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Macroeconomic Dynamics and their Impact on Bank Profitability

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Abstract

The study utilizes data from a diverse sample of 20 commercial banks operating in the Indian economy. The inflation rate, interest rate, and GDP growth rate are independent variables. Return on Assets and Return on Equity are the dependent variables. The panel data regression analysis allows for examining cross-sectional and time-series dimensions, facilitating an inclusive understanding of the relationship between macroeconomic variables and banks' profitability. The random effect model is utilized to control for unobserved heterogeneity. The results reveal a positive influence of GDP and inflation on banks' profitability, while interest rates do not significantly impact bank profitability. This study is unique in its exploration of how interest rates, inflation, and GDP affect Indian banks' profitability from 2011 to 2021. It finds that only inflation and GDP impact profitability.

Keywords: *GDP, Return on Assets, Macroeconomic variables,Inflation, Return on Equity*

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1. Introduction

Commercial banks have a major and diverse role in economic development. Commercial banks are essential in aggregating savings and directing these funds toward productive investments, stimulating economic growth and development. Banks benefit from a growing economy as it creates opportunities for increased lending and demand for financial services. Economic growth leads to increased business activities, investment, and consumption, generating a higher demand for credit and banking services. Banks can experience higher loan volumes, increased deposit inflows, and improved overall profitability as the economy expands. By growing their bank and generating non-interest revenue, banks can increase their profitability while lowering the ratio of lending to assets. A higher real interest rate can increase bank profitability (Haddad et al., 2022). Banks in financially developed economies, or those with high GDP, interest, and inflation rates, offer more attractive profit potential (Saif-Alyousfi, 2022).

A well-developed financial market with diverse instruments and products supports banks' growth. The larger the economic system, the less profitable the banks are (Ozili & Ndah, 2021). Regulatory frameworks and policies governing the banking sector significantly impact a bank's growth. Sound regulatory frameworks also contribute to financial stability, which is essential for sustained growth. Regulations encouraging transparency, risk management, and capital adequacy enhance banks' credibility and support their growth prospects. Economic factors such as economic growth, interest rates, inflation, financial market development, regulatory environment, technological advancements, demographic characteristics, and global economic integration all contribute to the growth and development of banks. Banks that effectively direct these economic factors can capitalise on opportunities, adapt to challenges, and drive sustainable growth in the dynamic banking industry.

2. Study Variables

Inflation can influence banks' profitability through several channels. High inflation rates may prompt banks to increase loan interest rates to maintain actual returns, potentially widening net interest margins and boosting profitability (Aulia & Arif, 2023; Dewi & Sudarsono, 2021). It can also spur loan demand as borrowers seek to hedge against rising prices. However, it may erode borrowers' repayment capacity, leading to higher default rates and increased provisions for loan losses, thus negatively impacting profitability (Alam et al., 2022).

Interest rates affect various aspects, such as net interest margins, loan demand, funding costs, asset quality, and investment income of the banks. When interest rates increase, banks can often widen their net interest margin by raising loan rates faster than deposit rates, which boosts profitability (Haddad et al., 2022). Negative interest rate policy influences the performance of the banking system (Molyneux et al., 2019); declining interest rates may squeeze net interest margin but can stimulate loan demand, offsetting margin pressures.

GDP positively influences bank profitability by driving loan demand and interest income during periods of economic growth, improving credit quality, and reducing loan defaults. Salike and Ao (2018) found that solid equity capital, operational efficiency, and the ratio of banking sector deposits to gross domestic product substantially improved bank profitability. GDP growth can stimulate investment banking activities and enhance market sentiment, indirectly benefiting banks by increasing fee income and investment returns.

Return on Assets (ROA) is a key profitability metric for banks, measuring how much profit they generate from their assets. It is one of the standard metrics to measure companies' financial performance in different sectors, namely supply chain (Galankashi & Rafiei, 2022) and human resource investments (Šebestová & Popescu, 2022). ROA reflects a bank's efficiency in using resources to create income and allows for competitor comparisons.

RoE measures how effectively a bank provides profit from shareholders' investments. A high ROE indicates

that the bank efficiently uses shareholder capital to create returns (Meng & Ugut, 2022). Ensuring sufficient equity is especially crucial for banks, given their reliance on it to uphold capital adequacy ratios mandated by regulators. This underscores the importance of the notable correlation between capital adequacy and return on equity (ROE), emphasising its significance (Ifeacho & Ngalawa, 2014). ROE also allows investors to compare profitability between banks and assess their potential for future growth based on their ability to generate returns on invested capital.

Research Questions

RQ 1: What is the relationship between specific macroeconomic variables and the Return on Assets of Indian banks?

RQ 2: How do fluctuations in macroeconomic variables impact the profitability of selected Indian banks?

