependencies in datasets that are often encountered in economic modeling. Artificial neural networks (ANNs) are computational models inspired by biological neural networks. ANNs are increasingly finding applications in economics and finance due to their ability

to handle nonlinear and intricate relationships within data, offering flexible and effective solutions (Mihaylova, 2019; *Vijh et al.,* 2020). Figure 1 shows the network architecture of ANN, particularly the MLP model.

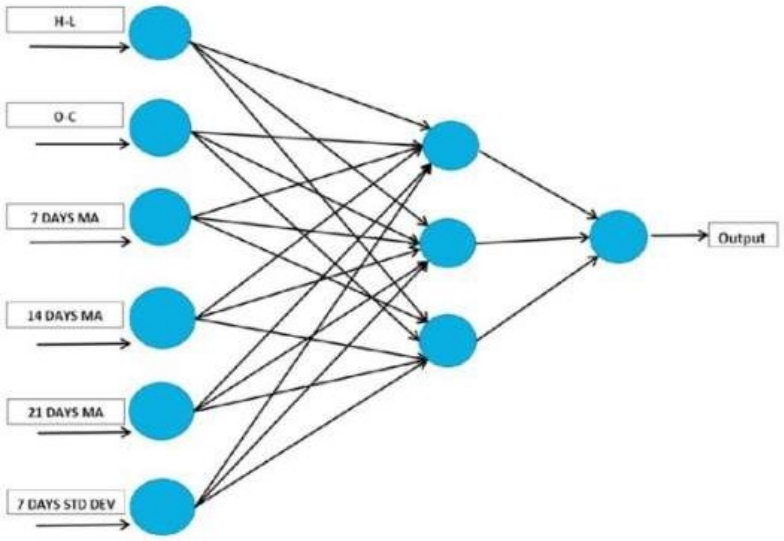

Figure 1: Architecture of Artificial Neural Network (ANN) (Vijh, 2020).

In this study, MLP is configured to model four major roles attributed to Nigerian commercial banks as financial intermediaries: ensuring fund flow to deficit economic sectors, effective allocation of savings, provision of short-term financing, and credit creation. This approach allows for a nuanced analysis of how each role influences banks' willingness and ability to mobilize funds for economic activities. The ANN model's capacity to adaptively weigh inputs and adjust through training enables it to capture the multifaceted influences affecting commercial banks' fund mobilization activities. By utilizing this model, this research provides insights into the main motivations behind fund mobilization in Nigerian commercial banks, which can help financial institutions optimize their economic contributions through more targeted financial strategies.

Previous studies highlight various factors influencing fund mobilization activities in commercial banks, such as market conditions, regulatory frameworks, and customer demand (Clò *et al.,* 2022; Hossain *et al.,* 2022). For instance, Uzoamaka and Nebo (2016) assert that Nigerian banks have an inherent role in sustaining economic growth by prioritizing sectors with the most significant capital requirements. Researchers like Shahabadi and Jafari (2017) argue that fund mobilization, achieved through commercial banking activities, directly contributes to economic resilience by maintaining liquidity for productive ventures. Similarly, Almansoori and Nobanee (2021) emphasize that ensuring an adequate flow of funds into deficit sectors is indispensable for stimulating growth and capital formation.

However, while prior research often explores fund mobilization through qualitative or statistical means, adopting predictive models such as ANNs in this context remains limited. ANNs, particularly MLP, have proven effective in economic and financial predictions, especially where linear models fall short due to complex variable interactions (Khan *et al.,* 2011; Mihaylova, 2019). Pattnaik *et al.* (2023) identified in their review that the BFSI (Banking,

