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Loan Portfolio Management and Bank Efficiency: A Comparative Analysis of Public, Old Private, and New Private Sector Banks in India

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Abstract: This comparative study analyzed the impact of loan portfolio composition on the efficiency of different types of banks in India—public sector, old private, and new private banks—in the period between 2013 and 2022. Efficiency was evaluated using data envelopment analysis (DEA). The study considered four loan variables—term lending, working capital, priority sector lending, and secured lending in proportion to the overall loans—as independent factors against the efficiency score as the dependent variable, using a random-effects generalized least squares (GLS) regression framework. The results indicate that there were no significant effects on the efficiency of old private banks, except for working capital, which had a marginally negative impact on bank efficiency. Working capital, priority sector lending, and term lending have been found to significantly impact the efficiency of new private banks. Only term and working capital loans significantly affected the efficiency of public sector banks.

Keywords: efficiency; data envelopment analysis; priority sector; GLS regression; Hausman; banking

JEL Classification: G21; G28

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1. Introduction

The Indian banking sector is a diverse landscape consisting of public sector, private sector, and foreign banks. Private banks are further classified as old and new private banks. Banks formed after the liberalization drive of the 1990s are considered new-generation banks. New-generation banks had the advantage of not being burdened with legacy issues and could seamlessly integrate technology into their operations. This advantage in technology helped these new-generation banks deploy innovative solutions with relative ease, thereby putting them at an advantage. The question of how these changes have impacted efficiency has been a fascinating question for researchers and there are a plethora of studies examining this aspect (Mahesh and Bhide 2008; Malik and Prakash 2008; Sensarma 2008).

The conventional belief is that private sector banks are likely to be more efficient; however, some earlier studies note that public sector banks outperform private banks (Mohan and Ray 2004). Interestingly, this finding also finds support in later studies that note that public sector banks do not lag behind private banks in efficiency (Mahesh and Bhide 2008; Patra et al. 2023). The reason for the counterintuitive finding could probably be that many of these studies were agnostic to differences between old and new private sector banks and often tended to treat all private sector banks as one homogenous entity. Are old-generation banks markedly different from their new-generation counterparts? Old private sector banks generally have a narrow geographical scope (Perera et al. 2012) and are burdened with old debts (Debasish 2006; Ismiyanti et al. 2018). Research conducted on the impact of new-generation private banks finds that the presence of new private banks could pose an existential threat to old private banks (Malik and Prakash 2008).

From the above discussion, it is clear that examining the differences among banks in terms of their categories merits further consideration. Banks are categorized in many

ways, including commercial banks, Islamic banks, and discount houses. Islamic banks have been found to be at par or much more efficient compared to conventional banks (Iqbal and Molyneux 2005; Johnes et al. 2014). However, the study is situated in the Indian context, where the main distinction is between old private banks, new private banks, and public-sector banks. We seek to examine the differences in efficiency between old private banks, new private banks, and public sector banks based on the composition of their loan portfolios. This study focuses on the composition of loan portfolios as banks have considerable autonomy in structuring their loan portfolios.

This study provides valuable insights to policymakers, thereby assisting them in devising strategies that align with the needs of the banking sector. Banks will benefit by understanding how varying their loan portfolio compositions will impact their efficiency and, interestingly, the results indicate that there are differences between public sector banks, new private sector banks, and old private sector banks in the way the loan portfolio is managed, and that new private sector banks are in general more efficient compared to public sector banks and their old private sector bank counterparts.

The paper is organized as follows: Section 2 covers the key scholarly output related to the topic, Section 3 presents the methods adopted in the study, Section 4 provides the results, and Section 5 offers a discussion of these results.

2. Literature Review

The literature review covers the institutions' hypothesis to highlight the relevance of studying different categories of banks. In addition, the resource-based view was examined. The literature covers four key themes: priority sector, secured, term, and working capital loans. Lensink and colleagues studied the institutions' hypothesis in terms of banking by examining whether foreign ownership affects efficiency. They examined data from 1998 to 2003 related to 2095 banks from 105 countries and arrived at the conclusion that foreign ownership tends to impact efficiency negatively, except that it is less pronounced in countries that are well governed (Lensink et al. 2008). The academic literature on bank efficiency is replete with interesting insights. We examined the scholarly output on bank lending and efficiency and found that fintech credit enhances bank efficiency (Le et al. 2021) and more to the point is the finding that large lending has an impact on efficiency (Andriakopoulos and Kounetas 2023).

We have already seen instances of how public sector banks tend to perform at par or better than private banks (Mahesh and Bhide 2008; Patra et al. 2023). An early study conducted in Germany notes that there is little substance to the argument that private banks are more efficient than public-sector banks (Altunbas et al. 2001). In the Vietnamese context, it has been found that public-sector banks outshine their private-sector counterparts (Le et al. 2021). It is pertinent to observe that some of the studies conducted in the Indian context did not differentiate between old and new private-sector banks.