3. Literature review, conceptual model and hypotheses development

A series of studies conducted by various researchers explored the complex dynamics influencing the banks' financial standing across diverse global landscapes (Chowdhury et al., 2022; Khan, 2022; Kumar & Bird, 2022; Jerish, 2021). Chowdhury et al. (2022) scrutinised Bangladesh's commercial banks, both Islamic and conventional, analysing their performance indicators and highlighting the subtle effects of macroeconomic, industry-specific, and bank-centric factors. Identically, Khan (2022) investigated the factors influencing banks' profitability in the Gulf Cooperation Council (GCC) nations, uncovering connections between bank size, GDP growth, and adverse effects from inadequate capital and poor asset quality. Meanwhile, Kumar and Bird's (2022) analysis of Chinese and Indian banks revealed the significance of cost management, bank size, and credit quality on profitability.

Bank Profitability and Macroeconomic Factors

Jerish (2021) emphasised the role of macroeconomic factors on Bangladeshi banks' profitability, contrasting the impacts of GDP growth and inflation. Patti and Palazzo (2020) emphasised how GDP growth affects European Union banks differently depending on their lending portfolios. Almaqtari et al. (2019) found that the profitability of Indian banks is significantly impacted by macroeconomic factors. Firm size, liquidity, asset tangibility, capital adequacy, leverage, and GDP growth boost bank profitability, while firm age and inflation have no significant impact (Isayas, 2022). COVID-19 negatively impacted Ugandan bank profitability in the long run. Short-run profitability declines with non-performing loans and liquidity risks, but it benefits from higher lending and treasury bill rates. Inflation has no significant effect (Katusiime, 2021). Gazi et al.(2024) examined the profitability determinants of Bangladeshi Shariah-based banks, finding that asset management quality, liquidity, and credit risk positively impact profitability, while capital adequacy, operational efficiency, and bank size have adverse effects.

Capital Adequacy, Bank Size, and Stability

Al-Qudah (2020) and Abdo et al. (2021) studied the influences on Islamic banks in Jordan, identifying significant impacts of capital and liquidity ratios. Alharbi (2017) found that capital ratio, GDP, and bank size have a positive impact on Islamic banks. Tennant and Folawewo (2009) highlighted factors impacting the banking industry in countries with low and medium incomes, and Tan and Floros (2012) focused on determinants of bank profitability in China. Higher non-performing advances and operating costs reduce Indian bank profitability, while non-interest income, interest income, capital adequacy, and GDP growth boost profits (Das & Uppal, 2021). Higher profits and capitalisation enhance Indian bank stability, while large size and high management costs reduce it; forex reserves boost stability, but unemployment weakens it (Kaur & Kaur, 2025).

Financial Inclusion and Income Diversification

Finally, Vu and Nahm (2013) emphasised the complex relationship between bank efficiency and various influencing factors. Financial inclusion, banking stability, macroeconomic factors, socioeconomic determinants, commercial banks, non-performing loans, profitability, capital adequacy, economic growth, monetary policy transmission, operating costs, bank resilience, and financial performance are key considerations in this domain (Khan & Sahu,

2025). Income diversification in Indian banks is positively influenced by bank size, technology, market competition, and inflation, while capital ratio, GDP, and financial intermediation ratio negatively affect it. Asset quality and liquidity ratio have no direct impact (Thakur & Arora, 2024).

Stock Market and Macroeconomic Linkages

Indian stock prices are strongly linked to macroeconomic factors like GDP, disposable income, and Foreign Institutional Investor (FII) participation, while interest rates, policies, exchange rates, and inflation negatively impact returns (Keswani et al., 2024). The Malaysian stock index (KLCI) shows a significant relationship with macroeconomic variables. Cointegration results indicate a long-term association, while VAR and IRF analysis reveal that the stock index responds negatively to money supply, inflation, and PPI. However, it reacts positively to exchange rate fluctuations (Mohnot et al., 2024)

Figure 1.

Theoretical model

4. Hypotheses Development

Investigating e-banking's impact on Bangladeshi banks' performance, focusing on Net Interest Margin, Return on Assets, and Return on Equity, suggests a positive contribution to Return on Equity with a two-year lag and raises implications for bank management and policymakers in developing countries (Siddik et al., 2016). In a fixed effects regression model, negative significant impacts are observed from credit risk, operating efficiency, and GDP growth rate on banks' ROE. The inflation rate demonstrates positive and statistically significant effects on both ROE and ROA, suggesting Islamic banks in Bahrain should fully leverage economies of scale and prioritise credit risk management, particularly in controlling and monitoring non-performing loans (Elseoud et al., 2020). The connection between a country's Gross Domestic Product (GDP) and the financial performance of banks is a crucial area of financial research. GDP serves as an indicator of fiscal health, and its fluctuations can significantly influence the Return on Equity (ROE)of banks either positively or negatively (Alharbi, 2017; Al-Qudah, 2020; Jeris, 2021; Ozili & Ndah, 2021; Patti & Palazzo, 2020). A robust GDP often correlates with increased economic activity, leading to higher loan demand and potentially enhancing ROE for banks.

