

Determinants and Forecasting of Islamic and conventional Banks Profitability in Pakistan by using Logistic Regression

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Keywords: Logistic Regression, Banks Profit, Return on Assets, Interest Rate

Journal Info:
Submitted:
June 9, 2024
Accepted:
March 20, 2025
Published:
April 26, 2025

Abstract

Banks' profitability has been an essential consideration for economists, investors, and researchers. It serves as a benchmark for the banking industry economy. In the previous literature, it was observed that an internal factor of Pakistan banks' profitability i.e. non-interest income was not included. This study examined in addition to other micro and macro factors, the non-interest income of banks' profitability in Pakistan. Data for the period 2007 to 2016 was obtained from State bank Pakistan and the Finance Division of Pakistan. Bank's profitability was measured by the return on assets taken as the dependent variable. An unusual technique for such studies, logistic regression was applied. Although, by default return on asset is a continuous variable it was converted to categorical by assigning "1" for profitable banks and "0" for the non-profitable bank. Results indicated that bank size, operating efficiency, and interest ratio have significant effects on the profitability of banks. Interest ratio and operating efficiency have a negative relationship with return on asset and the size has a positive effect on return on asset. It was found that non-interest income has no significant effect on banks' profitability.

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DOI: [10.21015/vtcs.v13i1.1822](https://doi.org/10.21015/vtcs.v13i1.1822)

1 Introduction

In today's world of globalization, the role of the banking sector cannot be limited to a specific country. Banks face greater risk during global crises as compared to other financial sectors of a country [1]. The presence of the financial sector is very important for economic growth and industrialization because it provides different financial services [2]. The banking sector is heavily responsible for the bulk of a country's economy. The banking sector provides funds to the industrial sector which are used for the economic growth and stability of a country. The banking sector also helps in reducing financial crises by offering different platforms for the country's economic system [3]. Keeping in view the important role of banks, the important determinants of bank profitability should



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be identified. Banks also play a key role in the economy's financial activities [4]. Efficient banks are better able to deal with negative shocks and help forecast the financial crisis [5]. The financial system is the backbone of our country; Pakistan is the modern world of capitalist economies. To boost up the real sectors of a country's economy, the financial system is used as a driving force and works as an engine for the development of a country. Pakistan has witnessed a great change from a government-owned to an advanced banking sector in the last two decades. The banking sector includes all commercial banks, Islamic banks, public sector banks, foreign banks, and financial institutions in Pakistan. The banking sector was opened in Asia for the first time during British colonialism, but after independence, the banking sector of Pakistan started growing widely. The first bank of Pakistan is the State bank of Pakistan (SBP). SBP is the central bank and is responsible for monitoring, regulating, and establishing rules for banks.

For the development and growth of a developing country like Pakistan, a strong financial system is needed. Keeping in view the role of the financial system in the economy of the country, it is important to know about the performance of the banking sector. The performance of the banking sector can be measured through its profitability which is important for long-term financial sustainability. The banking sector in a developing country like Pakistan serves the country in two ways. Banks encourage savings and provide financial support to the real economic sector for expansion and economic development. As a result, this expansion and economic development were produced to support to enhance the living standards of the poor population of the country. As there is the need to quantify the performance of the banking sector. of developing countries, corrective steps of banks should be taken [6].

1. To identify significant factors affecting banks' profitability
2. To identify the significant effect of the new internal factor of non-interest income on banks' profitability in Pakistan.

2 Literature Review

This part contains an overview of the different past research studies about determinants affecting banks' profitability. Research studies divided the determinants of banks' profitability into two parts that are external factors and internal factors [7]. Some studies included only internal factors and some researchers examined both factors. Several studies have been conducted to carry out the performance of the banking sector using different statistical techniques such as regression analysis, panel data analysis, ratio analysis, logistic, and hazard analysis.