Financial Services, and Insurance) sector has primarily adopted predictive modeling for specific issues, such as fraud and risk management, without exploring how these models interact with the practical constraints of financial institutions, including regulatory, economic, and infrastructural limitations. Applying MLP to study the roles of Nigerian financial institutions could address the implementation gap by providing insights that account for these constraints. Studies by Subbiah and Alagarsamy (2017) and Venkatesan (2012) reveal the potential of machine learning techniques in managing the non-linear and complex datasets typical of financial roles like fund mobilization. For instance, Radhakrishnan (2022) demonstrates how ANNs, by capturing hidden patterns within large datasets, offer a promising approach for complex predictions, making them highly relevant for studies on economic activities where traditional models might be inadequate. Sumi (2024) utilized artificial neural networks (ANNs) in forecasting liquidity risk in the Indian private banking sector, a critical issue emphasized by Basel recommendations for effective liquidity risk management. By developing and adopting a customized multilayer perceptron neural network, the author demonstrated that ANNs offer significant potential as a predictive tool, providing enhanced accuracy and timely insights into the Indian private banking sector and facilitating effective liquidity risk management. While literature exists on the individual functions of commercial banks and the application of ANNs in finance, few studies have integrated these two areas to analyze fund mobilization in a developing economy context. The current research bridges this gap by using the ANN model to predict fund mobilization based on specific bank roles, providing a novel analytical perspective. Although the foundational roles examined here are widely acknowledged in economic literature, this study's approach contributes a quantitative dimension to understanding how these roles collectively influence banks' fund mobilization efforts.

MATERIALS AND METHOD

Sampling

The study adopts a purposive sampling technique, selecting participants based on their relevance and expertise in the research context, specifically senior staff from ten commercial banks operating within Owerri Municipal Council in Nigeria. This sampling choice is grounded in gathering insights from individuals with substantial knowledge of fund mobilization practices within Nigerian banks, ensuring that the data reflects informed perspectives on the factors driving financial intermediation. By focusing on a targeted group, the study aims to achieve depth and accuracy in understanding the banks' motivations and operational priorities in fund mobilization. A total of 103 participants were chosen to ensure a diverse yet specialized respondent group that could provide reliable data on the banks' roles in economic development. Each participant was selected based on criteria such as years of experience, position in the organization, and direct involvement in financial decision-making processes related to fund mobilization. The researchers observed all ethical considerations regarding confidentiality or anonymity.

Research Instrument

The primary research instrument was a structured questionnaire designed to capture both the participants' perceptions and specific insights into the factors influencing fund mobilization in Nigerian banks. The questionnaire was developed on a four-point Likert scale, with response options ranging from "Strongly Agree" to "Strongly Disagree," enabling participants to express the degree to which they agree with statements related to fund mobilization roles. This

scale format ensures that responses are quantifiable, facilitating statistical analysis of the data. The questionnaire was divided into sections that aligned with the study's core variables:

1. *Ensuring Fund Flow to Deficit Sectors* - Questions targeted how banks prioritize channels for liquidity support to critical sectors in need.

2. *Efficient Allocation of Savings* - Items in this section assessed banks' practices in identifying and financing entrepreneurial or productive ventures.

3. *Provision of Short-Term Financing* - Questions examined the banks' role in providing short-term funds to businesses or sectors requiring immediate financial support.

4. *Credit Creation* - This section measured the degree to which banks engage in credit creation, assessing their focus on expanding lending to stimulate economic activity.

To validate the questionnaire, it was reviewed by two experts in measurement and evaluation from the Department of Educational Psychology, Alvan Ikoku Federal College of Education, Owerri. This expert validation process ensured that the questions had face validity (the questionnaire appeared to measure the intended factors) and content validity (the items adequately covered all relevant aspects of fund mobilization). This careful design and validation of the questionnaire aimed to enhance the reliability and validity of the data collected, enabling a robust analysis through the Artificial Neural Network (ANN) model.