H1: GDP has a significant positive influence on ROE

GDP and ROA

Examining how macroeconomic conditions directly impact company performance, mainly Return on Assets (ROA), while accounting for previous ROA and investigating the factors influencing profitability in Hong Kong and Singapore, considering prior profitability. Key indicators such as ROA, ROE, and Tobin's Q are used. Results confirm that company size, debt levels, and past profitability are significant predictors of performance (Cheong & Hoang, 2021). A model reveals a significant positive correlation between bank size and ROA, while operational efficiency and GDP growth are associated with lower ROA for banks (Elseoud et al., 2020).

H2: GDP has a significant positive influence on ROA

Interest rates and ROE

Several studies in the past have reported a direct link between the interest rate spread and bank effectiveness (Kabajeh et al., 2012; Musah et al., 2018; Pennacchi & Santos, 2021). For example, banks in Ghana experienced high profitability by charging high-interest rates on the loans offered. Despite reforms that enhance competition and efficiency in the banking sector to lower borrowing rates, these findings highlight Ghana's persistent high-interest rate spread (Musah et al., 2018)—relaxation of intra-state and inter-state bank branching rules in the 1980s and 1990s heightened bank competition. Also, banks benefited from under-priced deposit insurance. In such circumstances, banks aiming to maximise shareholder value would prioritise ROE

performance over EPS, reflecting managerial focus on ROE as a performance metric (Pennacchi & Santos, 2021). The pooled analysis of the three ratios of ROA, ROE, and ROI together revealed a solid and positive relationship with share prices (Kabajeh et al., 2012).

H3: Interest Rates have a significant and positive influence on ROE.

Interest rates and ROA

The correlation between bank performance and interest rates is essential to financial analysis. Interest rate fluctuations significantly impact a bank's return on assets (ROA) and equity (ROE). Credit risk and interest rate also significantly influenced ROA (Riaz & Mehar, 2013). The financial performance of banks can be enhanced by interest rates (Almaqtari et al., 2019; Haddad et al., 2022; Saif Alyousfi, 2022).

H4: ROA is significantly and favourably impacted by Interest Rates

Inflation and ROE

Analysing the influence of inflation rate changes on banks' performance is an important aspect of economic analysis (Fabian & Kočišová, 2023). Increased interest rates brought on by higher inflation may have an effect on borrowing costs and profitability indicators like ROE. Making wise financial decisions requires an awareness of and comprehension of this dynamic relationship between inflation and bank performance. Positive correlation exists between banks' profitability and Inflation (Abdo et al., 2021; Alfadli & Rjoub, 2020; Khan, 2022; Tan & Floros, 2012).

H5: Inflation has a significant positive influence on ROE

Inflation and ROA

Inflation is anticipated to have a favourable influence on ROA, similar to ROE. Discussions with credit officers and managers highlight that during high inflation periods, planning activities increase, contributing to effective asset utilisation (Khan et al., 2014). In times of inflation, central banks often raise interest rates to control escalating prices. Banks earn higher returns on assets, particularly on interest-bearing assets such as loans and securities. Also, inflation can inflate the value of banks' assets like real estate and securities, enhancing their overall return on assets (ROA). Anticipated inflation can also impact lending practices and interest rate spreads, potentially benefiting ROA when managed effectively. Additionally, moderate inflation tends to coincide with economic growth, fostering increased loan demand and economic activity, and boosting banks' returns on assets. The findings identified by previous authors strongly demonstrate a positive relationship between inflation and return on assets (Arifian & Noor, 2022; Maria & Hussain, 2023; Suseno & Bamahriz, 2017; Trang et al., 2021).

H6: Inflation and ROA have a positive relationship

5. Research Methodology

The study used balanced panel data from 2011 to 2021, covering 20 commercial banks in India, and ten private and ten public sector banks, chosen based on market capitalisation. Data from the World Bank's open data and Money Control platforms has been collected for examination. Our focus was on the dependent variables Return on Assets and Return on Equity, while adding independent macroeconomic variables: Gross Domestic Product, Inflation and Interest rate. The pooled Ordinary Least square method was applied to find out the significant relationship between macroeconomic variables and profitability. The choice of panel data analysis is justified by its ability to control for both cross-sectional and time-series variations, providing a more comprehensive understanding of the relationships compared to using cross-sectional or time-series data alone. This approach also addresses potential issues of omitted variable bias and endogeneity.

Table 1
Sources for Variables used

Variables used	Source
Gross Domestic Product	(Abadeh, 2018 ; Ali et al., 2018; Butt & Strtak, 2020; de Leon, 2020; Milhem & Yahya et al., 2017;)
Inflation Rate	(Jeevitha R et al., 2019; Hooshyari & Moghanloo, 2015; Senan et al., 2021; Sufian, 2012; Sufian & Habibullah, 2009)

Interest Rate	(Dineshbhai, 2022; Fabian & Kočišová, 2023; Musah et al., 2018; Sarfo-Kantanka et al., 2022; Sari, 2022)

6. Econometric Model

Using an econometric model, the effects of GDP, inflation, and interest rates are defined.

$$ROA_{it}=\beta_0 + \beta_1 GDP_{it} + \beta_2 INFL_{it} + \beta_3 INT_{it}+\epsilon \ldots(1)$$

$$ROE_{it}=\beta_0 + \beta_1 GDP_{it} + \beta_2 INFL_{it} + \beta_3 INT_{it}+\epsilon \ldots(2)$$

Where

ROA – Return on Assets

ROE – Return on Equity

GDP – Gross Domestic Product

INFL – Inflation

INT – Interest rate

7. Tools Used

Descriptive statistics were employed to gain initial insights into the data, followed by a unit root test to assess data stationarity, confirming the suitability of time series analysis.