In this regard, it is important to examine the impact of different types of lending on bank efficiency, and examining them within an institutional context will shed light on institution-specific factors that could influence bank efficiency. This study explores whether institutional factors have an impact on efficiency by examining how the loan portfolio across categories of banks tends to impact efficiency.

How do banks structure their loan portfolios? Loan portfolio composition is a crucial factor impacting profitability, and banks face an array of options when it comes to structuring their portfolios, with most of these choices revolving around balancing profitability with risk. The tradeoff between profit and risk is given by the following equation, which considers the net interest income as a proxy for profit and the risks associated with loan disbursements:

$$P = \Sigma_i(l_i \times r_i) - \Sigma_j(f_j \times C_j) - \Sigma_k(PD_k \times LGD_k \times EAD_k)$$

where P stands for profitability;

l_i represents the amount of the ith loan
r_i is the rate of interest for the ith loan;
f_j refers to the funds received from the jth source;
C_j refers to the cost of funds;
PD_k is the probability of default for the kth loan;
LGD_k is the loss, given a default occurs, on the kth loan;
EAD_k is the exposure, upon default, for the kth loan.

It is clear that there is a tradeoff between profit and risk. The desire to generate profits by taking risks is a real concern that bedevils banks, as they have to juggle between the need to ensure stakeholder satisfaction and the need to be sustainable in the long term. Although banks aim to allocate funds to projects that provide optimal returns taking into account the risk, their choices are constrained by regulatory requirements and other normative pressures. To foster socio-economic development, banks in India are mandated to set aside a portion of their funds for priority sector lending (Gaur and Mohapatra 2021), and 40% of the total credit must be disbursed to priority sectors. Priority sector lending is generally not profitable for banks (Seenaiah et al. 2015). Lending to these sectors entails a cost in addition to being risky; therefore, banks are constrained when it comes to pursuing opportunities to lend to more profitable sectors.

2.1. Priority Sector Lending

The operational cost of priority sector lending is on account of the fact that a large proportion of the credit created consists of low-value loans, and this entails transaction costs. In terms of risk, a recent study noted that priority sector lending does not cause a substantial increase in bad loans (Gaur and Mohapatra 2021). A comparative study of credit processes of public and private sector banks, conducted in the Indian context, indicated that private sector banks have better processes and sanctioning policies compared to public sector banks (Anis 2022).

In terms of the institutions' hypothesis, there are likely differences that exist among banks in their approach to priority sector lending, and the theoretical justification for this is the resource-based view theory, which propounds the idea that the manner in which a firm utilizes its resources and capacity impacts its performance (Wernerfelt 1984). This study proposes the following hypothesis to assess this viewpoint:

H1. *The impact of priority-sector lending on efficiency differs significantly between public-sector banks, old private banks, and new private banks.*

2.2. Secured Lending

Although the banking sector is highly regulated and banks are mandated to lend to priority sectors, they do have leeway when it comes to lending outside of the 40% that must be deployed to the priority sector. However, any form of lending is beset with risks, as information asymmetries are a part of any type of lending. These asymmetries arise because banks are unlikely to have access to information that the borrower is privy to. These asymmetries lead to the problem of adverse selection, whereby banks end up lending to borrowers with higher risk. Averting this would mean obtaining a higher amount of collateral to back the loans, but intense competition, generally, works in favor of borrowers, as banks tend to vie with one another to attract borrowers with the least risk.

Bank lending is, however, dependent on the capital available to banks (Peek and Rosengren 1995), but this capital is subject to constraints induced by Basel norms, which base capital requirements on the proportion of risk to weighted assets (Jacques and Nigro 1997).

$$K_{it} = \beta \; x \; RWA_{it}$$

where K is the capital requirement for bank 'I' at time 't', and β is the coefficient that translates the risk-weighted assets (RWAs) to assess the required capital, and RWA represents the risk-weighted assets of bank 'i' at time 't'.

On a relative scale, loans not backed by collateral entail a higher risk weight; therefore, banks must allocate more capital for these loans (Degryse et al. 2021). Thus, banks tend to price these loans higher to offset the risk and costs associated with these loans. However, there is a temporal component to this, as banks have to deploy funds at the earliest to maximize returns, and occasionally, this means investing in secured loans, which may not be the most efficient in terms of returns. Banks are also likely to prefer secured loans because of the incentives related to reduced capital requirements. There can be considerable differences among types of banks when examined from the perspective of the resource-based view. This aspect is explored in terms of the following hypotheses.

H2. *The impact of secured loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

2.3. Term Loans

A large component of bank lending may be in the form of term or working capital loans. Term loans have longer repayment windows and working capital loans are provided to cover the needs of the operating cycle and are usually short-term. In general, the proportion of term loans is higher than that of working capital loans. Private sector banks are considered to contribute significantly to businesses by offering term loans (Marinković and Minović 2019). Taking the resource-based view, we considered that differentials could exist in terms of efficiency among bank categories in so far as the manner in which the term loan and working loan components are structured.

