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Are private banks more sensitive to changes in reserve requirements? Evidence from an emerging market

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Abstract

Purpose – This article explores the effects of monetary policy rates and interest rate structures on bank profitability.

Design/methodology/approach – We studied 65 Indian commercial banks over time, including economic cycles, consolidation and the Great Financial Crisis. We categorized commercial banks by ownership (public, private or foreign) and predicted how they will react to monetary policy changes. We employed the instrumental variable estimate approach and panel Granger causality tests to give evidence of the direction of causation in the monetary policy and bank performance nexus.

Findings – Private and international banks, we believe, are more sensitive to changes in reserve requirements because they are more effective at maintaining statutory reserves. Private and international banks are more susceptible to repo rate fluctuations than state banks. In contrast, public banks are more sensitive to bank rates because they are more likely than private and international banks to use the bank rate window of accommodation.

Originality/value – We studied the impact of monetary policy rates on bank performance within the banking-dominated financial system of an emerging economy – a focus that has not been previously explored. There has been little research into the connection between monetary policy rates and bank performance in emerging markets, notably in India.

Keywords Monetary policy, Interest rate, Bank profitability, Financial crisis

Paper type Research paper

1. Introduction

Bank performance and monetary policy rates have become more closely linked since the global financial crisis. Although policy rates are near zero, long-term interest rates have historically been low. The central banks' aggressive response in the early stages of the crisis prevented the financial and economic disaster from worsening. However, continued expansionary monetary policy by the central banks is observed with concern, as it might cause adverse side effects, particularly on bank profitability (Dale, 2012; Plosser, 2012; Praet, 2012; Rajan, 2013).

Understanding the connection between policy rates and bank performance is critical considering the rising importance of the monetary policy stance, as it influences the financial sector's soundness. Though policy rates are not the sole influence on the interest rate structure, they significantly influence it because central banks set the short-term and long-term rates (Borio *et al.*, 2015).

Several researchers have investigated the relationship between bank profitability and business conditions. However, their examination of the relationship between the interest rate

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structure and the profitability of banks is a byproduct. Demirguc-Kunt and Huizinga (1999) investigated the relationship between bank profitability indicators and macroeconomic variables. In a similar strand of literature, using the banking sector data for ten Organization for Economic Cooperation and Development (OECD) banking markets, Albertazzi and Gambacorta (2009) notice a nexus between bank loss provisions and the short-term interest rate. Similarly, Bolt *et al*. (2012) observed comparable results for their analysis of 18 OECD banking markets from 1979 to 2007, allowing for asymmetrical effects over the business cycle.

In this paper, we set out three goals. First, we investigate the connection between Indian monetary policy rates and bank performance. We take macroeconomic parameters, such as gross domestic product (GDP) growth and inflation, as control variables. Second, we group commercial banks into groups according to their ownership patterns as public, private and foreign, and estimate how these bank groups respond to monetary policy changes. Third, we conducted panel Granger causality tests to offer evidence of the direction of causality.

This research contributes to the literature in two ways. Firstly, we explore the connection between policy rates and bank performance for 65 Indian banks. Secondly, this research is the first of its kind to explore how policy rates influence bank performance indicators within a banking-dominated financial system in a developing economy.

The analysis brings forth the following main results: First, higher interest rates increase bank profits, indicating the nexus between the interest rate structure and bank performance indicators. Furthermore, greater nonperforming assets (NPAs) relate to increased short-term interest rates and, as a result, higher loan loss provisions. Higher reserve requirements have a detrimental influence on bank performance. During the post-crisis period, the short-term policy rate has risen considerably – witnessing a similar rise in the NPAs – and bank profitability has experienced a steady decline. Second, we find that private and foreign banks are more susceptible to changes in reserve requirements when we scrutinize the influence of monetary policy on the bank groupings of ownership patterns – public, private and foreign. Private and international bank profitability is more vulnerable to fluctuations in the repo rate than public bank profitability. On the other hand, public banks are more sensitive to fluctuations in the bank rate since they frequently use the bank rate window of accommodation. Third, we demonstrate causation in the panel Granger causality test findings, running from the repo rate to the bank performance factors.

The rest of the paper is organized as follows: The second section looks at the relevant literature, such as the theoretical framework and empirical evidence. Section 3 describes the approaches. Section 4 presents the findings of the analyses. Section 5 discusses the crucial empirical findings. Finally, section 6 discusses policy consequences.

2. Literature review

In this section, we provide a comprehensive review of the existing literature related to the influence of reserve requirements on bank performance and develop study hypotheses. Monetary policy generally refers to central banks' attempts to manage the money supply using policy instruments such as reserve requirements, open market operations, repo rates, discount rates, direct interest rate regulation, direct control of banking system lending and moral suasion. Monetary policy seeks to control credit and money to accomplish economic development and financial stability goals. Traditional theories of monetary policy mainly focus on money supply and its changes, which change the interest rate and the level of spending in the economy (Friedman and Schwartz, 1963; King and Plosser, 1984; Sims, 1992). Long, fluctuating and unknown time delays characterize the transmission mechanism. We believe that monetary policy operates through four primary channels: (1) credit, (2) asset prices, (3) bank lending and (4) exchange rates. Monetary policy transmission has attracted much attention, particularly considering recent events, with a particular emphasis on the efficacy of the bank credit channel.

A monetary strategy focused on growth or amount of money implies interest rate fluctuations, which have an influence on bank performance. The question is whether banks

profit from the high interest rates mandated by monetary policy. There are three approaches to this problem. First, bank earnings are determined by all asset and liability interest rates instead of a single market rate [1]. Second, bank earnings are also determined by user expenses for all financial goods and services. Third, an examination of the relative price movements of financial and non-financial assets is necessary.

The "credit channel" underlines the significance of banking in transmitting monetary policy since financial markets are deficient. Because banks are distinct in their competence in financial intermediation, they manage and minimize financial frictions by adapting their loan conditions to monetary policy changes. However, in accordance with the "interest rate channel," the influence of monetary policy on saving and investment endures even when financial markets are closed. Monetary policy changes cause capital cost fluctuations and the rate of return on savings, which impact spending choices. Though interest rates and credit channels differ in emphasizing the importance of financial issues, we consider them complementary. As a result, both these transmissions work together to shape the effects of monetary policy on the economy, influencing borrowing costs, spending decisions and economic growth.

The recent debate focuses on the "credit channel" that assigns banks an essential role in the transmission of monetary shocks to the economy (Bernanke and Blinder, 1992; Friedman *et al.*, 1993; Gertler and Gilchrist, 1993; Kashyap and Stein, 1994; Bernanke and Gertler, 1995). However, Bernanke and Blinder (1992), among others, provide evidence that bank lending contracts do when monetary policy becomes tighter.

Rakshit and Bardhan (2023) investigated how growing competition in the Indian banking sector impacted monetary policy transmission via the bank lending channel from 1997 to 2017. The study, using a two-step system-generalized methods of moments (GMM) methodology, shows that heightened market power reduces monetary policy efficacy in different industries and ownership groups. Furthermore, increasing market dominance in the loan and deposit markets lessens the effect of monetary policy on the availability of bank loans. The results point to the need for policy actions to improve monetary policy transmission by mitigating the negative impacts of changes in bank rivalry.

In the "credit channel" represented by Gertler and Gilchrist (1993), Bernanke and Gertler (1995), Calomiris and Hubbard (1990), Bernanke *et al*. (1996) and Oliner and Rudebusch (1995), the financial position of borrowers has a crucial role in determining the ability to obtain external finance.

In a world of perfect financial markets in which the Miller and Modigliani (1958) proposition holds good, all forms of financing are perfect substitutes and yield the same interest rates. However, the "credit channel" and the "interest rate channel" are not mutually exclusive but complementary, implying that monetary policy can be effective through these transmission channels simultaneously (Cecchetti, 1995). Rate reduction in the positive zone tends to have a distinct effect. According to Nucera *et al.* (2017), the impact of negative interest rates on banks' systemic risk is dependent on the bank's business strategy. Large universal banks and fee-based banks have seen positive effects from negative interest rates, whereas other banks have not.

Samuelson's (1945) hypothesis states that changes in interest rates affect bank performance and, more specifically, profitability, via their effect on bank interest margins. Similarly, Hancock (1985) illustrates that an increase in interest rates charged by the bank boosts bank profitability, as lending rate elasticity is larger than deposit rate elasticity. Several studies have established that an expansionary monetary policy of the central banks decreases long-term interest rates (Krishnamurthy and Vissing-Jorgensen, 2011; Swanson and Williams, 2014; Wright, 2012). Falling interest rates may encourage investment in high-risk activities. This is because when interest rates are low, banks may lend money for less money, which encourages them to lend to riskier borrowers. According to Buch *et al.* (2014), monetary policy may have a major influence on bank risk taking, and this impact varies depending on the kind of bank and the time period.

Negative interest rates hurt bank stocks, particularly those that depend on deposits, due to unexpected yield curve movements and flattening. Bats *et al.* (2023) studied bank stock performance throughout positive and negative interest rate eras. They discover that changes in the long-end yield curve slope have no effect on bank stocks under negative interest rates. Accounting data demonstrate that the yield curve decreases harm to banks, mostly by reducing deposit profits.

The extant literature suggests that monetary policy could impact long-term interest rates through the portfolio balance channel (Gagnon *et al.*, 2011; Joyce *et al.*, 2012). Another is the signaling channel through which the central bank's expansionary actions could signal to market participants that central banks have changed their policy preferences (Bauer and Rudebusch, 2013).

Monetary policy shocks have a direct impact on bank health. Jung (2023) investigated the influence of the European Central Bank (ECB) on bank health following the 2008 financial crisis. ECB's policies and communication had varying effects on bank stocks and financing costs in the long term. Policy easing shocks hurt banks after the crisis, but forward-looking statements improved their health. The study found that ECB policy shocks affect banks in the long run. When the yield curve goes up, bank health improves; when it goes down, bank health decreases. These findings provide a new viewpoint on evaluating the ECB's effect on eurozone banks in the face of economic crises.