The unit root test, specifically the Im, Pesaran, and Shin (IPS) test and the Fisher-type test (ADF and PP), was chosen for its ability to handle unbalanced panels and account for cross-sectional dependence, which are common in macroeconomic panel data. Pearson correlation matrix was utilized to find out the relationships between macroeconomic variables. Panel data regression analysis was used to

Panel data regression analysis to search the relation between macroeconomic variables and profitability of the banks. The choice between Fixed Effects (FE) and Random Effects (RE) models was determined using the Hausman test. The FE model controls for time-invariant unobserved heterogeneity, while the RE model assumes that the unobserved heterogeneity is uncorrelated with the regressors. The Hausman test helps decide which of these assumptions is more appropriate for the data. Chow test used to check the suitability of model selection. The Chow test assesses whether the coefficients in a regression model are the same across different groups. If the test rejects the null hypothesis, it suggests that a model with different coefficients for each group (e.g., fixed effects model) is more appropriate than a pooled model.

The suitability of model selection was verified using a Chow test, endogeneity was measured to differentiate fixed effect and random effect model using Hausman test. The Artificial Neural Network (ANN) model used to identify the non-linear relationship between macroeconomic factors and profitabilitiy measures of banks. The ANN model was selected to capture potential non-linear relationships between macroeconomic variables and bank profitability. ANNs are capable of modeling complex interactions and patterns that linear regression models may overlook. The specific architecture (e.g., number of layers and nodes) was determined through experimentation and cross-validation to optimize predictive performance.

8. Analysis and Results

8.1. Descriptive Statistics

Descriptive statistics were computed for Return on Assets and Return on Equity for the 20 commercial banks, and macroeconomic variables of the Indian economy were presented in Table 2.

Table 2
Descriptive Statistics

Variable	*GDP*	*INFL*	*INT*	*ROA*	*ROE*
Mean	5.4636	6.1528	4.36	0.5201	5.3678
Std. Dev.	4.0809	2.2795	2.5654	1.0255	1.0023
Kurtosis	4.2197	-1.1942	-0.4150	9.3686	6.5456
Skewness	-2.2627	0.4934	-0.7239	-2.0961	-2.2289

As illustrated in Table 2, on average, the total ROA of selected banks was 0.52%. Besides, the average inflation rate stood at 6.15% during this period. In terms of the real interest rate, banks maintained an average rate of approximately 4.36%. The average growth rate of the Indian economy over the years 2011-2021 was 5.46%. A standard deviation of 1.02 for Return on Assets suggests a certain level

of volatility in the bank's profitability and returns to shareholders, respectively.

8.2. Pearson Correlation among the Macroeconomic and Banking Variables

The result of the Pearson Correlation among the Macroeconomic and Banking variables is presented in Table 3.

Table 3

Correlation Matrix

	GDP	INFL	INT	ROA	ROE
GDP	1.00				
INFL	-0.13*	1.00			
INT	0.08	-0.43**	1.00		
ROA	0.23**	0.29**	-0.07	1.00	
ROE	0.22**	0.39**	-0.13*	0.93**	1.00

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

As per statistics in Table (3) majority of the variables have a negative or poor correlation. The correlation matrix reveals relationships between Gross Domestic Product (GDP), Inflation (INFL), Interest Rates (INT), Return on Assets (ROA), and Return on Equity (ROE). There is a weak negative correlation between GDP and inflation (-0.1335) and a weak positive correlation between GDP and interest rates (0.0774). Inflation and interest rates exhibit a moderately negative correlation (-0.4307), while both GDP and inflation moderately correlate positively with ROA and ROE. The positive correlation between macroeconomic variables and the Return on Assets of a bank indicates that changes in those macroeconomic factors tend to coincide with a higher Return on Assets for the bank.

8.3. Variance Inflation Factor

With the Variance Inflation Factor, regression analysis is carried out among the independent variables. For every independent variable in the model, the VIF is computed. Greater VIF values signify an increased level of multicollinearity, suggesting that the independent variable is strongly correlated with other independent variables within the model. Table 4 displays the Variable inflation factors of the independent variables.

Table 4

Variance Inflation Factor

Variables	VIF
GDP	4.90
Infl	1.68
Int	1.39

Table 4 illustrates the assessment of multicollinearity in regression analysis. In broad terms, a VIF equal to one indicates no correlation among the selected independent variables, while values between 1 to 5 suggest moderate correlation, and values exceeding 10 indicate high correlation. An increase in VIF corresponds to decreased reliability of the regression results. According to Hair et al. (2011), multicollinearity is considered present when the VIF value exceeds 5. The consideration of multicollinearity is a vital step in constructing the regression model. As illustrated in Table 4 the variables Inflation (1.68) and Interest (1.39) exhibit relatively low multicollinearity with GDP (4.90), which is generally acceptable in regression analysis. The VIF values were assessed to ensure that multicollinearity did not unduly influence the regression results. The moderate VIF value for GDP suggests that while there is some correlation with other independent variables, it is within an acceptable range and does not significantly distort the regression estimates.