H3. *The impact of term loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

2.4. Working Capital Loans

Liquidity preference theory rests on the premise that banks likely have a preference for liquidity, and in this sense, a higher proportion of working capital provides banks with a degree of flexibility compared to term loans, which are locked in for a longer period of time. The lending of working capital loans by banks arises concomitantly with the need for businesses to fund their working capital requirements. Firms must align their requirements with the expected outcomes in terms of prescriptive theory. In this sense, a study conducted on Nigerian banks showed the impact of working capital on bank profitability and efficiency assessed on the basis of return on assets (Osuma et al. 2018). This leads to the formulation of hypothesis four.

H4. *The impact of working capital loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

There is a relative lack of studies on the impact of working capital loan disbursements on the efficiency of banks, particularly in the context of different categories of banks.

3. Methods

3.1. Measuring Efficiency

Increased competition from new-generation banks has resulted in better customer service (Singh et al. 2016). These new-generation banks are critical for economic development, and this is particularly important when seen in light of the marked inefficiency of public sector banks (Gupta and Mahakud 2020). These findings are echoed in some studies that find that private-sector banks in India are much more effective and efficient than public-sector banks (Babu and Kumar 2018). However, there are studies with contrasting findings, noting that public sector banks may actually be more efficient (Srinivasan and Britto 2017; Tanwar et al. 2020). Bank efficiency in India is a complex and evolving subject, and the differences in findings can also be explained in terms of the variables and methods

used to estimate efficiency. Much of the work on productive efficiency is based on the work of Farrell who laid the groundwork for assessing productive efficiency (Farrell 1957).

Banks' efficiency can be assessed using parametric or nonparametric methods. One of the better-known parametric methods is the stochastic frontier analysis (SFA) method, which considers a functional form for the frontier. Data envelopment analysis (DEA) is the most popular nonparametric method and the advantage of this method is that it does not call for specifying a functional form. A study conducted on the effectiveness of SFA and DEA indicates that both methods are equally effective and that the choice of method is guided by the research requirements (Kumar and Gulati 2014). In this sense, it is pertinent to observe that DEA permits multiple inputs and outputs and is therefore appropriate for the assessment of bank efficiency, which has been used in multiple studies related to bank efficiency (Moutinho et al. 2021; Omrani et al. 2023).

3.2. Data Envelopment Analysis and Choice of Approach

The main research question concerns the impact of different credit formulations on the efficiency of different bank categories. As the research question revolves around a comparison of the impact of lending policy on efficiency for different banking categories, we proposed conducting the research in two stages. In the first stage, we obtained efficiency scores, and in the second stage, we used these scores as independent variables in the regression. Regression analysis was carried out on the variables identified as representative of the lending policy. For this purpose, we consider term loans, working capital loans, priority sector loans, and secured lending as proportions of overall loans.

Both input- and output-oriented models have been used in banking research. Banks do not operate on the same scale within the banking industry; they vary in scale to the extent that Basel norms classify some of the larger banks as systematically important (Venugopal 2023). Banker et al. (1984) proposed an appropriate DEA formulation that takes into consideration differences in scale. The variable returns to scale (VRS) approach permits the inclusion of size differentials among banks to assess DEA. Banks are nonhomogeneous in terms of their risks, sizes, and various other factors, and the VRS model permits a flexible approach that can adapt to the differences in the structures of the banks being studied. Given the diversity in size between banks in India, we consider the VRS model (Banker et al. 1984) as being the most appropriate model for the purposes of this study.

The DEA output model involves ascertaining how a decision-making unit (DMU) can maximize its output from a given level of inputs, which can be determined by the following derivation:

Maximize θ subject to the following:

$$\text{Constraint 1 } \Sigma_{J=1}^{n} \lambda_j y_{rj} \geq \theta_{yr_0} \text{ for all } r = 1, 2 \ldots\ldots s \text{ (output adequacy)}$$
$$\text{Constraint 2 } \Sigma_{J=1}^{n} \lambda_j x_{ij} \leq x_{i0} \text{ for all } i = 1, 2 \ldots\ldots m \text{ (input conservation)}$$
$$\text{Constraint 3 } \Sigma_{J=1}^{n} \lambda_j = 1 \text{ (convexity)}$$
$$\text{Constraint 4 } \lambda_j \geq 0 \text{ for all } j = 1, 2 \ldots\ldots n \text{ (non-negativity)}$$

θ represents the efficiency score of DMU0
y_{rj} is the amount of the rth output produced by the jth DMU;
x_{ij} is the amount of the ith input consumed by the jth DMU;
λ_j is the weight assigned to each DMU;
yr_0 and x_{i0} represent the inputs and output of DMU0.