The ECB carried out three nontraditional monetary policies between 2011 and 2018: LTROs, asset purchase programs and interest rate adjustments. Dwyer *et al.* (2023) studied how policies affected eurozone banks' loans, government securities and cash at central banks. According to the authors, the unorthodox monetary policies of the ECB had a beneficial impact on bank lending, especially in crisis countries. The regulations also resulted in a decline in government securities owned by banks in non-crisis nations.

Studies based on accounting measures of profitability report mixed evidence on the response of bank profitability to the changes in the short-term rates or the slope of the yield curve (Hanweck and Ryu, 2005; Memmel, 2011; Begenau *et al.*, 2015).

Some recent studies, like Alper *et al.* (2018), observed that reserve requirements (RR) in emerging markets smooth credit cycles, but their transmission remains unclear. Barroso *et al.* (2017) investigated the impact of reserve requirements (RR) on credit supply in Brazil using a large loan-level dataset. By employing a difference-in-difference methodology, the study analyzes the effects of RR changes during and after the 2008 financial crisis. The findings indicate that more liquid banks are more capable of lessening the effects of RR increases on lending. Additionally, the study reveals that the easing of RR during the crisis had a larger impact on credit supply than subsequent tightening measures. Foreign and smaller banks were found to be less affected by RR changes. The paper also suggests that banks tend to reduce lending to riskier firms in response to tighter monetary policy.

Fang *et al.* (2022) explored the impact of raising bank capital requirements on lending in Peru, finding that higher requirements lead to lower credit growth, which becomes insignificant after six months. Some studies suggest that higher capital requirements temporarily reduce credit growth and increase lending rates, while others indicate that this effect is short-lived and becomes insignificant within six months.

In brief, while allowing for macroeconomic variables, the preceding theoretical underpinnings lead us to the following testable hypotheses:

(1) A positive and concave link exists between bank profitability indicators and policy rates.

This hypothesis aligns with traditional views of monetary policy transmission, where interest rates influence bank margins and profitability. Studies by Flannery (1981), Samuelson (1945) and Hancock (1985) provide foundational support for this relationship. However, the concave link implies a diminishing marginal impact of interest rates on profitability, which might require further empirical investigation.

(2) A negative and perhaps convex link exists between bank profits on investments and advances and monetary policy rates.

This hypothesis is consistent with studies such as those by Nucera *et al.* (2017) and Bats *et al.* (2023) that provide evidence that negative interest rates and yield curve flattening can negatively impact bank profitability, particularly for banks dependent on deposit-based funding. This suggests a negative relationship between monetary policy rates and bank profits from investments and advances, with potential convexity due to the differential impact of positive and negative rates.

(3) Performance indicators such as nonperforming assets and business per employee have a positive and concave connection with monetary policy rates.

The hypothesis suggests that higher interest rates may lead to increased NPAs due to financial distress among borrowers, indicating a positive relationship. The concave nature of this relationship implies a diminishing marginal impact of interest rates on NPAs. While empirical evidence supports the connection between monetary policy and asset quality, further investigation is needed to clarify the specific relationship with NPAs. Studies by Rakshit and Bardhan (2023) and Jung (2023) emphasize the link between monetary policy and bank performance indicators, showing that tighter monetary policy can result in higher NPAs and affect other performance metrics. This indicates a positive relationship that may weaken at higher policy rates, reflecting the hypothesized concavity.

(4) A negative and perhaps convex link exists between private and international bank profitability, on the one hand, and repo rates, on the other.

The hypothesis of a negative and potentially convex relationship between private and international bank profitability and repo rates aligns with the findings of Bats *et al.* (2023) regarding the impact of negative interest rates on bank profitability. The convexity implies that the effect of interest rate changes might vary across different types of banks. Research by Buch *et al.* (2014) and Dwyer *et al.* (2023) supports the notion that the impact of monetary policy can vary by bank type and ownership structure. For private and international banks, which may engage more in risk-taking activities, higher repo rates can reduce profitability, suggesting a negative and potentially convex relationship as these banks adjust differently to policy changes compared to public banks.

(5) The treasury bill rate has a positive relationship with public bank returns on investment and a negative relationship with international banks.

Studies by Gagnon *et al.* (2011) and Joyce *et al.* (2012) suggest that treasury bill rates, through the portfolio balance channel, affect public and international banks differently. Public banks may benefit from higher returns on safe investments like treasury bills, whereas international banks – which might rely more on global financial markets – could experience reduced profitability, reflecting the observed relationships.

By grounding each hypothesis in the existing literature, we aim to provide a comprehensive framework that supports our empirical analysis and enhances the robustness and relevance of our findings.

3. Method

This section outlines the research design, data and variables, and analytical procedures followed in this study. The Indian banking sector has experienced a paradigm shift, transforming from exclusivist into inclusivist. The broad brush of financial sector reforms has resulted in a change in banking sector oversight away from micro-level credit decision interference and toward prudential regulation and monitoring. In addition, the sector has experienced interest rate deregulation, the implementation of prudential standards and strengthened regulation and supervision.

Bank branches have grown from a meager 8,262 during the first phase of bank nationalization in 1969 to 149,775 in 2020. Bank branch expansion has increased by 149% since the start of financial sector reforms in 1991. The total commercial bank credit has grown from INR 116,301 crores in 1991 to INR 1,037,0861 crores in 2020, indicating an increase of 8,817%. However, "overhang" issues in the financial industry, such as nonperforming assets of banks and financial institutions, continue to plague us, even though the gross nonperforming assets ratio has fallen from a peak of 15.7% in 1996–1997 to a low of 9.6% in 2015–2016.

3.1 Research design/model

The study employs a quantitative approach with a focus on panel data to capture both temporal and cross-sectional dimensions of bank performance. The study period spans from 2005 to 2016, utilizing data from 65 scheduled commercial banks in India. This period covers post-liberalization phases, business cycles, consolidation periods and the global financial crisis. Annual data are analyzed to derive insights into the banking sector's performance.

We incorporate several key features to ensure an in-depth and robust analysis of the impact of monetary policy on bank performance by leveraging panel data to examine changes in bank performance over time, allowing for a dynamic understanding of trends and shifts. Additionally, cross-sectional comparisons are generated to evaluate the performance of different banks within the same time period, facilitating insights into relative performance across the sector. To control for unobserved heterogeneity, we use fixed effects, which effectively account for time-invariant bank-specific factors that could influence the results.

The methodological framework employs a fixed effect model, as proposed by Islam (1995), which is suitable for panel data to control for unobserved heterogeneity. The model specification is as follows:

$$Bank\ Performance_t^j = f\left(\alpha + Monetary\ policy\ variables_t^j + Bank\ specific\ control\ variables_t^j + Macroeconomic\ variables_t^j\right)$$

To address potential endogeneity concerns and capture the dynamic nature of the relationship, we employ both panel least squares (PLS) with fixed effects [cross-section weights (PCSE) standard errors and covariance] and GMM.

The PLS method allows us to control for unobserved heterogeneity by accounting for time-invariant bank-specific factors, ensuring that our estimates are not biased by these fixed characteristics. In contrast, the GMM approach addresses potential endogeneity issues, providing more reliable estimates of the causal effects of monetary policy on bank performance. Specifically, GMM panel regression enhances our analysis by incorporating instrumental variables (IVs), which are crucial for obtaining consistent estimates in the presence of endogeneity. This method is particularly beneficial when unobserved factors or measurement errors could bias the results. In the context of panel data, GMM can utilize both levels and differences of the variables, allowing for a more rigorous examination of the relationships at play. By employing GMM, we ensure that our estimates are not only consistent but also efficient, even in the presence of heteroskedasticity or autocorrelation in the error terms. This dual approach strengthens the overall robustness of our findings.

3.2 Data and variables

Table 1 presents the variables' description along with the notation used in the analysis, the measure and the data source. The bank performance variables of the study include ROA (Al-Harbi, 2019), ROE (Majumder and Li, 2018), return on advances (ROADV), return on investments (ROI), net nonperforming assets (NNPA) (Canh *et al.*, 2021) and business per employee (BPE).

Table 1. Description of variables

Notation	Measure
Dependent variables:	
1. Return on assets (ROA)	Return on assets (ROA) is a profitability ratio which indicates the net profit (net income) generated by total assets. It is computed by dividing net income by average total assets. Formula – (Profit after tax/Average total assets)*100
2. Return on equity (ROE)	Return on equity (ROE) is a ratio relating net profit (net income) to shareholders' equity. Here equity refers to share capital reserves and surplus of the bank. Formula – Profit after tax/(Total equity + Total equity at the end of the previous year)/2}*100
3. Return on advances (ROADV)	ROADV is the ratio of interest earned on advances and bills to total advances
4. Return on investments (ROI)	ROI is the ratio of interest earned on investments to the total investments
5. Net non-performing assets (NNPA)	A non-performing asset, including a leased asset, becomes nonperforming when it ceases to generate income for the bank. NNPA is the Gross NPA – (Balance in interest suspense account + DICGC/ECGC claims received and held pending adjustment + Part-payment received and kept in suspense account + Total provisions held)
6. Business per employee (BPE)	BPE is the ratio of total business to the number of employees
Monetary policy variables:	
7. Cash reserve ratio (CRR)	CRR is a specified minimum fraction of the total deposits of customers, which commercial banks must hold as reserves either in cash or as deposits with the central bank. For the second preceding fortnight, a scheduled commercial bank must maintain a prescribed CRR as a percentage of its net demand and time liabilities (NDTL). Banks must maintain a minimum of 95% of the required CRR daily and 100% on average during the fortnight
8. Statutory liquidity ratio (SLR)	SLR is the ratio of banks' liquid assets in gold, cash or other approved securities to their net demand and time liabilities (NDTL). A scheduled commercial bank must invest in unencumbered government and approved securities, a certain minimum amount as SLR daily
9. Policy repo rate (RR)	RR is the rate at which banks borrow funds from the central bank against eligible collaterals. The repo rate has emerged as the critical policy for signaling the monetary policy stance
10. Reverse repo rate (RRR)	RRR is the rate at which banks place their surplus funds with the central bank under the liquidity adjustment facility (LAF)
11. Bank rate (BR)	BR is the standard rate the central bank (Reserve Bank of India) is prepared to buy or re-discount bills of exchange or other commercial paper eligible for purchase under the Act
12. Treasury bill rate (TBR)	TBR is the rate of the 91-day Treasury Bills (money market instruments) that are issued weekly by the Government of India
Bank-specific control variables:	
13. Credit to deposit ratio (CDR)	CDR is the ratio of the loans created by the bank from the deposits it receives
14. The ratio of deposits to total liabilities (RD)	RD is the ratio of the total deposits to the total liabilities
15. The ratio of priority sector advances to total advances (PSR)	PSR is the ratio of the priority sector loans to the total advances
16. Capital adequacy ratio (CAR)	CAR is the ratio that divides the bank's capital with aggregated risk-weighted assets for credit, market and operational risks. The higher the CAR of a bank, the better capitalized it is NITA is the ratio of other income to the total assets