Data Analysis and ANN Prediction

Data collected through the questionnaire were initially analyzed using weighted mean statistics to obtain the relative weight of the responses, which validated the parameters used as the predictor variables to be actual variables that demonstrate the impact of financial institutions on the economic development of the studied case (Nigeria). The output was then deployed for the intelligent prediction using the multilayer perceptron (MLP) ANN model. The MLP was used to predict the “impact of the activities of financial institutions on their willingness to mobilize funds for economic development”—denoted as “P.” The other roles that financial institutions (commercial banks), as reported by some authors, play were summarised into four themes, which served as the input variables (Subbiah & Alagarsamy, 2017; Venkatesan, 2012; Li, 2023). The input parameters included “Ensuring the adequate flow of money to serve the deficit sectors of the economy and facilitate the movement of funds among economic units", “Efficient allocation of savings through identification and funding of entrepreneurs", “Provision of short-term financingat low risk”, and “Credit creation by commercial bank activities,”—respectively donated as “Q”, “R”, “S”, “T”, were fed to the MLP as covariates with a standardized rescaling effect to predict “P”. The modeler was configured to automatically select an architecture for prediction with a hyperbolic tangent activation function for the network. Training was performed on batch modes with a scaled conjugate gradient optimization algorithm, with 90% of the datasets used for trainingwhile 10% were used for model testing/validation. The prediction accuracy was

evaluated in termsof the Sum of Square Error (SSE), while the prediction ability (predictability) was evaluated in terms of the coefficient of simple determination (r^2).

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistics of the predictor and predicted variables are presented in the histograms (Figure 2a-e). 103 participants were sampled from 10 banks (n=103).

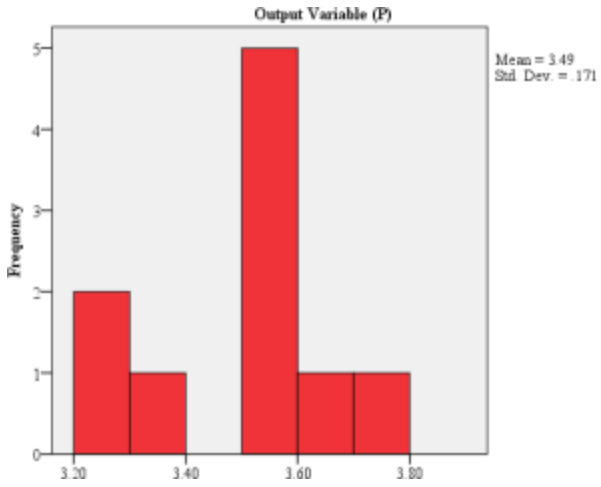

Figure 2a: Mobilization of funds for productive economic activities.

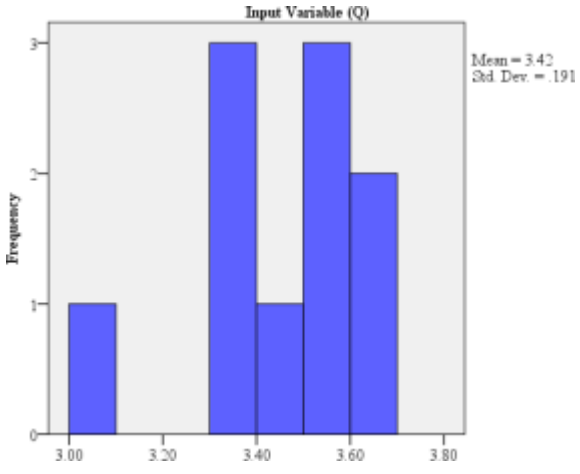

Figure 2b: Ensuring adequate flow of money toserve the deficit sectors of the economy andfacilitate the movement of funds among economic units.

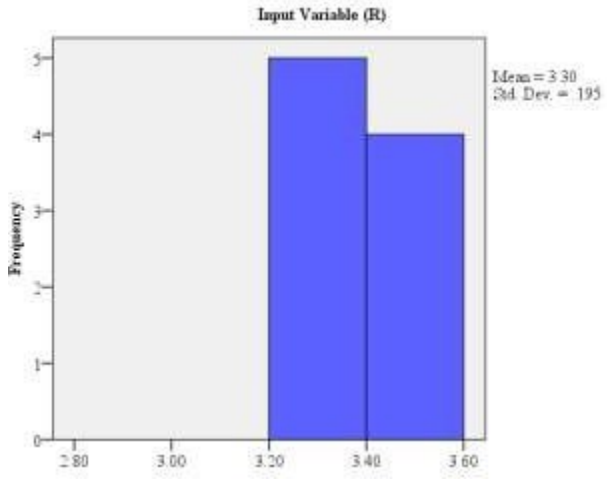

Figure 2c: Efficient allocation of savings throughidentification and funding of entrepreneurs