A diverse set of variables have been used in banking studies on efficiency, and the choice of variables is based on the goal of the research. In the context of banking, (Sealey and Lindley 1977) proposed an intermediation approach in which banks convert deposits and related variables to loans. Input- and output-oriented approaches are two different methods for assessing efficiency using DEA formulation. The input-oriented approach seeks to minimize the level of inputs required for a given level of output, whereas the output-oriented approach investigates efficiency by exploring the possibility of maximizing

the output for a given level of inputs. An assessment of the banking literature indicates that there are multiple studies that use the output-oriented model (Permadani et al. 2022; Bandyopadhyay et al. 2018). The output-oriented model is particularly significant in banking, as banks seek to optimize their performance while maintaining a certain level of input (Permadani et al. 2022).

3.3. Definitions of the DEA Variables

For the purposes of this study, we used the intermediation model and considered deposits, operating expenses, fixed assets, and net worth as the key inputs and loans, other income, and investments as outputs, which is in keeping with practice in extant research on the subject (Preeti and Roy 2022). The key variables in the efficiency estimation consist of the following inputs and outputs (Table 1):

Table 1. Inputs and outputs in the DEA formulation.

Inputs	Outputs
Deposits	Loans
Net worth	Other income
Operating Expenses	Investments
Fixed assets	

Note: Inputs represent the resources used by banks and outputs reflect the gains.

Deposits are the most important input in the intermediation model (Sealey and Lindley 1977). A major portion of bank expenses is channeled toward fixed assets, as branches are the mainstay of the brick-and-mortar banking model. Studies on the subject have used operating expenses, net worth, and fixed assets in addition to deposits (Abdul-Wahab and Haron 2017; Preeti and Roy 2022).

In this study, we propose to assess the DEA in the first stage to obtain efficiency scores and then use these scores as dependent variables in the second stage. The data related to the independent variables are skewed to the right; therefore, it was deemed necessary to effectuate a logarithmic transformation of the variables (Manning 1998). Adding a constant with a small value, such as 0.01, helps solve issues that arise from transformed variables with a value of zero (West 2022). We adopted the above approach to log transform the variables by adding a constant of 0.01 to affect the transformation. This study used a panel of banks across the period, but a cross-sectional analysis of efficiency was considered ideal for assessing efficiency. Cross-sectional analysis is suited to the banking domain, as this approach can capture technological, operational, and regulatory changes more effectively. In the second stage, we used term loans, working capital loans, secured lending, and priority lending as proportions of the total loans.

3.4. Choice of Inputs in the Efficiency Model

The DEA model involves identifying the choice of inputs and outputs, which is a critical step in ensuring the effectiveness of the analysis. The academic literature on the subject indicates that there are multiple approaches to assessing efficiency (Cichowicz et al. 2021), and the choice of inputs and outputs is inherently subjective (Emrouznejad and Tavana 2014).

The goal is to assess the impact of the structure of the lending portfolio on the efficiency of banks, and, for this purpose, we considered term loans, working capital loans, secured loans, and priority sector loans as relevant. Term loans are loans that are structured for a longer term and are harder to monitor (Ramakrishnan and Thakor 1984); therefore, they are a distinct class compared to working capital loans, which are, generally, provided to meet the working capital needs of the borrowers. Priority sector loans are loans that are policy-mandated and designed to enhance financial inclusion and further the goals of socio-economic development, but they are not necessarily profitable (Desai 2021).

3.5. Sample and Procedure

This study examined the research question by first assessing efficiency and then regressing the values of secured lending, term loans, priority sector loans, and working capital loans on these scores. The sample included data spanning a period of 10 years from 2013 to 2022; this was deemed sufficient, as it is similar to other studies on bank efficiency in the Indian context (Maity and Sahu 2022). The panel consisted of public-sector banks, old-generation private-sector banks, and new-generation private banks. Small finance banks and payment banks were excluded because they are relatively new and their areas of operations are restricted. Data were obtained from the website of the Reserve Bank of India. The panel was not fully balanced, as it included banks that merged at a later stage. This is, however, not an impediment, as a period of ten years is sufficiently large and the information available on the merged bank is subsumed by the bank with which it is being merged.

3.6. Analysis Technique

The analysis was conducted as follows.

1. Examination of the series for stationarity and cointegration
2. The data comprised a time series, thereby necessitating a stationarity test to mitigate the risk of the findings being spurious (Granger and Newbold 2003). A cointegration test was performed to assess long-term equilibrium, which was necessitated by the fact that the variables under analysis may indicate a long-term linear relationship.
3. Testing for heteroskedasticity
4. The study used generalized least squares regression (GLS) to assess the impact of the predictor variables on the predicted. We first tested for heteroskedasticity, as GLS is useful in instances where the error term displays heteroskedasticity. To this end, we used the modified Wald test for heteroscedasticity in the group data. This approach was deemed relevant because the panel data were related to multiple banks over a period.
5. Obtain the efficiency scores
6. Because the main focus is on the impact of lending variables on efficiency, it was necessary to first obtain efficiency scores using the data envelopment analysis approach.
7. Hausman testing for model specification
8. GLS regression can be conducted using a fixed-effects or random-effects approach, and it is important to assess which approach is the most effective. We used the specification test proposed by Hausman (Hausman 1978) to identify the endogeneity of the regressors and determine the appropriate model.
9. Generalized Least Squares (GLS) regression
10. A GLS approach was used, considering the proportion of loans in the loan portfolio as predictors and efficiency scores as the predicted variable.