(*continued*)

Table 1. Continued

Notation	Measure
17. The ratio of non-interest income to total assets (NITA)	
18. Ratio of intermediation cost to total assets (OICTA)	OICTA is the ratio of operating expenses to the total assets
19. The ratio of operating profits to total assets (OPPTA)	OPPTA is the ratio of operating profits to the total assets
Macroeconomic control variables:	
20. GDP growth (GDPGR)	GDPGR is India's annual percentage growth rate at market prices based on constant local currency. Aggregates are based on constant 2005 US dollars
21. Inflation (INFL)	INFL, as measured by the consumer price index, reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly

Source(s): Reserve Bank of India database. We source the macroeconomic variables from the World Development Indicators of the World Bank Database

The CRR, SLR, RR, RRR, BR and TBR are all monetary policy indicators of importance to us as described in Table 1. The bank-specific control variables include CDR, RD, PSR, CAR (Majumder and Li, 2018), NITA, OICTA and OPPTA (Al-Harbi, 2019).

We employ GDP growth (GDPGR) as one of the control variables to account for macroeconomic influences. GDPGR has a positive association with bank performance as the prosperous economic conditions provide increased business opportunities and improved recoveries, leading to an increase in profitability and credit growth (Lozano-Vivas and Pasiouras, 2010; Chortareas *et al.*, 2011; Kalyvas and Mamatzakis, 2014). We differ with Delis and Kouretas (2011) and Dietsch and Lozano-Vivas (2000), who find that GDPGR negatively affects bank performance variables. One possible explanation is that higher operational expenditures to provide a certain service level correlate with flourishing economic conditions.

We also consider INFL to be another control variable. We believe it to be negatively associated with bank performance, as banks often find it difficult to adapt their rates to the expected inflation levels immediately. This has a dampening impact on the revenues. Furthermore, as high inflation levels hurt the general public, bank repayments and potential bank loan prospects are negatively affected (Petersen, 1986; Lozano-Vivas and Pasiouras, 2010). Table 2 shows the descriptive data, while Table 3 shows the variables' correlations.

Figure 1 shows the bivariate analysis of the monetary policy and bank performance variables, while Figure 2 shows their relationships.

3.3 Analytical procedures

We start with a standard linear regression model, notwithstanding the conventional approach of accounting for both apparent and unobservable variability. We also incorporate other major macroeconomic factors to take into account their concurrent influence. We used the Islam (1995) model with the fixed effect estimator since it is appropriate for a panel dataset.

$$Bank\ Performance_t^j = f\left(\alpha + Monetary\ policy\ variables_t^j + Bank\ specific\ control\ variables_t^j + Macroeconomic\ variables_t^j\right) \quad (1)$$

Table 2. Descriptive statistics

	BPE	BR	CAR	CDR	CRR	GDPGR	INFL	NITA	NNPA	OICTA	OPPTA	PPE	PSR	RD	RIR	ROA	ROADV	ROE	ROI	RR	RRR	SLR	TBR
Mean	112.56	7.15	16.83	78.23	5.03	7.57	7.86	1.66	2.04	2.17	2.44	2.11	33.45	72.03	5.19	1.28	9.81	12.90	7.41	6.40	6.04	23.67	7.07
Median	96.40	6.00	13.23	72.92	4.94	7.46	7.40	1.17	1.21	1.89	2.10	0.61	33.27	81.70	5.20	1.09	9.87	13.04	7.35	6.50	5.75	24.00	7.29
Maximum	398.00	9.25	85.00	318.30	6.80	10.30	12.00	16.63	15.97	11.83	15.62	94.30	78.73	92.25	8.90	10.23	34.66	34.01	15.90	8.50	7.50	25.00	9.02
Minimum	1.40	6.00	7.51	0.60	4.00	3.90	4.20	0.05	0.01	0.56	0.00	0.01	1.18	6.92	0.60	0.01	0.03	0.06	1.58	3.25	5.00	21.50	4.38
Std. Dev	75.50	1.39	10.76	32.97	0.93	1.70	2.46	1.74	2.43	1.20	1.48	5.87	8.68	18.98	2.24	1.02	2.30	6.57	1.24	1.42	0.92	1.23	1.48
Obs	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780	780

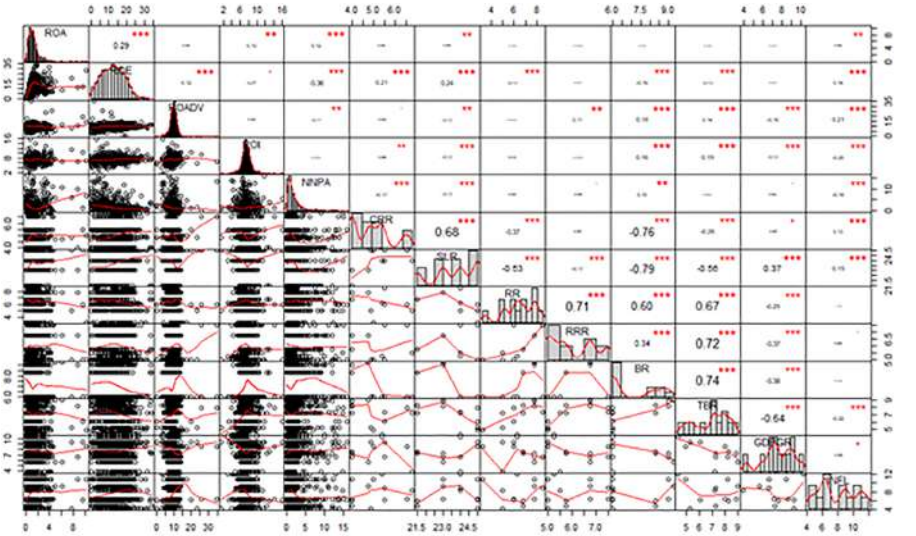
Source(s): Authors' own calculations

Table 3. Correlation analysis

	BPE	BR	CAR	CDR	CRR	GDPGR	INFL	NITA	NNPA	OICTA	OPPTA	PPE
BPE	1											
BR	0.39**	1										
CAR	0.15**	0.011	1									
CDR	0.47**	0.12**	0.057	1								
CRR	−0.35**	−0.76**	−0.013	−0.09*	1							
GDPGR	−0.16**	−0.38**	−0.01	−0.08*	−0.08*	1						
INFL	0.04	−0.05	0.06	0.042	0.13**	−0.08*	1					
NITA	−0.08*	−0.12**	0.22**	−0.13**	0.10**	0.037	0.010	1				
NNPA	0.09*	0.10**	0.31**	−0.13**	−0.17**	0.064	−0.17**	−0.003	1			
OICTA	−0.32**	−0.19**	0.17**	−0.13**	0.09**	0.034	−0.053	0.70**	−0.09**	1		
OPPTA	0.16**	−0.05	0.29**	0.072*	0.05	−0.006	0.07*	0.69**	0.002	0.212**	1	
PPE	0.29**	0.12**	0.101**	0.15**	−0.12**	−0.044	−0.026	0.218**	0.06	−0.08*	0.39**	1
PSR	−0.16**	−0.06	0.05	−0.12**	0.04	0.045	−0.008	0.164**	0.21**	0.19**	0.041	−0.076*
RD	−0.53**	−0.05	−0.44**	−0.51**	0.02	0.034	−0.021	−0.350**	−0.21**	−0.11**	−0.51**	−0.41**
RIR	0.14**	0.22**	−0.06	0.007	−0.39**	−0.043	−0.73**	−0.040	0.16**	−0.015	−0.057	0.088*
ROA	0.11**	−0.04	0.34**	0.048	0.05	−0.031	0.09**	0.526**	0.11**	0.15**	0.73**	0.39**
ROADV	−0.25**	0.17**	−0.10**	−0.19**	−0.06	−0.18**	0.21**	0.096**	−0.11**	0.17**	0.078*	−0.126**
ROE	−0.26**	−0.18**	−0.28**	−0.15**	0.21**	−0.01	0.14**	0.058	−0.36**	−0.036	0.153**	−0.016
ROI	−0.05	0.17**	−0.04	−0.11**	−0.11**	−0.12**	−0.20**	0.12**	0.004	0.17**	0.154**	−0.028
RR	0.220**	0.45**	0.03	0.10**	−0.21**	−0.24**	−0.02	−0.105**	0.002	−0.044	−0.066	0.032
RRR	0.14**	0.32**	0.02	0.08*	0.04	−0.36**	0.06	−0.068	−0.073*	−0.033	−0.016	0.011
SLR	−0.43**	−0.75**	0.01	−0.11**	0.67**	0.33**	0.19**	0.13**	−0.138**	0.11**	0.091*	−0.14**
TBR	0.25**	0.73**	−0.002	0.118**	−0.25**	−0.65**	−0.22**	−0.09**	0.005	−0.055	−0.048	0.073*