According to [8], there is a vital role of the financial sector in the development of a country's economy while banks in Pakistan have been facing key challenges for the last few years. Therefore, it was significant to identify important factors affecting the profitability of banks in Pakistan. In their study, they included the performance of the top 10 banks for the period of 2004 to 2008 in Pakistan to analyze the internal factors only. The included internal factors were assets, deposits, equity, loans, and the profitability or performances of banks were measured by return on assets (ROA). The Pooled Ordinary Least Square method was used to investigate the effect of these factors on the ROA. Results of this research revealed that total assets might not influence high performance and the loans contribute well to the bank performance, but they remained insignificant in the study. Deposits and Equities were found to have a significant effect on the performance of banks.

[9, 10] conducted a study over the five Islamic banks in Pakistan for the period of ten years from 2006 to 2015 to find determinants of Islamic banks' profitability. Four explanatory i.e. Size, Liquidity, Inflation, and GDP, and one dependent variable return on assets were included in the study. Panel data analysis technique was applied to carry out the study. Both fixed effect and random effect were developed and both the models found the same results that liquidity and size have significant effects on return on assets. Size has a negative effect on Islamic

banks' profitability whereas liquidity has a positive impact on the Islamic banks' profitability. To select a suitable model, a Hausman test was applied and a fixed effect model was suggested.

[11, 12] investigated the internal determinants of banks' profitability of both private and public banks in Pakistan for the period from 2010 to 2017 using balanced panel yearly data. The explanatory variables were credit risk, capital ratio, bank size, credit deposit ratio, interest expended to interest earned, and capital ratio. The results of the random effect model showed that interest expended to interest earned and credit deposit ratio has a negative impact on return on assets. Bank size has a significant and positive relationship with return on assets.

[13, 14] tested how the liquidity risk management influences the performance of commercial banks in Pakistan based on panel data analysis. To achieve financial stability and goals, the financial market of Pakistan is mostly dependent on the banking sector. So, the overall country's economy is affected by the banking sector's profitability. Data for the years 2006-2019 were obtained on the site of State Bank of Pakistan. The data reviewed enabled concluding that the positive and significant impact of increased liquidity on the performance of the banks exists. More internal variables of the banking sector in Pakistan can be also used to contribute to this study. Further studies may include other non-commercial banks to further strengthen the study and increase its reliability.

[15, 16] studied that size and non-interest income have positive and significant impacts on the profitability of banks. [17] concluded that there is a negative relationship between bank size and return on asset as well as between operational efficiency and return on asset. [18] indicated that the interest ratio has a positive and significant effect on return on assets.

[19] analyzed the fact that the profitability of the Malaysian banks is greatly and positively influenced by size of banks. [20] indicated that the size and Banks profitability has a positive and strong correlation with liquidity of the bank. [21] found that the size of banks is a major determinant to ROA. [22] and [23] established the fact that liquidity is one of the most critical elements of bank profitability. [20] found that liquidity has a positive effect on the profitability of banks. [19] indicated that liquidity has no impact on banks' profitability. [15] analyzed the size, real interest rate and non-interest income to significantly and positively affect ROA. [18] concluded in their study that profitability is positively and directly affected by assets management, size, and operating efficiency. [9] used the panel data to establish that non-performing loans affect the profitability of banks negatively and significantly. [8] concluded that there is a good correlation between capital adequacy and the profitability of the banks. [5] indicated that real interest rates have a significant effect on the profitability of banks. [24, 25] evaluated the logistic regression and discriminant analysis to calculate the profitability of the financial firms and established that the rate of classifying the logit model was better than the discriminant model.

From the above literature, it is learned that one internal factor non-interest income is not included in the study in Pakistan. One of the statistical techniques, logistic regression was also not used in Pakistan for banks' profitability study. So, in this study, the non-interest income factor along with internal and external factors is added to the banks' profitability study using logistic regression.