4. Results

4.1. Descriptive Statistics

This study covers term loans, secured loans, priority sector loans, and working capital loans as the key independent variables.

The variables are defined as follows:

- ➢ Term loans: Loans that have a maturity of more than a year. These loans have a specified maturity and are payable in installments or bullet form (Reserve Bank of India 2023).
- ➢ Secured loans: Loans that are covered fully by the value of tangible security (Reserve Bank of India 2023).
- ➢ Priority sector loans: Lending that impacts weaker sections and employment-intensive sectors and those that affect large sections of the population (Government of India 2023).

➢ Working capital loans: These loans are made available by banks for acquiring current assets (MSME 2023).

For an equitable comparison between the variables, we considered the ratio of the above variables to the total credit issued by the bank. Table 2 provides the descriptive statistics related to the variables.

Table 2. Descriptive statistics of variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
Priority sector loans	427	−1.009	0.292	−2.831	−0.004
Term loans	427	−0.588	0.289	−2.007	0.003
Secured loans	427	−0.183	0.183	−2.139	0.007
Working capital loans	427	−1.013	0.553	−4.986	−0.206

The variables priority sector loans, term loans, secured loans, and working capital loans represent the proportion of term loans to total loans, secured loans to total loans, priority sector loans to total loans, and working capital to total loans, respectively. The information was sourced from the Reserve Bank of India website.

The panel contained 427 observations and is an unbalanced panel as some banks were merged during the period. As the goal is to extract efficiency for each bank individually, there is no rationale for balancing the panel. Each observation stands for a decision-making unit (DMU) in a particular year. The standard deviation of the variables indicates a high degree of diversity between the banks, and this is to be expected as the panel consists of banks of varying sizes.

4.2. Stationarity Test and Cointegration

The logged values of the variables were assessed for stationarity using the augmented Dickey–Fuller formulation (Dickey and Fuller 1979). The results of the first lag (Table 3) indicate clear evidence of stationarity for priority sector loans, working capital loans, and term loans. To avoid the issue of spurious regression arising from non-stationarity between variables, researchers often employ unit root and cointegration procedures (Ghouse et al. 2021). We conduct the cointegration test of Kao (Table 4) and the test indicates long-run equilibrium (Kao 1999).

Table 3. Unit root test—Dickey–Fuller test on panel data.

Variable	Obs	Test Statistic	*p* Value
Priority sector loan to total loans	50	1.6743	0.0470
Working capital loan to total loans	50	5.5372	0.0000
Secured loans to total loans	50	−0.4820	0.6851
Term loan to total loans	50	12.1599	0.0000

Note: stationarity test conducted using the Dickey–Fuller test. The panel consists of old private banks, new private banks, and public sector banks.

Table 4. Kao panel test for cointegration.

	Statistic	*p*-Value
Modified Dickey–Fuller test	−1.7801	0.0375
Dickey–Fuller test	−5.5606	0.0000
Augmented Dickey–Fuller test	−1.4638	0.0716
Unadjusted modified Dickey–Fuller test	−6.1030	0.0000
Unadjusted Dickey–Fuller test	−7.8572	0.0000

Note: The Kao test for cointegration was conducted on term loans, working capital loans, secured loans, and priority sector loans as a proportion of the overall advances portfolio.

4.3. Modified Wald Test for Groupwise Heteroskedasticity

The modified Wald test for groupwise heteroskedasticity (Table 5) shows a high chi-square value and is seen to be highly significant. We therefore fail to accept the null hypothesis of homoskedasticity and conclude that there is strong evidence of heteroskedasticity. We therefore utilize robust standard errors in the assessment as there is clear evidence of heteroskedasticity.

Table 5. Modified Wald test for groupwise heteroskedasticity in fixed effect regression.

Statistics	Value
Chi-square	2.4×10^9
Degrees	50
Pr > ChiSq	<0.0001

4.4. Hausman Test

We proposed to use the Stata 17 software (StataCorp 2021) to carry out the DEA estimations as well as panel regression. The data consists of panel data for all domestic banks spanning the period 2013–2017, but we exclude small finance banks and payment banks as the nature of their operation is different and the regulatory requirements are not the same as those of other commercial Indian banks. We follow the literature on research of a similar nature (Goswami et al. 2019) and test for misspecification by following the specification test proposed by (Hausman 1978). The results of the Hausman test indicate that the random effects model is more appropriate ($\chi^2 = 2.927$, $p = 0.57$). The random effects model is therefore considered for the GLS regression.