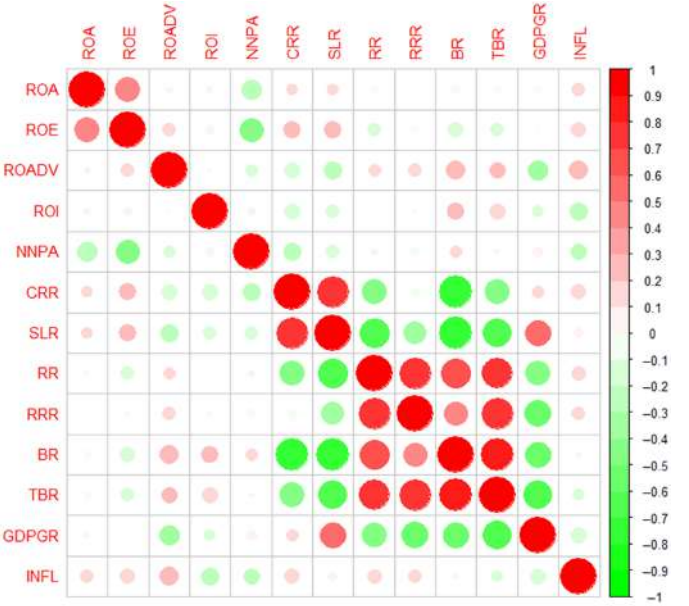
(*continued*)

	PSR	RD	RIR	ROA	ROADV	ROE	ROI	RR	RRR	SLR	TBR
BPE											
BR											
CAR											
CDR											
CRR											
GDPGR											
INFL											
NITA											
NNPA											
OICTA											
OPPTA											
PPE											
PSR	1										
RD	0.084*	1									
RIR	0.001	0.012	1								
ROA	0.018	−0.49**	−0.09*	1							
ROADV	−0.006	0.219**	−0.02	0.056	1						
ROE	0.067	0.323**	−0.17**	0.290**	0.11**	1					
ROI	0.131**	0.071*	0.19**	0.096**	0.06	0.07*	1				
RR	−0.038	−0.044	−0.16**	−0.047	−0.04	−0.11**	−0.004	1			
RRR	−0.038	−0.046	−0.025	−0.001	0.10**	−0.020	−0.003	0.71**	1		
SLR	0.021	0.014	−0.46**	0.105**	−0.10**	0.24**	−0.13**	−0.34**	−0.11**	1	
TBR	−0.064	−0.050	0.28**	−0.037	0.14**	−0.12**	0.192**	0.61**	0.71**	−0.521**	1



Source(s): Authors' own elaboration

Figure 1. Bivariate analysis of the relationship between monetary policy and bank performance variables



Source(s): Authors' own elaboration

Figure 2. Correlations between monetary policy and bank performance variables

$$Bank\ Performance_t^j = \alpha_0 + \sum_{j=1}^{n} \beta_1 monetary\ policy\ variables_t^j + \beta_j X_t^j + \mu_j + \nu_t + \varepsilon_{jt} \quad (2)$$

where X_t^j is the kth bank j variable at time t. μ_j denotes the idiosyncratic error term, ν_t is the bank-specific unobserved effect and ε_{jt} represents the error term.

First, we run the model with ROA as the dependent variable. We rewrite Eq (2) as shown below:

$$\begin{aligned} ROA_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (3)$$

We repeat the estimation using ROE as the dependent variable as follows:

$$\begin{aligned} ROE_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (4)$$

We repeat our experiment with two performance variables related to advances (ROADV) and investments (ROI). We write our model as follows:

$$\begin{aligned} ROADV_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (5)$$

$$\begin{aligned} ROI_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (6)$$

Finally, we analyze the remaining two bank performance variables, NNPA and BPE, with the following specifications:

$$\begin{aligned} NNPA_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (7)$$

$$\begin{aligned} BPE_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j \\ & + \beta_{13} BR_t^j + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \quad (8)$$

3.3.1 Monetary policy affects the performance of bank groups. We divide our dataset into bank groupings based on ownership patterns as public, private or foreign. As a result, our specification has been changed as follows:

$$\begin{aligned} \textit{Public banks' performance variable}_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j \\ & + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j \\ & + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j + \beta_{13} BR_t^j \\ & + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \tag{9}$$

$$\begin{aligned} \textit{Prvate banks' performance variable}_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j \\ & + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j \\ & + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j + \beta_{13} BR_t^j \\ & + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \tag{10}$$

$$\begin{aligned} \textit{Foriegn banks' performance variable}_t^j = {} & \alpha_0 + \beta_1 CDR_t^j + \beta_2 RD_t^j + \beta_3 PSR_t^j \\ & + \beta_4 CAR_t^j + \beta_5 NITA_t^j + \beta_6 OICTA_t^j \\ & + \beta_7 OPPTA_t^j + \beta_8 GDPGR_t^j + \beta_9 INFL_t^j \\ & + \beta_{10} CRR_t^j + \beta_{11} SLR_t^j + \beta_{12} RR_t^j + \beta_{13} BR_t^j \\ & + \beta_{14} TBR_t^j + \mu_j + \nu_t + \varepsilon_{jt} \end{aligned} \tag{11}$$

3.4 Testing for causality

We use pairwise Granger causality tests to assess whether the past values of one variable can help forecast the present values of another. The study is carried out in a panel data framework, which allows us to account for both the temporal and cross-sectional dimensions of the data.

Panel data bivariate regressions are as follows:

$$y_{i,t} = \alpha_{0,i} + \alpha_{1,i} y_{i,t-1} + \ldots + \alpha_{1,i} y_{i,t-1} + \beta_{1,i} x_{i,t-1} + \ldots + \beta_{1,i} x_{i,t-1} + \quad _{i,t} \tag{12}$$

$$x_{i,t} = \alpha_{0,i} + \alpha_{1,i} x_{i,t-1} + \ldots + \alpha_{1,i} x_{i,t-1} + \beta_{1,i} y_{i,t-1} + \ldots + \beta_{1,i} y_{i,t-1} + \quad _{i,t} \tag{13}$$

where t represents the panel's temporal dimension and i is the cross-section dimension.

The Granger causality tests were performed using a model that included bivariate regressions for each pair of variables in the panel. We analyze two equations (Eq 12 and 13) for each pair of variables, y and x, in this "vanilla model."

Using the pairwise Granger causality tests, we may ascertain if the lagged variables' values have a statistically significant impact on the "resent other variables" values. If such causation is identified, it shows a temporal link between the two variables, suggesting that changes in one variable might anticipate or "cause" changes in the other variable. These tests help identify the strength and direction of any causal connections among the variables in the panel data.

4. Results

The following section describes the empirical findings, detailing the relationship between monetary policy and bank performance, with a particular focus on the differential impact across bank ownership categories.

We start by running a series of tests to ascertain stationarity. The Levin *et al.* (2002) and Breitung (2000) *t*-tests test the absence of a unit root in the panel under the assumption of a

standard unit root process across the panel units. The PP-Fisher chi-square (Maddala and Wu, 1999) test assumes individual unit root processes, confirming that all data series are unit root processes. Moreover, Hadri's (2000) test strongly rejects the null of stationarity' in all cases. We also carried out panel unit root tests following Pesaran (2007) and verified the cross-section correlation properties of the raw data. Table 4–6 displays the stationarity test results.

4.1 Effects on bank profitability

Figures 3 and 4 depict monetary policy variables' interactions with ROA and ROE. Over a year, the monetary policy contraction that raises the RR from 0 to 1% boosts the ROA by

Table 4. Panel unit root tests for policy rates

Variable	At level LLC test	IPS test	ADF test	PP test	At first difference LLC test	IPS test	ADF test	PP test
BR	−0.81	−3.03	52.95	52.95	−21.55	−13.32	389.46	389.59
	(0.21)	(0.99)	(1.00)	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)
CRR	−1.75	3.67	46.83	49.91				
	(0.04)	(0.99)	(1.00)	(1.00)				
RR	−10.67	−1.94	125.19	117.22				
	(0.00)	(0.02)	(0.60)	(0.78)				
RRR	−19.91	−11.07	334.87	345.03				
	(0.00)	(0.00)	(0.00)	(0.00)				
SLR	18.33	18.74	0.82	4.79	−45.96	−35.48	903.78	1024.30
	(1.00)	(1.00)	(1.00)	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note(s): This table reports the test statistic, followed by the probability values in parentheses, for the four tests performed in ascertaining the stationarity of the variables. The first panel reports the test results in level form, and the second panel reports the results in the first difference
LLC test: The Levin, Lin and Chu test; IPS test: The Im, Pesaran and Shin (IPS) test; ADF test: The Augmented Dickey–Fuller (ADF) test; PPS test: The Augmented Dickey–Fuller (ADF) test
Source(s): Authors' own calculations

Table 5. Panel unit root tests for performance variables

Variable	At level LLC test	IPS test	ADF test	PP test	At first difference LLC test	IPS test	ADF test	PP test
BPE	−0.45	−6.94	70.27	98.85	−19.77	−13.14	403.13	451.30
	(0.33)	(1.00)	(1.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
NNPA	3.88	4.74	153.47	209.22				
	(0.99)	(1.00)	(0.07)	(0.00)				
ROA	−13.25	−8.27	279.45	268.53				
	(0.00)	(0.00)	(0.00)	(0.00)				
ROADV	−16.58	−8.86	289.59	280.12				
	(0.00)	(0.00)	(0.00)	(0.00)				
ROE	−9.24	−5.87	239.85	271.85				
	(0.00)	(0.00)	(0.00)	(0.00)				
ROI	−13.81	−7.13	256.49	280.74				
	(0.00)	(0.00)	(0.00)	(0.00)				