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More internal variables of the banking sector in Pakistan can be also used to contribute to this study. Further studies may include other non-commercial banks to further strengthen the study and increase its reliability.

From the above literature, it has been found that banks' profitability can be evaluated by various methods like panel data analysis, logistic regression, discriminant analysis, hazard model, etc. So in this research, I used panel data analysis, logistic regression and discriminant analysis and compared the result of logistic and discriminant analysis.

3 Methodology

This section outlines the variables included in the study, the data sources used, and the statistical methods applied to analyze the relationship between various factors and bank profitability. Fig 1 illustrates methodology flowchart.



Figure 1. Flow Chart Of methodology

3.1 Variables:

The variables utilized in this study are carefully selected based on the existing literature and their relevance to the research question. The following are the variables considered, along with their definitions:

3.1.1 Return on Assets

Return on assets (ROA) is a popular financial measure which measures the efficiency of a bank to make profit out of its assets. It is computed by dividing the net profit by the total assets of the bank which is given in a percentage form. Even though ROA is a continuous variable, to fit it in the logistic regression model, it is categorised into a categorical variable by defining profitability using binary terms. A bank that has a positive ROA is said to be profitable (denoted by 1) and a bank that has a negative ROA is said to be non-profitable (denoted by 0). The given transformation allows applying logistic regression, which is suitable with the categorical dependent variables.

3.1.2 Non-Interest Income to Total Assets:

This ratio tells how much money a bank is making on other activities other than the normal income-generating activities of the bank like interests, commissions, fees, as well as trading income. It is determined by taking the non-interest income to the total assets of the bank. The variable is used to determine the diversification of the sources of income and how they may affect the profitability.

3.1.3 Interest Ratio:

Interest ratio is the cost of debt of the bank. It is calculated as interest paid to depositors/learned interest on loans and other interest generating activities. A below interest ratio will indicate a better cost structure which may result in improvement in profitability. The ratio of interest paid divided by the interest received is the interest ratio.

3.1.4 Liquidity Ratio:

The liquidity ratio shows the ratio of the assets of a bank which can be easily converted into cash or are very liquid. This is the ratio that shows how the bank can cover the short-term liabilities without having to incur too much loss, which is vital in stabilizing the bank and making it to be profitable.

3.1.5 Credit Risk:

The ratio of non-performing loans (NPLs) to gross advances represents credit risk. An increase in the NPL ratio will mean an increase in the credit risk, which will be detrimental to the profitability of the bank since the bank is likely to experience loan defaults and financial instability.

3.1.6 Size:

Bank size is a very important factor that determines profitability and is considered by the total assets that the bank possesses. The economies of scale may work to the advantage of larger banks and they are more likely to be efficient and profitable in their operations.

3.1.7 Operating Efficiency:

Operating efficiency is the measure of how well a bank management can decrease its costs in terms of its revenue generation. The cost-to-income ratio usually represents this variable and a smaller ratio means greater operational efficiency and this could positively affect profitability.

3.1.8 Capital Adequacy:

Capital adequacy is a necessary indicator of the financial strength of a bank. It is calculated as a ratio of the total equity to the total assets. An increased capital adequacy ratio implies that the bank has more capital base which may lead to increase in its capacity to withstand losses and remain profitable.

3.1.9 Asset Compositions:

Asset composition is defined as the combination of assets of a bank especially the amount funded by debt. An increased proportion of debt might lead to an increment in financial risk, which might lower profitability.

3.1.10 Real Interest Rate:

Real Interest rate = Nominal Interest rate - Inflation (An Expected or Real) The actual interest rate is obtained by subtracting the inflation rate with the nominal interest rate. It is the actual expense to borrow or the rate of investment, factoring in the inflation.

3.1.11 Exchange Rate:

The exchange rate is the rate of one currency in comparison to the other. The exchange rates may go up and down affecting the profitability of banks that had international transactions or currency trading.