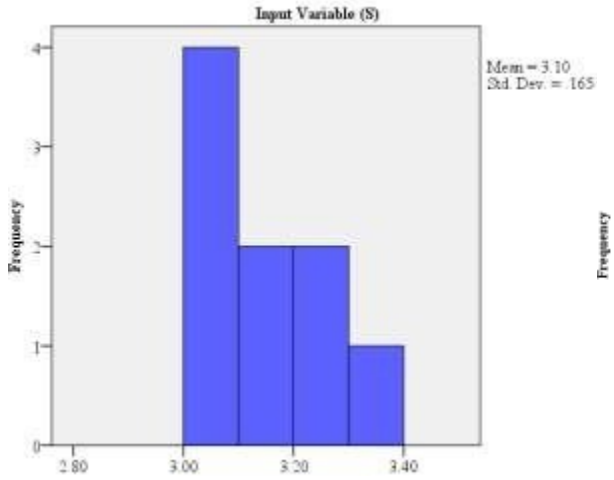

Figure 2d: Provision of short-term financing at bankactivities.

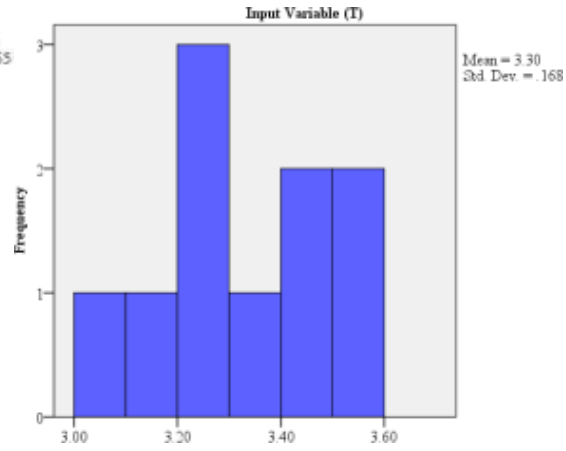

Figure 2e: Credit creation via commercial low risk

As seen from Figure 2a-e, the mean value of the weighted variables showed that variable P had the highest weight on average (3.49 ± 0.171), followed by Q (3.4 ± 0.191), and least in variable S (3.10 ± 0.165). Variables R and T, on average, have an equal-weighted mean of 3.30 ± 0.195 and 3.30 ± 0.168, respectively. This implies that the output variable having the greatest weight suggests a more significant coefficient for deciding the role and impact of financial institutions. The descriptive Statistics further showed that while the S role and T roles received equal affirmations and rebuttals, the views varied much more across the samples (banks) in the former than in the latter. It can, therefore, be concluded that participants gave different responses concerning the activities of commercial banks that impact fund mobilization for economic activities leading to economic development. This collaboration with literature is based on various researchers' linking the many roles of financial institutions to contribute to overall economic development (Li, 2023; Jacob *et al.,* 2023). For example, Shahabadi and Jafari (2017) remarked that the mobilization of financial resources through capital markets is one of the determining factors of economic growth and increasing gross domestic product. Almansoori and Nobanee (2021) believed that ensuring an adequate flow of money to serve the deficit sectors of the economy and facilitate the movement of funds among economic units, as well as efficient allocation of savings through the identification and funding of entrepreneurs, were very critical for economic development (Lusardi & Messy, 2023). Njoku (2023) maintained that financial institutions usually ensure an adequate flow of money to serve the deficit sectors of the economy. Also, when funded, entrepreneurs worldwide adopt sustainable business practices and development by prioritizing the need to serve cooperative societal needs,thereby providing solutions to unattained environmental and social needs.

Datasets used for the MLP prediction.

Table 1 is the dataset obtained from the responses of participants and the calculated weighted means, which were used as the predictor and predicted variables.

Table 1: Datasets for Network Training and Validation.