Panel Unit Root Test

Panel unit root test used to determine the stationarity properties of variables in panel datasets. If variables are non-stationary, it can affect the validity and interpretation of the estimated coefficients. The results of the Stationarity test are shown in Table 5.

Table 5

Stationarity Test Result

Variable	Method	I(0)	I(1)
GDP	IPS	0.9607	0.0000*
	Fisher	0.9990	0.0000*
	LLC	1.0000	1.0000

Infl	IPS	0.3015	0.0001*
	Fisher	0.7167	0.0000*
	LLC	0.0000*	0.0941
Int	IPS	0.6845	0.0000*
	Fisher	0.9785	0.0000*
	LLC	0.9997	0.0000*
RoA	IPS	0.5075	0.0005*
	Fisher	0.6900	0.0001*
	LLC	0.0008*	0.9334
RoE	IPS	0.7900	0.0000*
	Fisher	0.9448	0.0000*
	LLC	0.1784	0.0000*

As shown in Table (5) the panel unit root test result indicates that all the variables achieve stationarity at the first difference, I (1). The finding that all variables are stationary at the first difference justifies the use of differenced data in subsequent panel regression analyses. This transformation ensures that the regressions are not spurious and that the estimated coefficients provide reliable estimates of the relationships between the variables.

Table 6

Chow Test Result

Redundant Fixed Effects Tests				
Test cross-section fixed effects				
Effects Test	Statistic (ROA)	Statistic (ROE)	d.f.	Prob.
Cross-section F	9.64008	5.25577	-19,197	0.0000
Cross-section Chi-square	144.626	90.2123	19	0.0000

Chow test results are presented in Table 6. The cross-section chi-square test with a statistic of 144.63 (ROA), 90.2123 (ROE) and a p-value of 0.0000 indicates strong evidence against the null hypothesis, suggesting significant differences in coefficients across various cross-sections or groups within the data. These results imply that employing fixed effects, which accommodate unique variations specific to each cross-section, might be more suitable than assuming uniform effects across all groups. Thus, considering the substantial evidence of differences in coefficients among groups, integrating fixed effects into the model appears warranted to capture the individual nuances present within each cross-section. The rejection of the null hypothesis in the Chow test provides a strong statistical basis for choosing a fixed effects model over a pooled model. This ensures that the regression analysis accounts for unobserved heterogeneity across banks, leading to more accurate and reliable estimates of the effects of macroeconomic variables on bank profitability.

Table 7

Hausman Test Result

Correlated Random Effects - Hausman Test			
Test cross-section random effects			
Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**
Cross-section random	0.00000	3	1.0000

The Hausman test, with a chi-square statistic of 0.00000 and a p-value of 1.0000, indicates that the differences in coefficients between the correlated random effects model and the fixed effects model are not statistically significant. This means that any variations in coefficients between these models are probably just random and not because of systematic differences. Both models (illustrated in Tables 6 and 7) give similar coefficient estimates, and as per the computed results, the correlated random effects model might be preferred for its efficiency (Islam, 2023). The result of the Hausman test justifies the choice of the random effects model for the panel regression analysis.

8.5. Panel Regression Analysis

Table 8

Impact of Macro factors on ROE & ROA

	RoE -t-statistic				RoA t-statistic			
Variable	**Coeff.**	**PLS Ests.**	**FE**	**RE**	**Coeff.**	**PLS Ests.**	**FE**	**RE**
C	-0.978	-4.444	-3.35	-3.744	-18.888	-4.643	-5.443	-4.966
GDP	0.068*	5.782	4.358	5.782	1.0121*	4.613	5.408	5.408
INFL	0.163*	6.965	5.25	6.965	2.895*	6.674	7.824	7.824
INT	0.026	1.295	0.976	1.295	0.208	0.543	0.637	0.637
R^2		0.568	0.166	0.26		0.231	0.167	0.292
Adjusted R^2		0.519	0.155	0.25		0.22	0.155	0.282
Prob (F-statistic)		0.000	0.000	0.000		0.000	0.000	0.000
DW stat		1.584	0.82	1.444		1.088	0.821	1.496

Variables with coefficients marked * are statistically significant at the 5% level.

When examining the impact of macroeconomic variables on profitability metrics like Return on Assets (ROA) and Return on Equity (ROE), consistent trends become evident. Gross Domestic Product (GDP) consistently exhibits a positive effect on financial performance, which agrees with (Kosmidou, 2008). For instance, considering ROA and ROE, a one-unit increase in GDP corresponds to an increase in profitability. However, the influence seems more pronounced on ROE compared to ROA. Specifically, for ROA, the coefficients for GDP range around 0.06, while for ROE, these coefficients are notably higher, approximately 1.01. This indicates a stronger relationship between GDP and the return generated on equity compared to assets. Inflation (INFL) similarly shows a positive correlation with profitability metrics. While it positively impacts ROA, its effect on ROE is notably stronger, which is consistent with (Almaqtari et al., 2019). For instance, the coefficients for INFL range around 0.16 for ROA, whereas for ROE, they are substantially higher, approximately 2.90. This suggests that changes in inflation rates have a much more considerable influence on the return generated on equity compared to assets.