3.1.12 Money Supply:

Money supply is the sum of money in an economy which is in circulation that comprise currency, bank deposits, and other liquid instruments. The interest rates, inflation, and even activity of the economy can be affected by any changes in the money supply hence the profitability of the banks.

3.2 Data Collection

The statistics in this paper were obtained in the State Bank of Pakistan and the Finance Division of Pakistan between the years 2007 and 2016. All the variables in the dataset are a mix of microeconomic (bank-specific) and macroeconomic variables that can be used to analyze the profitability. The data of 124 banks (including 62 profitable banks 62 non-profitable banks) is used in the study (with negative ROA). This balanced data gives an opportunity to make a solid comparison of various types of banks in terms of profitability.

3.3 Statistical Method

For the analysis of factors influencing bank profitability, we employ logistic regression, which is well-suited for situations where the dependent variable is categorical (binary in this case, with "1" for profitable and "0" for non-profitable). Logistic regression is a versatile statistical method that allows for the analysis of both continuous and discrete independent variables, making it an ideal choice for this study.

3.4 Logistic Regression Model

Logistic regression has the same objectives as the discriminant analysis. Logistic regression is used to identify the predictors which have an impact on the group membership in the response variable [29]. Like discriminant analysis, logistic regression can classify other observations into pre-defined groups. The simplest form of the logistic regression model is

$$(Y) = \log \log(\text{odds}) = \ln \ln \left(\frac{\pi}{1 - \pi} \right) = \alpha + \beta X \quad (1)$$

Taking the antilog on both sides of Equation (3.2), the equation is derived to predict the probability of occurrence of the outcome of interest as follows:

Where:

- π is the probability of the bank being profitable (ROA > 0),
- α is the intercept, and
- β_i are the coefficients of the independent variables (X_i) representing factors influencing profitability.

To derive the predicted probability of a bank being profitable, we apply the antilog transformation:

$$\pi = P(X = x) = \frac{e^{\alpha + \beta x}}{1 + e^{\alpha + \beta x}} \quad (2)$$

is the logistic regression model. This equation allows us to estimate the likelihood of a bank being profitable based on the values of the independent variables.

3.5 Model Evaluation

Assessing the Goodness of Fit of the Estimated Model To assess the goodness of fit for the logistic regression model, we use two key methods:

1. **Pseudo R-squared:** The use of pseudo R^2 is to assess the model fit. It is calculated as:

$$R^2 = \frac{-2LL(\text{null}) - (-2LL(\text{model}))}{-2LL(\text{null})}$$

Where:

- $-2LL(\text{null})$ is the log-likelihood of the model with no predictors (intercept only),
- $-2LL(\text{model})$ is the log-likelihood of the model with predictors included.

A larger Pseudo R^2 would represent a better fit and a value nearer to 1 would represent a good model.

2. **Classification Matrix:** The classification matrix is employed to test the predictive power of the model. It overlays the forecasted results and the actual results to calculate the percentage of accurate classifications. A high classification accuracy indicates that the model is effective in predicting bank profitability.

3.6 Data Split

For the purposes of model validation, 30% of the data (37 out of 124 observations) is held out as a test set. This ensures that the model's performance is evaluated on unseen data, providing a more robust estimate of its predictive power. The remaining 70% of the data is used for training the model.

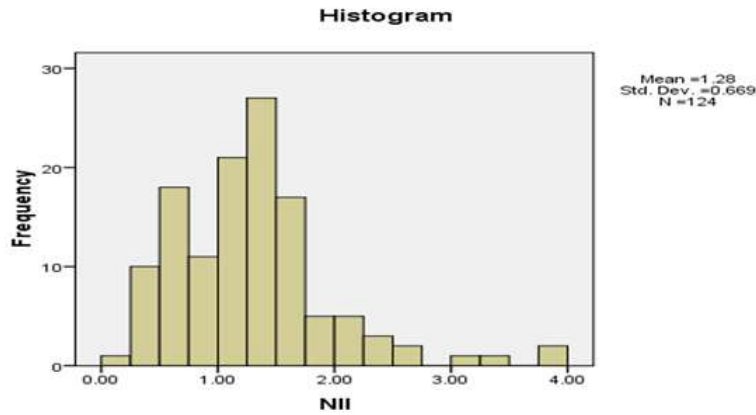
3.7 Comparison with Discriminant Analysis