BANKS/ SCORE		**Zenith Bank**	**Fidelity Bank**	**Access Bank**	**First Bank**	**GT Bank**	**Union Bank**	**Eco Bank**	**FCMB**	**UB A**	**Polaris Bank**
					INPUT VARIABLE Q						
SA	68	10	3	10	12	6	3	2	10	9	3
A	20	2	1	2	3	2	2	2	2	2	2
D	8	1	1	1	1	1	1	0	0	1	1
SD	7	1	0	2	1	1	1	0	1	0	0
Weighted Mean		3.5	3.4	3.33	3.52	3.3	3	3.5	3.61	3.7	3.33
					INPUT VARIABLE R						
SA	57	8	2	8	10	5	4	2	7	7	4
A	26	3	1	3	5	4	2	1	3	3	1
D	16	3	1	3	1	1	1	1	3	1	1
SD	4	0	1	1	1	0	0	0	0	1	0
Weighted Mean		**3.36**	**2.8**	**3.2**	**3.41**	**3.4**	**3.42**	**3.25**	**3.31**	**3.3**	**3.5**
					INPUT VARIABLE S						
SA	55	9	2	9	9	5	3	1	7	7	3
A	22	2	1	2	6	2	2	2	2	2	1
D	13	1	1	1	1	1	2	1	2	2	1
SD	13	2	1	3	1	2	0	0	2	1	1
Weighted Mean		**3.29**	**2.8**	**3.13**	**3.35**	**3**	**3.14**	**3**	**3.08**	**3.3**	**3**
					INPUT VARIABLE T						
SA	51	7	2	7	10	4	2	2	7	7	3
A	36	6	2	6	6	2	4	2	3	3	2
D	11	1	0	1	1	2	1	0	2	2	1
SD	5	0	1	1	0	2		0	1	0	0

Weighted Mean		**3.42**	**3**	**3.26**	**3.53**	**3.2**	**3.14**	**3.5**	**3.23**	**3.4**	**3.33**
OUTPUT VARIABLE P											
SA	66	9	2	10	13	7	3	2	9	8	3
A	26	3	2	3	2	2	3	2	4	2	3
D	8	1	1	2	1	1	1	0	0	1	0
SD	3	1	0	0	1	0	0	0	0	1	0
Weighted Mean		**3.36**	**3.2**	**3.53**	**3.58**	**3.5**	**3.28**	**3.5**	**3.69**	**3.8**	**3.5**

The network model is configured for automatic selection of data points, which will be used fortraining (90%) and testing/validation (10%).

Network Architecture

Figure 3 is the network architecture of the prediction of the 4-input variables critically influencing fund mobilisation for economic activities (P).