Note(s): This table reports the test statistic, followed by the probability values in parentheses, for the four tests performed in ascertaining the stationarity of the variables. The first panel reports the test results in level form, and the second panel reports the results in the first difference
LLC test: The Levin, Lin and Chu test; IPS test: The Im, Pesaran and Shin (IPS) test; ADF test: The Augmented Dickey–Fuller (ADF) test; PPS test: The Augmented Dickey–Fuller (ADF) test
Source(s): Authors' own calculations

Table 6. Panel unit root tests for control variables

Variable	At level LLC test	IPS test	ADF test	PP test	At first difference LLC test	IPS test	ADF test	PP test
CAR	−9.42	−5.23	217.62	223.61				
	(0.00)	(0.00)	(0.00)	(0.00)				
CDR	−30.95	−10.88	309.36	345.33				
	(0.00)	(0.00)	(0.00)	(0.00)				
GDPGR	−31.30	18.20	545.18	510.12				
	(0.00)	(0.00)	(0.00)	(0.00)				
INFL	−1.92	−1.30	113.63	113.63				
	(0.03)	(0.09)	(0.85)	(0.85)				
NITA	−13.87	−7.94	285.91	308.06				
	(0.00)	(0.00)	(0.00)	(0.00)				
OICTA	−13.98	−7.60	275.15	352.41				
	(0.00)	(0.00)	(0.00)	(0.00)				
OPPTA	−14.40	−8.05	268.40	291.04				
	(0.00)	(0.00)	(0.00)	(0.00)				
PPE	−6.01	−1.89	169.88	171.62				
	(0.00)	(0.02)	(0.01)	(0.01)				
PSR	−8.14	−4.44	209.28	194.12				
	(0.00)	(0.00)	(0.00)	(0.00)				
RD	−7.92	−6.99	266.56	283.02				
	(0.00)	(0.00)	(0.00)	(0.00)				
TBR	−20.38	−8.43	282.39	145.19				
	(0.00)	(0.00)	(0.00)	(0.17)				

Note(s): This table reports the test statistic, followed by the probability values in parentheses, for the four tests performed in ascertaining the stationarity of the variables. The first panel reports the test results in level form, and the second panel reports the results in the first difference
LLC test: The Levin, Lin and Chu test; IPS test: The Im, Pesaran and Shin (IPS) test; ADF test: The Augmented Dickey–Fuller (ADF) test; PPS test: The Augmented Dickey–Fuller (ADF) test
Source(s): Authors' own calculations

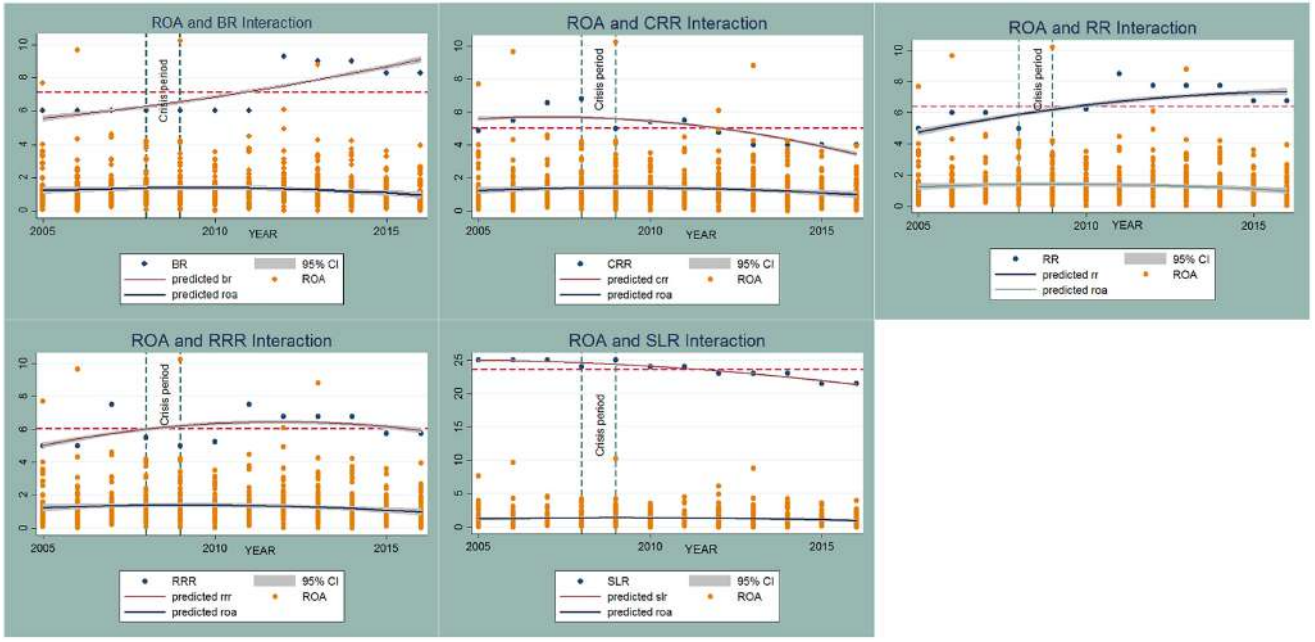
0.02%. Table 7 displays the panel regression results using PLS and the GMM approach. ROA and ROE are influenced favorably and considerably by the CRR and the SLR. The central bank's RR issued to banks is positive and highly connected with ROA. On the other hand, RR is significantly and negatively associated with ROE. A year of contractionary monetary policy that rises the RR from 0 to 1% decreases the ROE by 0.15%.

4.2 Effects on return on advances and investments

Following our hypothesis, the results indicate a negative association of policy variables (RR, CRR and SLR) with ROADV and ROI (Table 8). Particularly, CRR and RR exert a statistically significant impact, indicating a substantial drain on the ROADV and ROI as the policy variables increase. Figures 5 and 6 provide a graphical presentation of the interplay of monetary policy factors with ROADV and ROI, respectively. Higher interest rates dampen the return on advances and investments, negatively affecting net interest income (NII). Policy rates have a concave connection with ROADV and ROI, evidencing our hypothesis that rising monetary policy rates inhibit bank returns on their advances and investments.

4.3 Effects on nonperforming assets and employee business

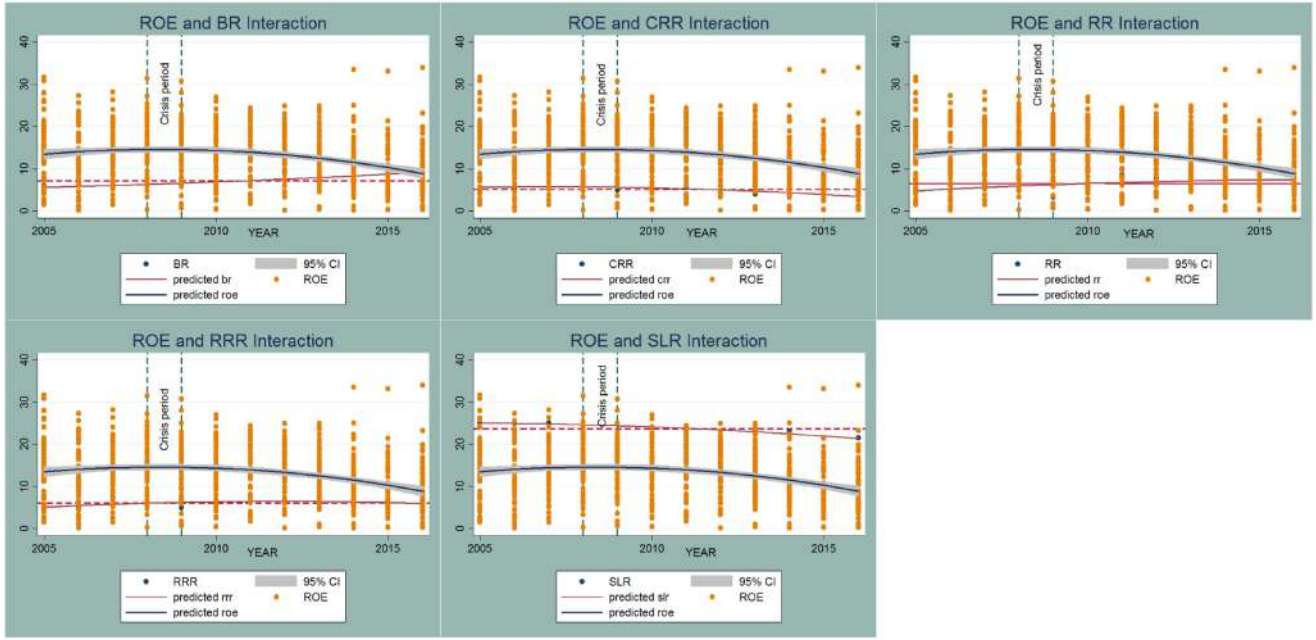
The policy variable RR positively correlates with the performance variables NNPA and BPE (Table 9). CRR and SLR, however, have a detrimental association with NNPA and BPE, indicating that the RR has a large positive link while the long-term ratios have a negative



Note(s): We present the interaction of monetary policy variables and banks' return on assets. Each of the graphs includes the predicted policy variable and the predicted ROA. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. The crisis period is denoted between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 3. Impact of monetary policy on return on assets



Note(s): We present the interaction of monetary policy variables and banks' return on equity. Each of the graphs includes the predicted policy variable and the predicted ROE. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. The crisis period is denoted between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 4. Impact of monetary policy on return on equity