In addition to logistic regression, the study also employs discriminant analysis to identify significant factors affecting bank profitability. Both techniques are compared to determine which model provides a higher classification accuracy. Discriminant analysis is similar to logistic regression in its objectives but differs in the assumptions it makes about the data distribution. By comparing both models, we aim to identify the best-fitting model for predicting bank profitability.

4 Results and Discussion

Before running logistic regression, it also requires some assumptions except the normality assumption. So first we examined the following assumptions. Multicollinearity was checked by using the variance inflation factor (VIF). A variable having a VIF value of more than 5 is to be considered a multicollinearity problem (TAY, 2017). Here the exchange rate and money supply have VIF values of more than 5 so these two variables were excluded to maintain the no multicollinearity problem in the data. By applying the Box Tidwell approach, it was found that all the predictor variables are linearly related to the logit of the dependent variable and hold the assumption of linearity.

Table 4.1 provides us with three significant variables: Interest Ratio, Operating Efficiency, and Logsize. The proposed model is given by:



$$(y) = 5.940 \cdot \log(\text{size}) - 0.101 \cdot \text{Operating efficiency} - 0.471 \cdot \text{Interest} \tag{3}$$

$$\pi = P(y) = \frac{e^{5.940 \cdot \log(\text{size}) - 0.101 \cdot \text{Operating efficiency} - 0.471 \cdot \text{Interest}}}{1 + e^{5.940 \cdot \log(\text{size}) - 0.101 \cdot \text{Operating efficiency} - 0.471 \cdot \text{Interest}}} \tag{4}$$

Logsize has a positive sign which indicates that Logsize has a positive relationship with the increasing probability similarly Operating Efficiency and Interest Rate have negative signs which indicate the negative relationship of operating efficiency and interest ratio with the predicted probability.

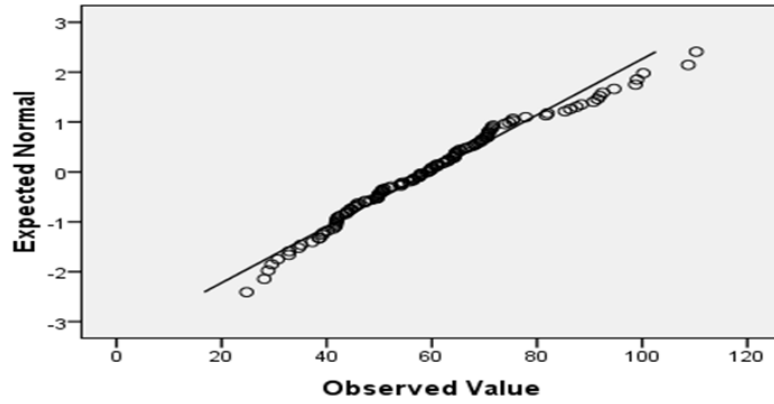
Table 1. Descriptive Statistics

Variables	ROA	Size (Millions)	NII	Interest	Liq	Asset	NPL	AC	Interest	Exchange Rate	Money Supply (Millions)	Operating Eff
N	124	124	124	124	124	124	124	124	124	124	124	124
Minimum	0	5.73	0.2	24.76	2.89	57.28	0.02	0.12	-5.08	60.6	4.06	8.88
Maximum	1	2507.18	3.97	110.28	27.76	99.49	95.2	50.22	8.32	104.8	12.82	136.06
Mean	0.5	351.68	1.29	59.64	9.64	87.14	19.56	12.62	1.42	83.61	6.73	39.87
Std Deviation	0.5	462.05	0.67	17.83	4.82	8.19	20.06	9.049	4.46	13.48	2.5	22.47
Skewness	0.00	2.21	1.35	0.56	1.42	-1.5	1.96	1.63	-0.3	-0.22	1.1	1.56
Kurtosis	-2.03	5.87	3.23	0.15	2.2	2.08	3.25	2.87	-1.26	-0.93	0.13	2.72