On the other hand, Interest Rates (INT) demonstrate a relatively smaller impact and lack statistical significance across profitability metrics. The coefficients for INT are minimal, around 0.02 for ROA and approximately 0.21 for ROE, indicating that changes in interest rates have limited effects on both ROA and ROE, failing to establish a significant correlation with either financial metric, which resembles the results of (Cornellya et al., 2022).

The panel least squares method fits the data better, as shown by its higher R-squared and Adjusted R-squared values compared to other methods. These findings highlight the importance of considering GDP and inflation as key drivers of bank profitability in India.

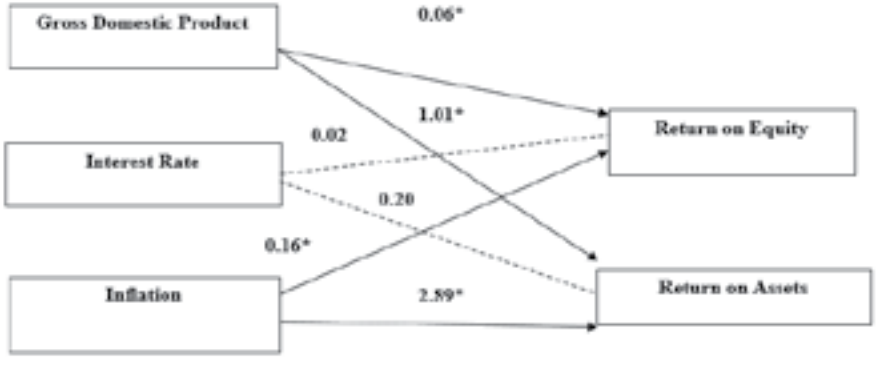

Figure 2 –

Empirical Model

8.6. Relationship between Macroeconomic Factors and Return on Assets

ANN model examines how economic factors like GDP, inflation, and interest rates influence Return on Assets by assigning weights to each factor. It suggests that higher GDP is generally associated with an increase in ROA, as indicated by the positive weight (0.321) in the Input Layer, although the negative weight (-0.417) in Hidden Layer 1 shows a more complex relationship. Inflation has a positive weight (0.178) in the Input Layer but a negative weight (-0.293) in Hidden Layer 1, suggesting a complex influence potentially moderated by other factors. Likewise, the Interest Rate shows a positive weight (0.391) in the Input Layer, indicating a possible increase in ROA with higher rates, but a negative weight (-0.438) in Hidden Layer 2, indicating a more complex relationship.

The scatter plot accompanying this diagram shows actual Return on Assets (ROA) values (likely ranging from around the values indicated in the Input Layer, -7.5 to 2.5) on the x-axis and the model's predicted ROA values on the y-axis. The weight estimates and the scatter plot together suggest that the model might perform better at predicting ROA for positive values, possibly due to the stronger influence of GDP and the complex interplay of Inflation and Interest Rate.

Network diagram Parameter Estimates for a Neural Network Predicting Return on Assets (ROA) presented in Figure 3

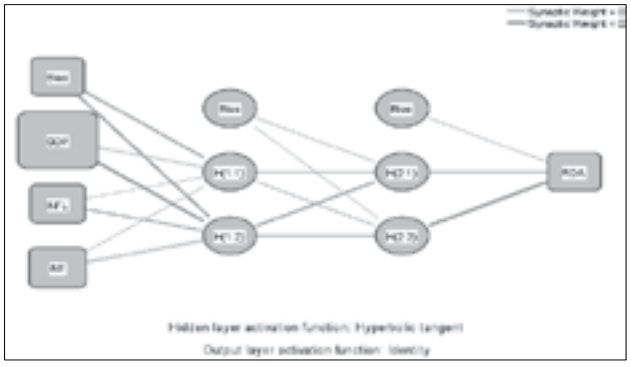

Figure 3.