Table 7. Impact of monetary policy on bank profitability

Variable	ROA		ROE	
	PLS	GMM	PLS	GMM
Credit-deposit ratio (CDR)	−0.001	−0.001	−0.01	−0.01
	(0.00)	(0.00)	(0.01)	(0.01)
Ratio of deposits to total liabilities (RD)	−0.01	−0.01*	−0.03	−0.03
	(0.00)	(0.00)	(0.04)	(0.05)
Ratio of priority sector advances to total advances (PSR)	0.001	0.001	0.02	0.02
	(0.00)	(0.00)	(0.04)	(0.04)
Capital adequacy ratio (CAR)	0.01***	0.01**	−0.06**	−0.06*
	(0.00)	(0.00)	(0.02)	(0.03)
Ratio of non-interest income to total assets (NITA)	0.12**	0.12***	−1.01**	−1.01*
	(0.05)	(0.03)	(0.47)	(0.62)
Ratio of intermediation cost to total assets (OICTA)	−0.13***	−0.13***	−0.06	−0.06
	(0.04)	(0.03)	(0.62)	(0.62)
Ratio of operating profits to total assets (OPPTA)	0.44***	0.44***	2.29***	2.29***
	(0.03)	(0.02)	(0.39)	(0.47)
Gross domestic product growth (GDPGR)	−0.01*	−0.01	−0.11***	−0.11
	(0.00)	(0.01)	(0.02)	(0.13)
Inflation (INFL)	0.02***	0.02***	0.39***	0.39***
	(0.01)	(0.001)	(0.04)	(0.12)
Cash reserve ratio (CRR)	0.04***	0.04***	1.40***	1.40***
	(0.01)	(0.01)	(0.06)	(0.31)
Statutory reserve ratio (SLR)	0.02**	0.02	0.53***	0.53***
	(0.01)	(0.01)	(0.05)	(0.17)
Repo rate (RR)	0.02**	0.02**	−0.15***	−0.15
	(0.01)	(0.01)	(0.02)	(0.15)
Bank rate (BR)	0.001	0.001	0.24***	0.24*
	(0.01)	(0.01)	(0.02)	(0.13)
Treasury bill rate (TBR)	0.01	0.01	0.07	0.07
	(0.01)	(0.01)	(0.08)	(0.23)
Intercept	0.07	0.07	2.97	2.97
	(0.41)	(0.35)	(4.80)	(5.83)
R-squared	0.86	0.86	0.56	0.56
Adj *R*-squared	0.84	0.84	0.51	0.51
D-W stat	1.31	1.31	1.10	1.10
VIF range	1.10–4.92	1.10–4.92	1.47–5.30	1.47–5.30
Fixed effects	Yes	Yes	Yes	Yes
Cross sections	65	65	65	65
Observations	715	715	715	715

Note(s): We report the results of the Panel Regression (linear) models of the baseline specification using the profitability measures (ROA and ROE) as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) and Generalized Methods of Moments (GMM) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks ***, ** and * indicate significance levels at 1, 5 and 10%, respectively

Source(s): Authors' own calculations

influence. Figures 7 and 8 provide a graphical presentation of the interface between monetary policy variables with NNPA and BPE, respectively.

4.4 Effects on the performance of bank groups

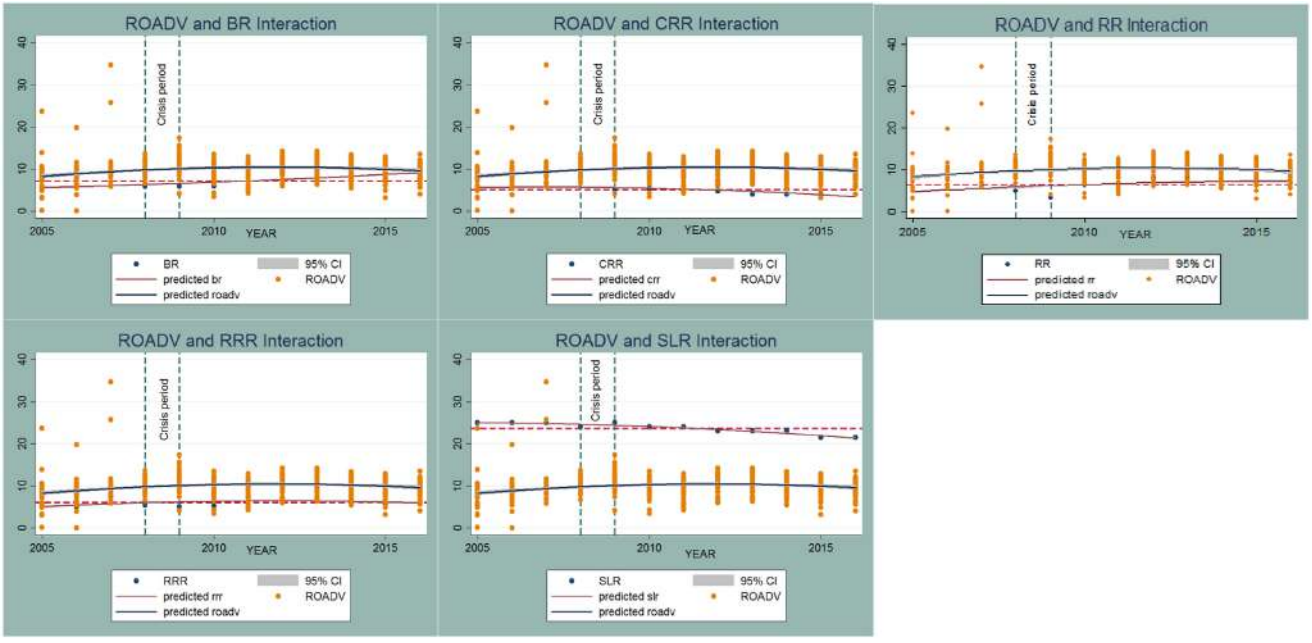
The results of an examination into the influence of monetary policy determinants on bank groups based on ownership patterns are provided below. The repo rate (RR) positively correlates with the ROA of all three bank groups – public, private and foreign (Table 10). CRR

Table 8. Impact of monetary policy on bank returns

Variable	ROADV		ROI	
	OLS	GMM	OLS	GMM
Credit-deposit ratio (CDR)	−0.01**	−0.01**	−0.001	−0.002***
	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of deposits to total liabilities (RD)	0.01	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Ratio of priority sector advances to total advances (PSR)	−0.001	−0.001	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Capital adequacy ratio (CAR)	−0.03***	−0.03***	−0.03***	−0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Ratio of non-interest income to total assets (NITA)	0.11	0.11	−0.34***	−0.34***
	(0.09)	(0.09)	(0.07)	(0.07)
Ratio of intermediation cost to total assets (OICTA)	0.25***	0.25***	0.43***	0.43***
	(0.09)	(0.09)	(0.08)	(0.08)
Ratio of operating profits to total assets (OPPTA)	0.31***	0.31***	0.38***	0.38***
	(0.06)	(0.06)	(0.05)	(0.05)
Gross domestic product growth (GDPGR)	−0.13***	−0.13***	−0.05***	−0.05***
	(0.02)	(0.02)	(0.02)	(0.02)
Inflation (INFL)	0.23***	0.23***	−0.07***	−0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Cash reserve ratio (CRR)	−0.52***	−0.52***	−0.22***	−0.22***
	(0.03)	(0.03)	(0.03)	(0.03)
Statutory liquidity ratio (SLR)	−0.05	−0.05	−0.01	−0.01
	(0.04)	(0.04)	(0.03)	(0.03)
Repo rate (RR)	−0.31***	−0.31***	−0.12***	−0.12***
	(0.02)	(0.02)	(0.02)	(0.02)
Bank rate (BR)	0.01	0.01	0.02	0.02
	(0.03)	(0.03)	(0.02)	(0.02)
Treasury bill rate (TBR)	0.32***	0.32***	0.08***	0.08***
	(0.03)	(0.03)	(0.03)	(0.03)
Intercept	10.35***	10.35***	8.35***	8.35***
	(0.97)	(0.97)	(0.94)	(0.94)
R-squared	0.83	0.83	0.59	0.59
Adj *R*-squared	0.8	0.8	0.54	0.54
R-squared (between)	0.0409	0.0409	0.03	
D-W stat	1.25	1.25	1.43	1.43
VIF range	1.22–4.72	1.22–4.72	1.19–4.80	
Fixed effects	Yes	Yes	Yes	Yes
Cross sections	65	65	65	65
Observations	715	715	715	715

Note(s): We report the results of the Panel Regression (linear) models of the baseline specification using the bank return measures (ROADV and ROI) as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) and Generalized Methods of Moments (GMM) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks *** and ** indicate significance levels at 1 and 5%, respectively
Source(s): Authors' own calculations

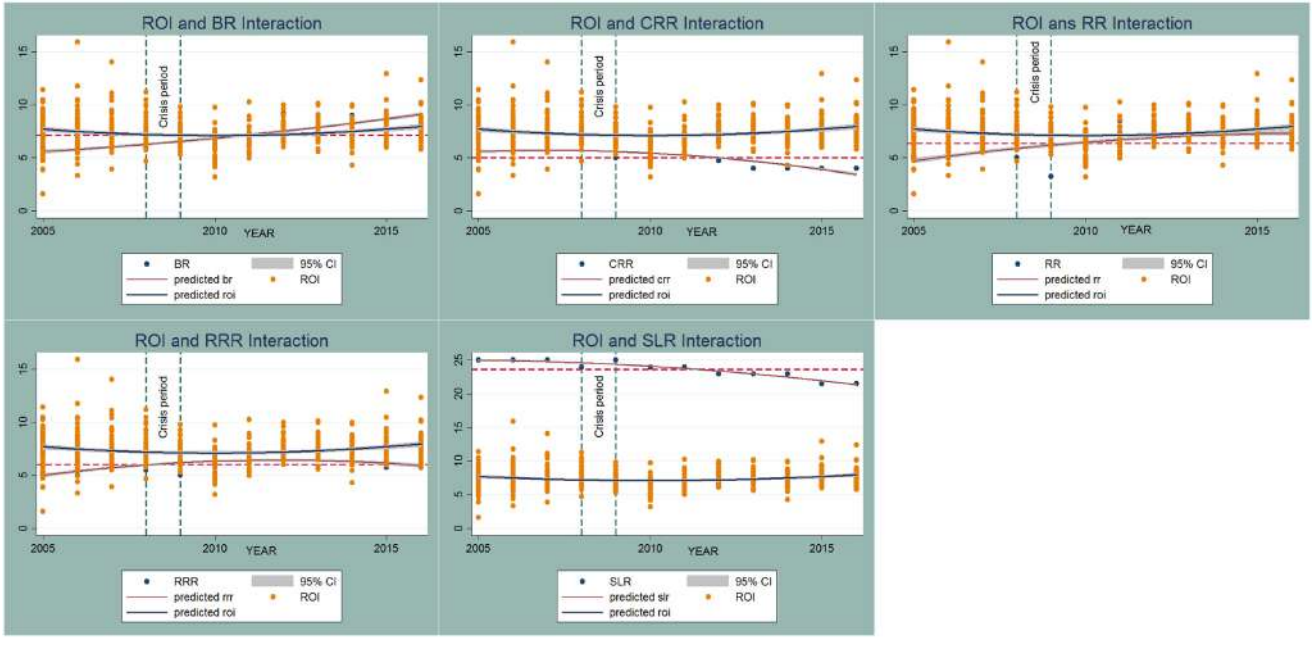
has been discovered to have a substantial positive link with the ROA of public banks and a large negative association with the ROA of private and international banks. In the case of the ROE, however, the CRR is noted to have a large positive association with public banks and an adversarial relationship with private and international banks. These findings imply that increased CRR has a favorable influence on public banks.