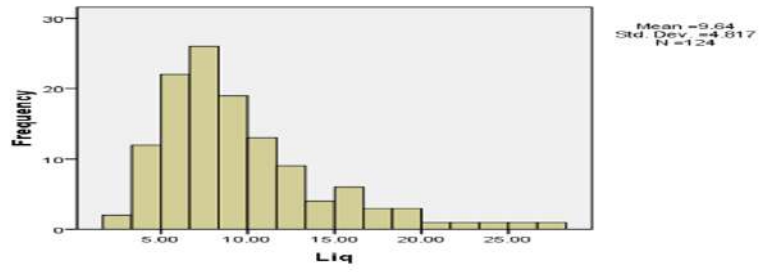
Logistic regression coefficients are quite different from the coefficients of the ordinary regression analysis and discriminant analysis. It is difficult to interpret the logistic coefficient in its original form because they are expressed in terms of logarithms when we use the logit as the dependent measure. For this reason, we transform the original logistic coefficient into exponential logistic coefficients because it becomes easier and does not need a logarithmic transformation. The transformed exponential coefficient will be interpreted as a change in odds with a unit change in the predictor. It is similar to logistic regression's coefficient but easier to comprehend. If the original coefficient has a positive sign, its transformed exponential coefficient value will become greater than 1 which would mean that a unit increase in the predictor will cause an increase in the odds of the outcome. Likewise, if the original coefficients have a negative sign its transformed exponential coefficient will be less than 1 and would describe that with a unit increase of predictor, the odds of the outcome occurring will decrease. If the transformed exponential coefficient is 1, it means that there is no change in the dependent variable.

In table , the transformed exponential value of the interest ratio variable is less than 1 which means that with the unit increase in the interest ratio, the odds of occurring bank profitability will come to decrease similarly

Normal Q-Q Plot of Interest



Histogram



Normal Q-Q Plot of Liq

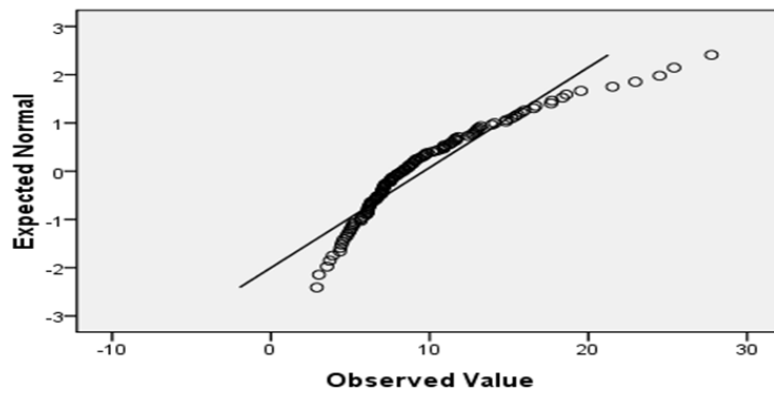


Table 2. Significant Variables

Predictors	B	S.E.	Wald	df	Sig.	Exp(B)
NII	3.042	2.086	2.127	1	0.145	20.956
Interest	-0.471	0.220	4.583	1	0.032	0.625
Liq	-0.573	0.300	3.645	1	0.056	0.564
Asset	-0.036	0.114	0.099	1	0.753	0.965
NPL	-0.070	0.141	0.251	1	0.616	0.932
AC	-0.063	0.091	0.483	1	0.487	0.939
Real Interest	-0.124	0.164	0.577	1	0.447	0.883
Operating Eff	-0.101	0.051	4.009	1	0.045	0.904
Logsize	5.940	2.816	4.448	1	0.035	380.028
Constant	-7.699	15.123	0.259	1	0.611	0.000