Estimates for a Neural Network Predicting Return on Assets (ROA)

Parameter Estimates for a Neural Network Predicting Return on Assets (ROA) is presented in Table 9

Table 9

Parameter Estimates for a Neural Network Predicting Return on Assets (ROA)

Predictor		Predicted				
		Hidden Layer 1		Hidden Layer 2		Output Layer
		H(1:1)	H(1:2)	H(2:1)	H(2:2)	ROA
Input Layer	(Bias)	-.335	-.377			
	GDP	.321	-.417			
	INFL	.178	-.293			
	INT	-.012	.391			
Hidden Layer 1	(Bias)			.265	-.054	
	H(1:1)			.208	-.145	
	H(1:2)			-.347	.521	
Hidden Layer 2	(Bias)					-.113
	H(2:1)					.390
	H(2:2)					-.438

Predicted values presented in Figure 4

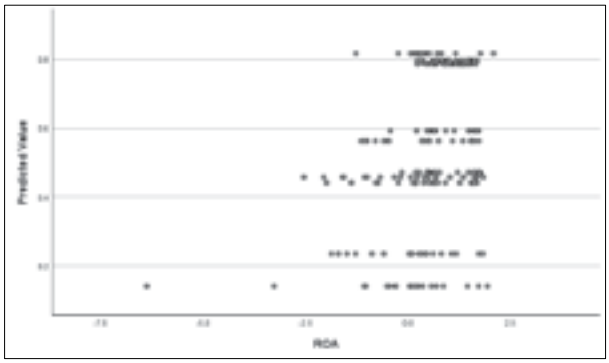

Figure 4.

Predicted Values

Independent variable importance is presented in Table 10

Table 10

Independent Variable Importance

	Importance	Normalized Importance
GDP	0.477	100.00%
INFL	0.253	53.10%
INT	0.27	56.70%

[insert Table 10 here]

Normalized importance figure shows that GDP as the influential factor for predicting Return on Assets (ROA) in this neural network model. Its normalized importance of 100% signifies a stronger influence compared to Inflation (53.1%) and Interest Rate (56.7%). While both Inflation and Interest Rate hold moderate importance, GDP emerges as the key driver of ROA predictions within this specific model. Normalized importance presented in Figure 5.

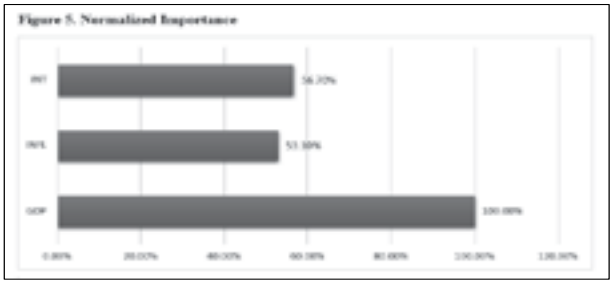

Figure 5.

Normalized Importance

8.7. Relationship between Macroeconomic factors and Return on Equity

This ANN model analyzes the relationship between economic factors and Return on Equity (ROE), assigning weights to factors like GDP, Inflation, and Interest Rates. It indicates that GDP and Inflation positively influence ROE, with respective weights of 0.685 and higher, while Interest Rate has a negative influence with a weight of -0.340. Inflation seems to wield the strongest influence with a weight of 0.984, followed by GDP. As GDP increases or inflation rises, ROE is likely to increase, but when interest rates go up, ROE tends to decrease.

The model portrays Inflation as the most influential factor on ROE prediction, followed by GDP, while Interest Rate has the least effect. The scatter plot shows actual ROE values (ranging from about -75 to 25) on the x-axis and predicted values (ranging from about -5 to 20) on the y-axis. There are distinct clusters, such as around 0 for negative ROE values and around 10 to 15 for positive ROE values. This indicates that the model predicts higher values for positive ROE and more scattered, generally lower values for negative ROE.

Network diagram Parameter Estimates for a Neural Network Predicting Return on Assets (ROA) presented in Figure 6

Figure 6.

Estimates for a Neural Network Predicting Return on Equity (ROE

Parameter Estimates for a Neural Network Predicting Return on Assets (ROA) is presented in Table 11

Table 11

Parameter Estimates for a Neural Network Predicting Return on Equity (ROE)

Predictor		Predicted				
		Hidden Layer 1		Hidden Layer 2		Output Layer
		H(1:1)	H(1:2)	H(2:1)	H(2:2)	ROE
Input Layer	(Bias)	-.238	-.244			
	GDP	.685	.680			
	INFL	.724	.984			
	INT	.269	-.340			
Hidden Layer 1	(Bias)			-.246	.171	
	H(1:1)			-.659	.073	
	H(1:2)			-.353	.285	
Hidden Layer 2	(Bias)					.061
	H(2:1)					-.832
	H(2:2)					.000

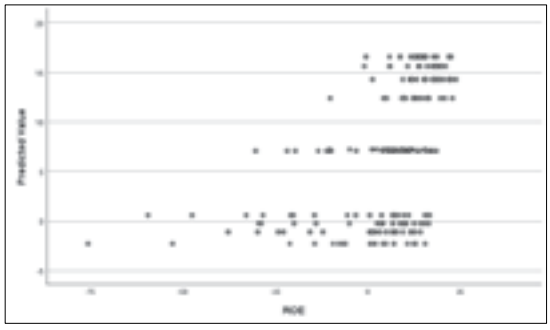

Figure 7.

Predicted Values

Independent variable importance is presented in Table 12

Table 12

Independent Variable Importance

	Importance	Normalized Importance
GDP	.414	78.3%
INFL	.529	100.0%
INT	.056	10.6%

Normalized importance chart highlights that, Inflation (100%) is the most critical factor for predicting ROE (Return on Equity) within this specific model. While GDP (78.3%) and Interest Rate (10.6%) hold some importance. Normalized importance presented in Figure 8.