4.5. Hypothesis Testing

The model's explanatory power is moderate but nevertheless noteworthy when seen in the context of the fact that only the variables relating to credit have been isolated for the purposes of analysis and also the fact that only a selected set of variables have been considered for evaluating efficiency.

4.6. Significance Level of Coefficients

The generalized least squares (GLS) regression is conducted using the random effects model. In the case of public sector banks (Table 6), the overall R square value is 0.0422, which indicates that the model explains about 4.22% of the overall variance (Appendix A). Working capital to total loans ratio and term loan to total loans ratio are significant for public sector banks, although the impact is negative, as evidenced by the negative coefficients.

Table 6. GLS regression relating to public sector banks conducted using the dependent variable 'variable return to scale'.

Variables	Coefficients	Sig.
Constant	−0.1625	0.001
Term loans	−0.1092	0.034
Priority sector loans	−0.0311	0.172
Secured loans	0.046	0.361
Working capital loans	−0.056	0.096

'lnvrs' is the dependent variable and stands for variables returns to scale. Each of the loans is considered as a proportion of the overall loans.

Results of GLS regression

bankgeneration = public sector banks
bankgeneration = new private banks
bankgeneration = old private banks

The GLS regression for new-generation private sector banks (Table 7) indicates that the model explains 16.41% of the total variance. All variables except secured lending are seen to be significant, with priority sector lending being a drag on efficiency, as evidenced by the negative coefficients (Appendix B)

Table 7. GLS regression relating to new private sector banks conducted using dependent variable 'variable return to scale'.

Variables	Coefficients	Sig.
Constant	0.0624266	0.350
Term loans	0.2196623	0.036
Priority sector loans	−0.0454201	0.000
Secured loans	−0.0520763	0.181
Working capital loans	0.0604249	0.035

'lnvrs' is the dependent variable and stands for variables returns to scale. Each of the loans is considered as a proportion of the overall loans.

In the case of new-generation private banks (Table 7), the explanatory power is strong, and working capital, term loans, and priority sector lending are seen to impact efficiency. Secured lending does not seem to impact efficiency. In the case of old-generation banks (Table 8), only the working capital to total loans ratio appears to have a moderate impact on efficiency (Appendix C).

Table 8. Output of GLS regression—old private sector banks.

Variables	Coefficients	Sig.
Constant	−0.0392795	0.279
Term loans	−0.0245703	0.308
Priority sector loans	0.0429099	0.253
Secured loans	0.1524177	0.250
Working capital loans	−0.0437002	0.060

'lnvrs' is the dependent variable and stands for variables returns to scale. Each of the loans is considered as a proportion of the overall loans.

H1: *The impact of priority-sector lending on efficiency differs significantly between public-sector banks, old private banks, and new private banks.*

The hypothesis that there is a difference between the categories of banks is significant only for new private-sector banks. Priority sector lending has a negative impact on the efficiency of new private-sector banks ($p = 0.000$). It does not have a significant impact on the efficiency of public sector banks or old private sector banks. This finding is consistent with the findings of some studies that priority sector lending has an impact on the financial stability of banks (Chaturvedi 2022).

H2: *The impact of secured loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

Secured lending does not appear to be significant for all three institutions, although it appears to be negative for new private-sector banks. In general, secured lending is likely to be lower-priced, and a higher degree of secured lending means that the cost is borne by those with unsecured credit (Hudson 1995). Secured lending does not appear to be statistically significant in the findings, but this does not necessarily imply that it does not affect efficiency. One possible explanation is that there is an interplay between risk and profit efficiency in the banking sector, as banks must balance the need for profit with the need to manage risk.

H3: *The impact of term loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

The coefficient for term loans regressed on efficiency scores is negative but not significant for old private banks. The results indicate that the relationship between efficiency and the proportion of term loans is negative but significant (p = 0.034) for public-sector banks. This value is positive and significant (p = 0.036) for new private banks. This is insignificant in the case of old private-sector banks. New private banks are concerned about enhancing customer relationships, and long-term loan contracts are beneficial for building banker–customer relationships (Misra and Dhal 2010). It is clear from the analysis that new private-sector banks are more efficient at managing term loans.

H4: *The impact of working capital loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.*

The proportion of working capital loans in the loan portfolio has a negative impact on the efficiency of public sector banks and old private banks, as evidenced by the negative coefficients. However, the impact is not as significant in the case of public-sector banks (p = 0.096) and is only marginally significant in the case of old private banks (p = 0.067). In the case of new private banks, there is a positive impact on efficiency, and this is seen to be highly significant (p = 0.035). This could be because well-capitalized banks, which are usually private, are more efficiently managed (Bolarinwa et al. 2021). It is pertinent to note here that this finding is in contrast to a recent study that finds that public sector banks perform better than private banks overall (Patra et al. 2023). One possible reason for the divergence could be because the current study considered new-generation private banks as being different from old-generation private banks.