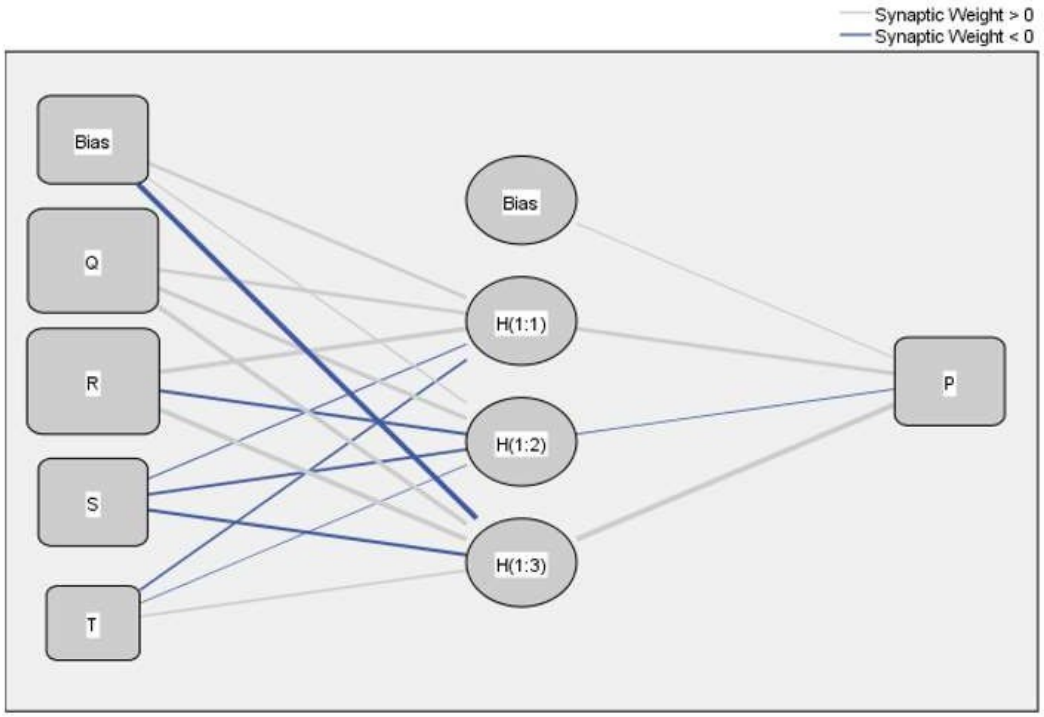

Figure 3: Network Architecture of predictor and predicted variables using the MLP model (Hiddenand Output layer activation functions is Hyperbolic tangent)

As observed in Figure 3, the input layer (4 variables plus bias), the hidden layer (one hidden layer comprising of 4 neurons), and one were able to predict the output (P). The degree of prediction of how each variable influences commercial banks' ability to mobilise funds for productive economicengagements is illustrated in Figure 4.