Note(s): We present the interaction of monetary policy variables and the banks' return on advances. Each of the graphs includes the predicted policy variable and the predicted ROADV. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. The crisis period is denoted between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 5. Impact of monetary policy on return on advances



Note(s): We present the interaction of monetary policy variables and banks' return on investment. Each of the graphs includes the predicted policy variable and the predicted ROI. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. The crisis period is denoted between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 6. Relationship between monetary policy and return on investments

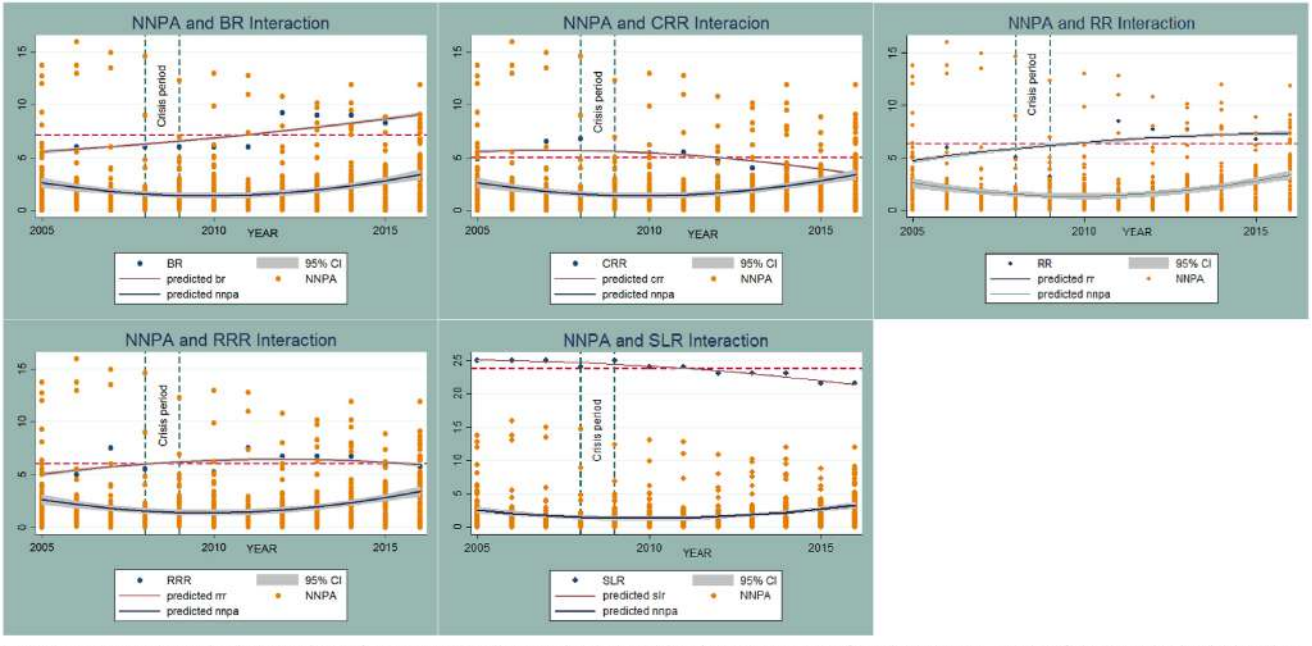
Table 9. Impact of monetary policy on bank performance – NNPA and BPE

Variable	NNPA		BPE	
	OLS	GMM	OLS	GMM
Credit-deposit ratio (CDR)	0.001	0.001	0.10**	0.10**
	(0.00)	(0.00)	(0.04)	(0.04)
Ratio of deposits to total liabilities (RD)	0.01	0.01	–	–
	(0.01)	(0.01)	–	–
Ratio of priority sector advances to total advances (PSR)	0.03***	0.03***	−0.25***	−0.25***
	(0.01)	(0.01)	(0.06)	(0.06)
Capital adequacy ratio (CAR)	−0.02**	−0.02**	0.001	0.001
	(0.01)	(0.01)	(0.07)	(0.07)
Ratio of non-interest income to total assets (NITA)	0.38***	0.38***	−1.01	−1.01
	(0.10)	(0.10)	(0.91)	(0.91)
Ratio of intermediation cost to total assets (OICTA)	−0.29***	−0.29***	−1.69*	−1.69*
	(0.11)	(0.11)	(0.98)	(0.98)
Ratio of operating profits to total assets (OPPTA)	−0.47***	−0.47***	1.72**	1.72**
	(0.07)	(0.07)	(0.68)	(0.67)
Gross domestic product growth (GDPGR)	−0.05*	−0.05*	−0.45**	−0.45**
	(0.03)	(0.03)	(0.20)	(0.22)
Inflation (INFL)	−0.19***	−0.19***	0.34**	0.34**
	(0.02)	(0.02)	(0.17)	(0.16)
Cash reserve ratio (CRR)	−0.09	−0.09	0.91***	0.91***
	(0.08)	(0.08)	(0.31)	(0.33)
Statutory reserve ratio (SLR)	−0.05	−0.05	−0.17	−0.17
	(0.04)	(0.04)	(0.43)	(0.41)
Repo rate (RR)	0.06**	0.06**	0.97***	0.97***
	(0.03)	(0.03)	(0.26)	(0.26)
Bank rate (BR)	0.28***	0.28***	−0.07	−0.07
	(0.08)	(0.08)	(0.30)	(0.30)
Treasury bill rate (TBR)	−0.33***	−0.33***	−1.11***	−1.11***
	(0.06)	(0.06)	(0.37)	(0.38)
Intercept	4.66***	4.66***	8.78	8.78
	(1.68)	1.68)	(6.69)	(6.80)
R-squared	0.67	0.67	0.3	0.30
Adj *R*-squared	0.63	0.63	0.21	0.21
D-W stat	1.31	1.31	2.04	2.04
VIF range	1.12–15.04	1.12–15.04	1.30–4.30	1.30–4.30
Fixed effects	Yes	Yes	Yes	Yes
Cross sections	65	65	65	65
Observations	715	715	715	715

Note(s): We report the results of the Panel Regression (linear) models of the baseline specification using the performance measures (NNPA and BPE) as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) and Generalized Methods of Moments (GMM) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks ***, ** and * indicate significance levels at 1, 5 and 10%, respectively

Source(s): Authors' own calculations

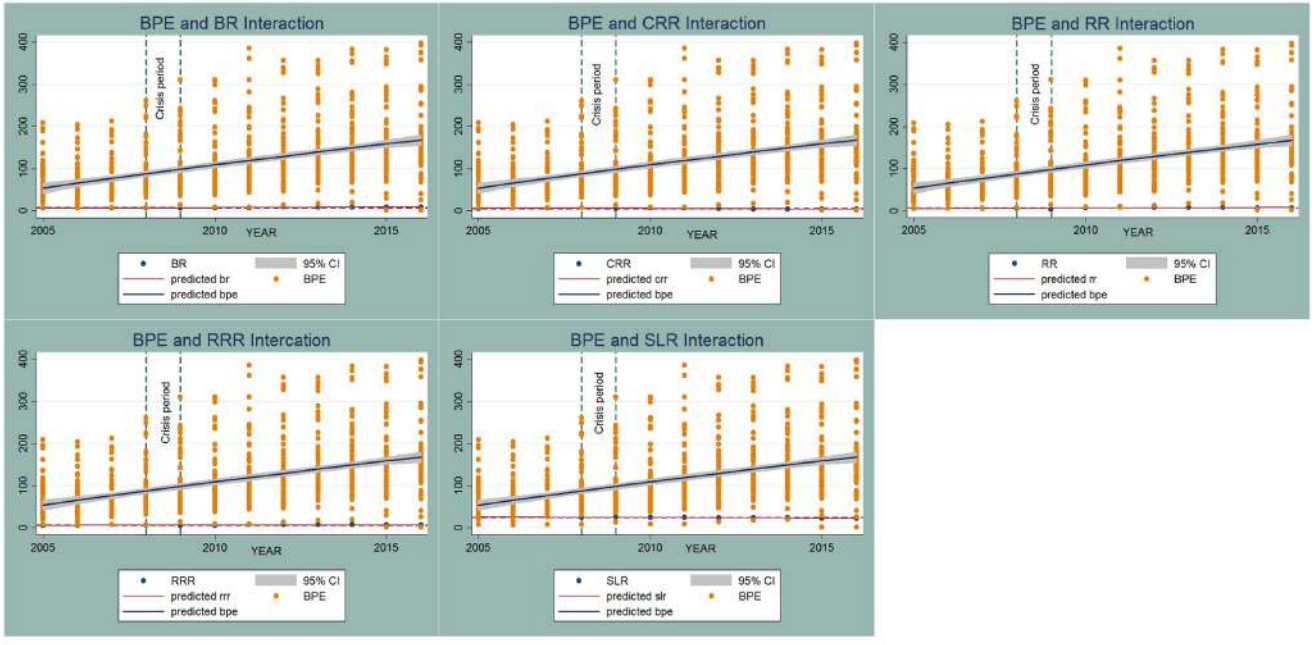
Private and international banks, on the other hand, are more vulnerable to CRR increases, which harm them. SLR shows a substantial positive association with public bank ROA but a large negative link with private bank ROA, implying that private banks are more vulnerable to SLR increases than public banks. We find that RR has a considerable favorable influence on public bank ROE while having a negative impact on private and international banks (Table 10). The BR has a strong favorable influence on public banks' ROA and ROE. However, this link is unimportant in the case of private and international banks.