5. Discussion

The analysis conducted using the GLS regression provides hitherto unknown insights about bank efficiency, and three out of the four hypotheses were validated. Priority sector loans show a significant negative association with the efficiency of new private-sector banks. The negative impact of priority sector loans can be explained by the fact that these loans are disbursed primarily to further a social cause and are largely set within constraints put in place by regulatory authorities (Kumar et al. 2016).

Hypothesis	Outcome
H1: The impact of priority sector lending on efficiency differs significantly between public sector banks, old private banks, and new private banks	Failed to be rejected
H2: The impact of secured loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.	Not supported
H3: The impact of term loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.	Failed to be rejected
H4: The impact of working capital loans on efficiency differs significantly between public sector banks, old private banks, and new private banks.	Failed to be rejected

In the case of secured loans, there appears to be no significant difference between banks. This can be explained in terms of the tradeoffs occasioned by the need to reduce risk-weighted assets and the need for profitability. Maintaining this delicate trade-off means that private sector banks are inexorably forced to renege on efficiency in the greater interest of reducing loan defaults and ensuring adequate capital. Riskier loans are associated with higher interest rates (Auh and Landoni 2022) secured lending generally entails obtaining security on the loan, and secured loans are likely to be less efficient in terms of extracting the maximum income from the assets deployed.

In contrast to public sector banks, new private banks have been effective at managing their term loans, as evidenced by the positive impact of term loans on bank efficiency ($p = 0.036$). Private sector banks are more efficient at managing spreads (Ghosh 2008) and this efficiency could underpin the reason why new-generation private banks are able to effectively leverage their term loans better. The efficiency of private sector banks in terms of term loans can also be related to the fact that private sector banks are more agile and better adept at utilizing technology. This is in keeping with the resource-based view (Wernerfelt 1984) whereby the new generation of private sector banks are more adept at exploiting their resources as a consequence of the greater flexibility in decision-making, which is in contrast with public sector banks that are governed largely by state diktat. This study did not find a significant impact of term lending on the efficiency of old private banks.

In the case of working capital loan disbursements, the results indicate that old private banks and public sector banks are less efficient, as evidenced by the negative impact of working capital loans on efficiency. This is in keeping with the resource-based view, as new private banks are seen to be very efficient at managing working capital loans. The overall findings align with previous research that indicates that private-sector banks exhibit increasing returns to scale (Mahathanaseth and Tauer 2014). Old private sector banks are seen to be inefficient at managing their working capital portfolio but the impact is only marginally significant.

6. Conclusions

This study sought to examine the relevance of the institutional hypothesis in explaining how credit formulations of banks impact their efficiencies. The study was done on a panel dataset of domestic Indian banks covering a period of 10 years from 2013 to 2022 and data were obtained from the website of the Reserve Bank of India. The Hausman test was conducted and the random effect model was considered ideal. The stationarity test was conducted using the Dickey–Fuller formulation and this was followed by an assessment of cointegration using the method proposed by Kao. The cointegration test established a long-term equilibrium between the variables. Since a determining factor is the level of heteroskedasticity, the study conducted a Modified Wald test and identified heteroskedasticity.

The dependent variable is the efficiency score of banks and the variable return to scale model was chosen to account for the varying sizes of banks. Data envelopment analysis was used to arrive at the efficiency score. The resource-based view was used as the theoretical framework and the study examined four hypotheses with the common goal of examining whether differentials in bank lending impact efficiency. The final results showed that there is a clear nexus between the bank category and the manner in which the lending behavior tends to impact efficiency. A critical finding was that priority sector lending had a negative impact on the efficiency of new private-sector banks. Another important finding is that all lending variables, except for secured lending, tend to impact the efficiency of new private banks and this supports the resource-based view theory as new private banks are clearly effective at exploiting and managing their capabilities.

The key policy implication is that Central Banks should examine priority sector lending policies such that they achieve the stated social purpose for which they were intended without compromising the need for banks to be efficient. It is particularly important for the policymakers to provide greater flexibility to new private sector banks and to exploit their capabilities to disburse term loans and working capital loans effectively.

Implications

The assessment of the impact of the lending structure on efficiency throws up vistas for further exploration, particularly as pertaining to priority sector lending. The inverse relationship between priority sector loans and efficiency challenges theories that cite social banking as being inherently beneficial. The key implication for theorists is that they have to take a more nuanced approach to examine the impact of priority sector lending on

efficiency. The proportion of term lending to overall lending is seen to produce a negative impact on public sector bank efficiency, which contrasts sharply with the positive impact on the efficiency of new private sector bank efficiency. The key theoretical implication is that researchers should take into account the nature of the banks as generational differences, as well as bank incentives, tie in to create different efficiency paradigms.

Firstly, the core finding that priority sector loans have a negative impact on efficiency suggests that new private sector banks should revisit their strategy on priority sector lending and find ways and means to enhance the efficiency of their priority sector loans. One possible way is to collaborate with other institutions such as microcredit institutions and lend wholesale as this can help new private banks reduce operational costs while also helping them reach their priority sector targets.