the transformed exponential value of operating efficiency is also less than 1 which indicates that with the unit increase of operating efficiency will decrease the occurrence of bank profitability. The value of the transformed exponential coefficient of log size has more than 1 which shows that the profitability of the bank will increase with the unit increase of log size.

Table below shows the classification result, among the 5 profitable banks 5 were chosen as profitable, and among 32 non-profitable 29 were chosen as non-profitable banks which implies that the accuracy rate of the logit model is fully 92 percent.

The literature shows that logit model has a greater probability of classifying profitability and non-profitability of financial firms as compared to the discriminant analysis. It was found that the discriminant analysis possesses higher classification rate compared to the logistic regression and has greater ability to be utilized in the classification of profitability of banks.

Interpretations of logistic regression coefficients are quite different from the coefficients of the ordinary regression analysis and discriminant analysis. It is difficult to interpret the logistic coefficients in their original form because they are expressed in terms of logarithms when we use the logit as the dependent measure. For this reason, we transform the original logistic coefficient into exponential logistic coefficients because it becomes easier and does not need logarithmic transformation. The transformed exponential coefficient is interpreted as the change in odds with the unit change in the predictor. It is similar to logistic regression's coefficient but easier to comprehend. If the original coefficient has a positive sign, its transformed exponential coefficient value will be

come greater than 1 which would mean that a unit increase in the predictor will increase the odds of the outcome. Likewise, if the original coefficients have a negative sign, its transformed exponential coefficient will be less than 1 and would describe that with a unit increase of the predictor, the odds of the outcome occurring will decrease. If the transformed exponential coefficient is 1, it means that there is no change in the dependent variable [30].

In table, the transformed exponential value of the interest ratio variable is less than 1 which means that with the unit increase in the interest ratio, the odds of occurring bank profitability will come to decrease similarly the transformed exponential value of operating efficiency is also less than 1 which indicates that with the unit increase of operating efficiency will decrease the occurrence of bank profitability. The value of the transformed exponential coefficient of log size has more than 1 which shows that the profitability of the bank will increase with the unit increase of log size.

5 Hosmer and Lemeshow Test

The Hosmer and Lemeshow test is used to diagnose the model fit. The model is to be considered fit if the Hosmer and Lemeshow test are insignificant, when the Hosmer and Lemeshow test is significant then it will indicate that the model is not well fitted. The P-value of the Hosmer and Lemeshow test is 0.999 and is insignificant so the model is fit.

6 Assessing Model Fit

There are two ways to assess the logistic regression model. One way is using pseudo R² (Nagelkerke R Square) and the second way is predictive accuracy (classification matrix)

7 Conclusion

In this study, one of the statistical techniques, logistic regression was used which is not used for banks' profitability in Pakistan. This technique is not applicable when the dependent variable is quantitative, In this case, we have a return on assets as the dependent variable which is quantitative, Due to logistic regression, we converted the return on the asset into the binary variable by assigning '1' to positive return on asset and assigning '0' to the negative return on asset. The result of the logistic regression is almost consistent with other studies. The new added internal factor non-interest income was found insignificant.

Author Contributions

Zahid Iqbal: Conceptualization, Methodology ,Supervision, Writing- Original draft preparation , Editing. **Saadat-ullah Khan:** Software, Validation, Writing- Reviewing and Data curation.

Compliance with Ethical Standards

It is declared that all authors don't have any conflict of interest. It is also declare that this article does not contain any studies with human participants or animals performed by any of the authors. Furthermore, informed consent was obtained from all individual participants included in the study.

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