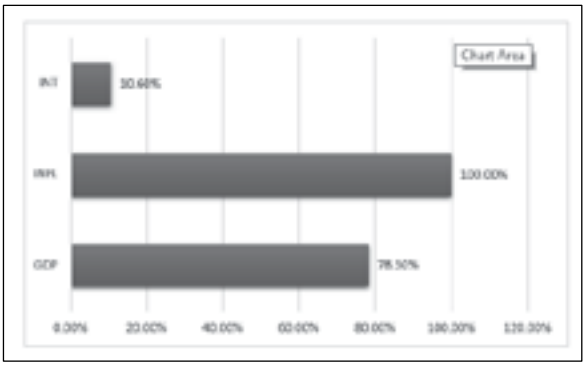

Figure 8.

Normalized Importance

9. Discussion

The banking sector plays a pivotal role in shaping the country's economy which serves as a significant mediator between the flow of capital and growth of various sectors. If we deeply look into the GDP, it is rising, and the inflation is fluctuating often, and it is very crucial for studying how these macroeconomic indicators influence the profitability of the bank. This is very important for the policymakers and top-level leaders of the industry. A bank is not only a lending centre; it is a financial health indicator of any country. The country's stability shall be assessed using the relationship between the profitability of the bank and the GDP, inflation, and interest rates. The present study shows that GDP and inflation are the most significant macroeconomic indicators which impact the bank's profitability. Since the GDP is rising, the demand for loans is increasing which shows a favourable environment, in turn showing a positive influence on the return on assets (ROA) and Return on Equity (ROE). This association shows that the banking sector is fuelling economic growth by providing the necessary financial sources during the change in the consumption basket. The analysis demonstrates a clear relationship between specific macroeconomic indicators and the profitability metrics of Indian banks, particularly in terms of ROA and ROE. GDP and Inflation emerged as significant factors affecting bank profitability. GDP positively correlated with ROA and ROE, indicating its strong influence on banking sector profitability. Similarly, Inflation showcased a positive association with ROA and a notably stronger impact on ROE, emphasizing its substantial influence on the return generated on equity compared to assets. Interest Rates demonstrated a relatively limited impact and lacked statistical significance across profitability metrics, suggesting a minimal influence on ROA and ROE. Despite being a critical macroeconomic factor, interest rates were not found to correlate strongly with the profitability metrics of the selected Indian banks which challenge the traditional view. These findings suggest that banks may be more resilient to interest rate changes than previously thought, possibly due to improved risk management practices. This finding aligns with the earlier example. After the 2008 crisis, managing GDP and inflation helped maintain profitability despite the challenges. India has not been significantly impacted by the financial turmoil in developed countries. (Mohan, 2008).

10. Theoretical implications

The theoretical implications of the study shed light on the complex connection between GDP growth rate, Inflation, and Interest rate on the profitability of Indian Banks. One of the essential contributions this study made was understanding the relationship between GDP and banks' profitability. Changes in GDP demonstrate an effect on bank profitability. Economic growth can lead to a surge in loan demand and improve asset quality, boosting profits. Increased

competition and inflation could affect the profit margins.

11. Practical implications

This study provides a logical connection between the macroeconomic indicators and the financial viability of banks in India. The analysis shows the significance of GDP and Inflation in impacting the performance of the banking sector, particularly in terms of ROA and ROE. These findings demonstrate the potential to bring a practical implication for decision-making and strategic planning within the industry. For leaders in this industry, this study clearly shows that trends in GDP and the forecast of inflation should be the prime indicators for profit optimisation. As per the earlier study conducted by Sarkar & Rakshit (2023), the study evidenced a strong association between GDP and bank profitability, which shows a need for macroeconomic stability to ensure the healthiness of the banking sector. Policymakers shall encourage the banks to adopt the AI-based advanced risk management tools which can predict how GDP fluctuations could affect the industry in terms of default risk and financial health.(Hassan et al., 2023; Milojević & Redzepagic, 2021)

12. Limitations

This study is having limitation in terms of narrow focus on a limited set of macroeconomic variables, namely inflation rate, interest rate, and GDP. The study period between 2011 and 2021 which covered only for a decade. The panel data analysis might have yet to explore the complex relationships.

13. Scope for Future Research

Future research could be incorporated with the variables namely exchange rates, unemployment rates, and fiscal policies. Advanced financial analysis like Structural Equation modelling and Machine learning shall be applied for forecasting. Future studies could also expand the sample of banks to ensure greater representativeness and applicability of the findings to the broader banking industry, thereby enriching the academic discourse on this topic.

14. Conclusion

This research work emphasizes the importance of economic indicators like GDP, interest rate, and Inflation in determining the financial results of banks and its impact on ROA and ROE. The correlation established in this study is useful for the stakeholders, policy makers and financial institutions. The results provide that there is a strong correlation between the GDP and the profitability of the banks which implies that the government should continue in attracting foreign direct investments and supporting new start-ups like how it is presently doing.

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