Secondly, the drivers of efficiency of old-generation banks have to be explored as these banks appear to be operating with a different set of enablers. One of the key findings is that the overall efficiency of new private sector banks is much higher than the other banks and this implies that the old generation banks and public sector banks should examine their process for working capital loan disbursement as this tends to impact their efficiency negatively. Studying the best practices adopted by new private sector banks in managing their working capital portfolio can be a step in this direction.

Public sector banks can do well to re-examine the entire loan portfolio process as the overall loan disbursement process is less than efficient as is evidenced by the negative impact of working capital loans and term loans on overall efficiency.

This study highlights the significance of assessing banks on the basis of categories such as old private and new private banks based on the consistency of factors affecting them collectively.

The conventional method of clubbing all private sector banks as one entity may lead to spurious findings as there are differences between institutions in the form of institutional constraints. While this research has been conducted in the Indian context, the core idea that homogeneity of factors affecting institutions should be a prime consideration for categorization is relevant in all contexts.

7. Limitations and Future Direction

The research used an unbalanced panel of banks and it is possible that a balanced panel of banks might provide a more precise understanding of the impact of these factors. It is also possible to embrace other variables and possibly conduct an instrumental variables regression analysis. It is also possible that volume tends to impact the outcome and therefore it is possible to use quantiles to segregate various clusters. There is also the possibility that a production approach to efficiency or a stochastic model might yield a different result. The findings may not be universally applicable as market conditions, regulatory frameworks, and banking practices differ. The unique characteristics of the population of banks studied restrict the possibility of generalizability and this is a major limitation. Despite these limitations, the key finding holds that managing resources effectively can help banks be much more efficient.

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Appendix A. Output of GLS Regression Conducted on Public Sector Banks

Random-effects GLS regression Group variable: DMU			Number of obs = 222 Number of groups = 27	
R-squared Within = 0.0696 Between = 0.0158 Overall = 0.0422			Obs per group: min = 5 avg = 8.2 max = 10	
Corr(u_i, X = 0 (assumed)			Wald chi2(4) = 12.16 Prob > chi2 = 0.0162	
lnvrs	Coefficient	Robust std.err	z	P > |z|
Term loans	−0.1091531	0.0514893	−2.12	0.034
Priority sector loans	−0.0310516	0.0227257	−1.37	0.172
Secured loans	0.0459941	0.0503023	0.91	0.361
Working capital loans	−0.0560047	0.033676	−1.66	0.096
Constant	−0.1624963	0.0504512	−3.22	0.001

Appendix B. Output of GLS Regression Conducted on New Private Sector Banks

Random-effects GLS regression Group variable: DMU			Number of obs = 102 Number of groups = 12	
R-squared Within = 0.1290 Between = 0.2391 Overall = 0.1641			Obs per group: min = 3 avg = 8.5 max = 10	
Corr(u_i, X = 0 (assumed)			Wald chi2(4) = 31.78 Prob > chi2 = 0.0000	
lnvrs	Coefficient	Robust std.err	z	P > |z|
Term loans	0.2196623	0.104742	2.10	0.036
Priority sector loans	−0.0454201	0.0117382	−3.87	0.000
Secured loans	−0.0520763	0.0389006	−1.34	0.181
Working capital loans	0.0604249	0.0287216	2.10	0.035
Constant	0.0624266	0.0667834	0.93	0.350

Appendix C. Output of GLS Regression Conducted on Old Private Sector Banks

Random-effects GLS regression Group variable: DMU			Number of obs = 103 Number of groups = 12	
R-squared Within = 0.0055 Between = 0.4438 Overall = 0.1262			Obs per group: min = 3 avg = 8.6 max = 10	
Corr(u_i, X = 0 (assumed)			Wald chi2(4) = 11.53 Prob > chi2 = 0.0212	
lnvrs	Coefficient	Robust std.err	z	P > |z|
Term loans	−0.0245703	0.0240851	−1.02	0.308
Priority sector loans	0.0429099	0.0375057	1.14	0.253
Secured loans	0.1524177	0.1323614	1.15	0.250
Working capital loans	−0.0437002	0.0238258	−1.83	0.067
Constant	−0.0392795	0.0362569	−1.08	0.279

Appendix D. Kao Panel Cointegration Test

H0: No cointegration Ha: All panels are cointegrated	Number of panels = 50 Avg. number of periods = 6.54	
Cointegrating vector: Same Panel means: Included Time trend: Not included AR parameter: Same	Kernel: Bartlett Lags: 1.32 (Newey-West) Augmented lags: 1	
	Statistic	*p*-value
Modified Dickey–Fuller test	−1.7801	0.0375
Dickey–Fuller test	−5.5606	0.0000
Augmented Dickey–Fuller test	−1.4638	0.0716
Unadjusted modified Dickey–Fuller test	−6.1030	0.0000
Unadjusted Dickey–Fuller test	−7.8572	0.0000

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