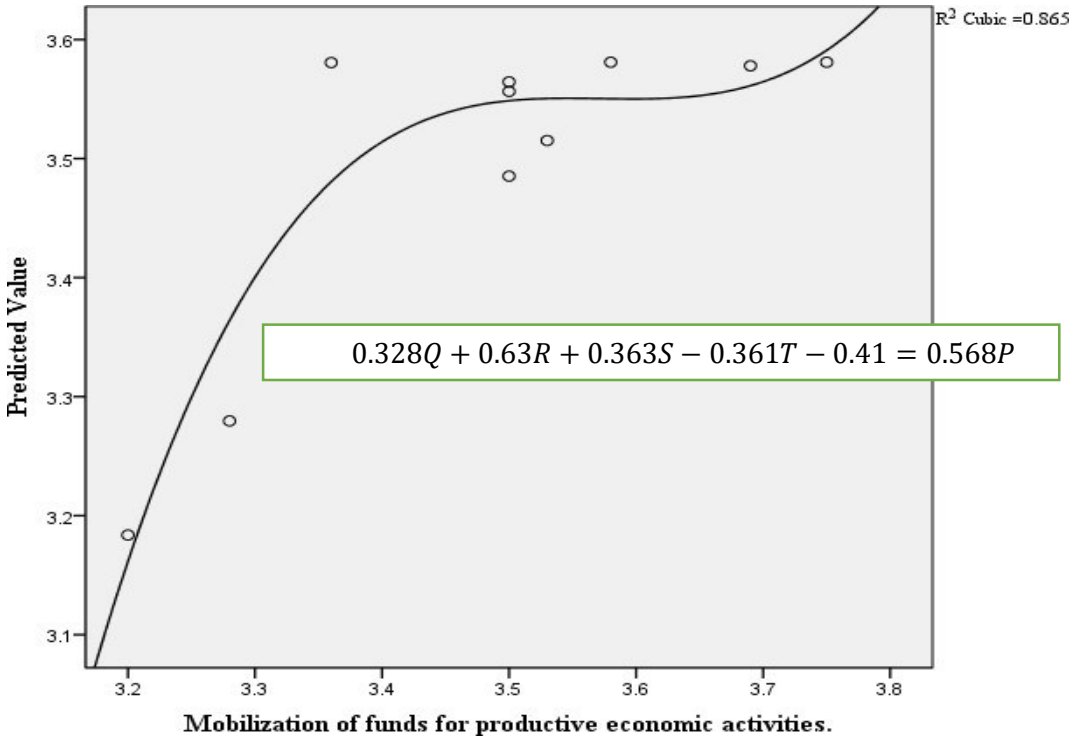

Figure 4: Prediction Performance of MLP

As shown in Figure 4, the MLP predicted financial institutions' mobilisation of fund ability best as a cubic function with a coefficient of simple determination of 0.865 (r2=86.5%). This means that the propensity of financial institutions to mobilise funds for economic activities could be reliably associated with their quest to meet some of their other roles, including ensuring an adequate flow ofmoney to serve the deficit sectors of the economy and facilitate the movement of funds among economic units, efficient allocation of savings through identification and funding of entrepreneurs,providing short term financing at low risk, and credit creation by commercial bank activities. The MLP model operates by adjusting the weights of these connections during training, refining its ability to predict outcomes as it minimizes errors over multiple iterations. This training process is especially valuable in financial settings where the variables interact non-linearly, as is often the case with fund mobilization determinants such as liquidity needs, credit extension, and short-term financing (Yang, 2024). Similarly, the prediction accuracy of the MLP after the testing phase is 0.022 (2.2%). This error value is minimal compared to the recommended maximum value of 7.45 (Radhakrishnan *et al.,* 2022), which shows the high reliability of the prediction of the output variable. Moreover, the predictability model (equation), which associates the variables, enabling ease for further predictions or measurements of affecting variables, has been generated. The high accuracy achieved by the MLP model demonstrates its suitability for analyzing financial data in emerging economies like Nigeria, where

economic variables often exhibit complex, non-linear relationships due to diverse market dynamics and regulatory conditions. The model's capacity to capture these intricate patterns enabled it to predict fund mobilization behavior based on nuanced factors, providing a reliable basis for decision-making. Recent research supports this approach, indicating that ANN models like the MLP are advantageous in handling large datasets with hidden patterns, particularly in the finance sector (Yang *et al.,* 2024). This model(Equation 1) can also be applicable in any setting where similar financial institutional roles are analogous or with similar economic situations like that of the study setting (Nigeria). The MLP model indicates that "Ensuring Fund Flow to Deficit Sector" is a top priority for banks, as it enables them to support economically essential but financially underserved sectors. This finding aligns with economic theories advocating that channeling funds to deficit sectors stimulates economic activity, helping to balance regional development and promote inclusivity (Islam, 2024).

$$0.328Q + 0.63R + 0.363S - 0.361T - 0.41 = 0.568P \quad (1)$$

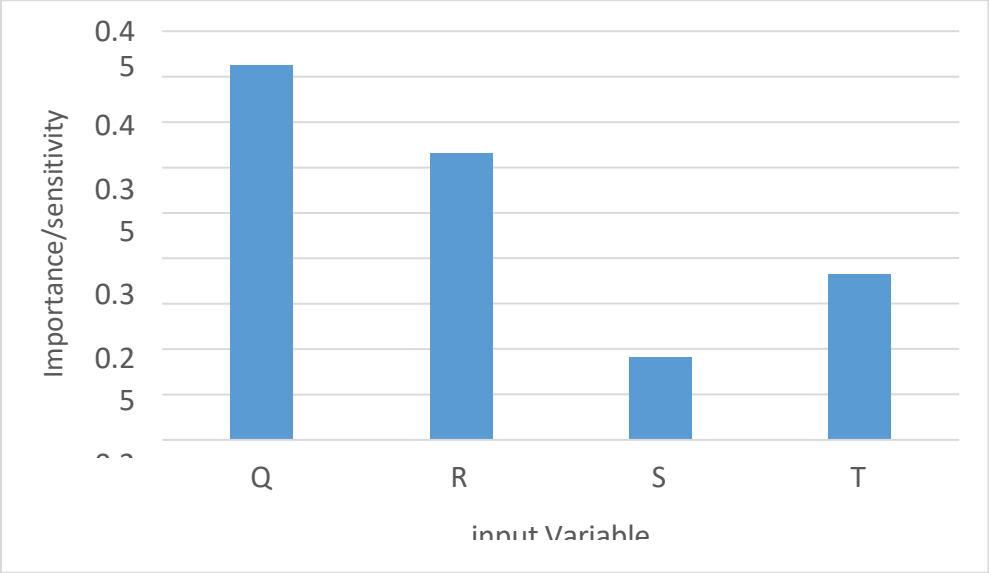

Figure 5: Sensitivity of the inputs in predicting the output.

The result (Figure 5) showed that the degree of independent importance or contribution of each of theinput variables Q, R, S, and T in determining the output (P) are in the order 0.412 (41.2%), 0.315(31.5%), 0.091 (9.1%), and 0.182 (18.2%) respectively. This means that financial institutions (commercial banks) in Nigeria are primarily driven to mobilize funds for economic development by their desire to ensure an adequate flow of money to serve the deficit sectors of the economy and facilitate the movement of funds among economic elements, followed by efficient allocation of savings through identification and funding of entrepreneurs. They, however, channel the least energy in providing short-term financing at low risks. The finding is complemented by the position of Oluyemis (2010), and

Wanzala and Obokoh (2024), who opined that the prime mover of the financial sector for economic development is the mobilization of savings from surplus to deficit economic units.

CONCLUSION AND RECOMMENDATIONS

This study investigates the key drivers behind fund mobilization in Nigerian commercial banks, utilizing an Artificial Neural Network (ANN) model to analyze complex, non-linear relationships among financial intermediation activities. The findings reveal that the primary motivations for banks' fund mobilization include ensuring liquidity flow to deficit sectors, efficient allocation of savings, short-term financing, and credit creation. The developed model follows a cubic function, with a predictability model/equation $\mathbf{0}.\mathbf{328}\boldsymbol{Q} + \mathbf{0}.\mathbf{63}\boldsymbol{R} + \mathbf{0}.\mathbf{363}\boldsymbol{S} - \mathbf{0}.\mathbf{361}\boldsymbol{T} - \mathbf{0}.\mathbf{41} = \mathbf{0}.\mathbf{568}\boldsymbol{P}$, which can assist future investigations within the location or other settings with comparable financial or economic operations. The high predictive accuracy (86.5%) of the Multilayer Perceptron (MLP) model indicates that these factors are reliable predictors of fund mobilization behavior, underscoring the value of AI in economic modeling. The following recommendations are worth noting:

(i) *Financial Institutions:* Nigerian banks and other emerging market financial institutions should consider integrating AI-driven predictive models like MLP in their strategic planning processes. By doing so, banks can better anticipate which sectors and customers require financial support, optimize resource allocation, and enhance operational efficiency. This data-driven approach can lead to more effective fund mobilization, improved profitability, and greater socio-economic impact.

(ii) *Policymakers:* The findings suggest that policy interventions promoting fund flow to deficit sectors and supporting efficient savings allocation can positively influence banks' roles in economic development. Policymakers are encouraged to create incentive structures, such as tax benefits or reduced regulatory barriers, to motivate banks to prioritize fund mobilization for underserved sectors. Additionally, adopting AI in policy planning can help regulatory bodies anticipate financial trends and develop responsive policies.

(iii) *Further Research:* Future studies should consider expanding the ANN model to include additional economic and social variables, such as inflation rates, customer behavior analytics, and industry-specific growth rates. These factors could deepen our understanding of fund mobilization dynamics in emerging economies. Comparative studies across multiple countries using similar AI models could also provide insights into cross-regional fund mobilization patterns and the scalability of these models.

The study's findings have several important implications for the banking sector, policymakers, and economic modeling. First, the high predictive accuracy of the ANN model illustrates that AI can reliably forecast fund mobilization activities, especially in complex economic environments like Nigeria. For banks, this demonstrates the potential of AI to enhance decision-making, enabling them to better support economic development by effectively channeling funds into key areas of need. From a policy perspective, the study underscores the importance of targeting deficit sectors and promoting efficient savings allocation to stimulate economic growth.

With the right regulatory support, banks could become even more proactive in mobilizing funds toward productive sectors, essential for addressing economic disparities and achieving sustainable growth. This study confirms that ANN models, particularly the MLP, are valuable tools for understanding and predicting the motivations behind fund mobilization. By adopting AI-driven strategies, financial institutions, and policymakers can make data-informed decisions that maximize their economic impact, supporting resilient and inclusive growth in emerging markets.

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