Note(s): We present the interaction of monetary policy variables and banks' net non-performing assets. Each of the graphs includes the predicted policy variable and the predicted NNPA. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. The crisis period is denoted between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 7. Interaction between monetary policy and net nonperforming assets



Note(s): We present the interaction of monetary policy variables and banks' business per employee. Each of the graphs includes the predicted policy variable and BPE. The long-dash reference line on the horizontal axis indicates the mean value of the policy rates BR, CRR, RR, RRR, and SLR, respectively. We denote the crisis period between dotted lines on the X-axis

Source(s): Authors' own elaboration

Figure 8. Impact of monetary policy on business performance per employee

Table 10. Impact of monetary policy on ROA and ROE across bank groups

Variable	ROA			ROE		
	Public	Private	Foreign	Public	Private	Foreign
Credit-deposit ratio (CDR)	−0.001	−0.001	−0.001	−0.001	−0.001*	−0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of deposits to total liabilities (RD)	−0.001	−0.001*	−0.001	−0.003	0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Ratio of priority sector advances to total advances (PSR)	0.001	−0.001**	0.001	0.001	−0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Capital adequacy ratio (CAR)	0.001	0.001*	−0.002	0.003*	0.001	−0.03**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Ratio of non-interest income to total assets (NITA)	−0.01***	−0.001***	0.13***	−0.24**	−0.00	0.35***
	(0.01)	(0.00)	(0.02)	0.10	(0.00)	(0.12)
Ratio of intermediation cost to total assets (OICTA)	0.01	−0.001	−0.07***	0.05	−0.01**	−0.19***
	(0.00)	(0.00)	(0.01)	(0.07)	(0.00)	(0.05)
Ratio of operating profits to total assets (OPPTA)	0.01***	0.001***	0.09***	0.22***	−0.00	0.30***
	(0.00)	(0.00)	(0.02)	(0.08)	(0.00)	(0.08)
Gross domestic product growth (GDPGR)	0.001	−0.001***	−0.001	−0.02	0.001**	−0.01**
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)
Inflation (INFL)	0.001***	−0.001	−0.001	0.05***	0.001***	−0.001
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Cash reserve ratio (CRR)	0.02***	−0.001***	−0.01***	0.21***	−0.00	−0.02*
	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)	(0.01)
Statutory reserve ratio (SLR)	0.01***	−0.001***	0.001	0.12***	0.001**	0.02**
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.01)
Repo rate (RR)	0.001***	0.001*	0.001**	0.04**	−0.001	−0.001
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.01)
Bank rate (BR)	0.001***	−0.001	−0.001**	0.05***	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Treasury bill rate (TBR)	−0.00**	−0.001**	0.01***	−0.07***	0.001***	0.01*
	(0.00)	(0.00)	(0.00)	(0.03)	(0.00)	(0.01)
Intercept	0.22***	0.35***	0.42*	1.76***	4.06***	2.15***
	(0.03)	(0.01)	(0.24)	(0.67)	(0.03)	(0.56)
R-squared	0.91	0.97	0.89	0.91	0.97	0.91
Adj *R*-squared	0.89	0.97	0.87	0.89	0.97	0.90
D-W stat	0.82	1.01	1.52	0.82	1.04	1.75
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cross sections	65	65	65	65	65	65
Observations	715	715	715	715	715	715

Note(s): We report the results of the linear models using the bank groups' ROA and ROE, based on ownership structures, as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks ***, ** and * indicate significance levels at 1, 5 and 10%, respectively

Source(s): Authors' own calculations

We provide the findings of evaluating the influence of repo rate on bank groups' ROA and ROI (Table 11). The short-term policy rate RR has a substantial negative association with all three bank groups' ROADV and ROI. Similarly, CRR and SLR show a substantial negative relationship with all three bank groups' ROADV and ROI. TBR has a considerable positive association with all three bank groups' ROADV. TBR, however, shows a large positive link with public bank ROI and a negative relationship with foreign bank ROI. The bank rate (BR) has little effect on the ROADV and ROI of bank groups. However, in this situation, the connection is significantly unfavorable.

Table 11. Impact of monetary policy on ROADV and ROI across bank groups

Variable	ROADV			ROI		
	Public	Private	Foreign	Public	Private	Foreign
Credit-deposit ratio (CDR)	0.001	−0.001	−0.01***	−0.001**	0.001	0.002*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of deposits to total liabilities (RD)	0.01***	−0.001***	−0.01**	−0.001	0.001	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of priority sector advances to total advances (PSR)	−0.001	0.001	−0.01**	0.001***	0.001*	−0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Capital adequacy ratio (CAR)	0.001	−0.001*	−0.01**	−0.001	0.001	−0.01***
	(0.00)	(0.00)	0.01	(0.00)	(0.00)	(0.00)
Ratio of non-interest income to total assets (NITA)	0.06*	0.001	−0.02	−0.01*	−0.01***	−0.01
	(0.04)	(0.01)	(0.07)	(0.00)	(0.00)	(0.03)
Ratio of intermediation cost to total assets (OICTA)	−0.07	0.02***	0.13***	0.02***	0.02***	0.01
	(0.05)	(0.01)	(0.03)	(0.01)	(0.01)	(0.02)
Ratio of operating profits to total assets (OPPTA)	−0.05*	−0.001	0.18***	0.01	0.01***	0.07***
	(0.03)	(0.00)	(0.04)	(0.00)	(0.00)	(0.02)
Gross domestic product growth (GDPGR)	−0.02***	−0.01***	0.01*	0.001	−0.001***	−0.003***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Inflation (INFL)	0.04***	0.01***	0.03***	−0.01***	−0.001***	−0.001
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Cash reserve ratio (CRR)	−0.07***	−0.04***	0.00	−0.01**	−0.01***	−0.003*
	(0.01)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Statutory reserve ratio (SLR)	−0.001	−0.01	−0.07***	0.002	−0.001	−0.001
	(0.01)	(0.00)	(0.03)	(0.00)	(0.00)	(0.00)
Repo rate (RR)	−0.03***	−0.02***	−0.04***	−0.004***	−0.001**	−0.004***
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
Bank rate (BR)	0.01	−0.002	−0.03	0.001	0.001	0.001
	(0.01)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Treasury bill rate (TBR)	0.05***	0.01***	0.05**	0.001*	0.001	−0.002
	(0.01)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)
Intercept	3.72***	3.52***	5.63***	2.98***	2.98***	2.24***
	(0.16)	(0.08)	(1.04)	(0.05)	(0.05)	(0.29)
R-squared	0.99	0.99	0.98	0.99	0.99	0.98
Adj *R*-squared	0.99	0.99	0.98	0.99	0.99	0.98
D-W stat	0.96	0.92	1.31	0.99	1.20	1.35
Fixed effects	Yes		Yes	Yes	Yes	Yes
Cross-sections	65		65	65	65	65
Observations	715		715	715	715	715

Note(s): We report the results of the linear models using the ROADV and ROI of the bank groups, based on ownership structures, as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks ***, ** and * indicate significance levels at 1, 5 and 10%, respectively

Source(s): Authors' own calculations

Table 12 shows the findings of evaluating the influence of RR on the bank groups' NNPA and BPE. According to our findings, CRR has a considerable negative impact on the NNPA and BPE of all bank groups. SLR has a considerable negative relationship with public bank NNPA and private and foreign bank BPE. The RR has a considerable beneficial influence on the NNPE and BPE of all three bank groups, implying that if the short-term policy rate rises, so will the NNPA levels of all banks. All three bank groups' NNPA and BPE have a favorable link with RR. However, there is a substantial negative association between TBR and the NNPA in all three bank categories.

Table 12. Impact of monetary policy on NNPA and BPE across bank groups

Variable	NNPA			BPE		
	Public	Private	Foreign	Public	Private	Foreign
Credit-deposit ratio (CDR)	−0.001	0.001	−0.001	−0.001**	0.001	−0.002*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ratio of deposits to total liabilities (RD)	0.001	−0.001	−0.002	–	–	–
	(0.00)	(0.00)	(0.00)	–	–	–
Ratio of priority sector advances to total advances (PSR)	0.003	0.001***	0.004***	−0.001***	0.001	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Capital adequacy ratio (CAR)	−0.001	−0.001	−0.003	−0.001	−0.001	0.01*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Ratio of non-interest income to total assets (NITA)	0.08**	−0.00	−0.01	0.001	−0.004	0.05
	(0.03)	(0.00)	(0.00)	(0.00)	(0.01)	(0.09)
Ratio of intermediation cost to total assets (OICTA)	0.03	0.01	−0.04*	−0.01***	−0.03*	−0.45***
	(0.04)	(0.00)	(0.02)	(0.00)	(0.02)	(0.08)
Ratio of operating profits to total assets (OPPTA)	−0.07**	0.00	−0.02	−0.001	0.04***	0.33***
	(0.03)	(0.00)	(0.02)	(0.00)	(0.01)	(0.06)
Gross domestic product growth (GDPGR)	−0.01	0.001***	−0.002**	−0.002***	−0.01***	−0.01***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Inflation (INFL)	−0.05***	−0.003***	0.001	0.002***	−0.003	−0.02***
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Cash reserve ratio (CRR)	−0.03**	−0.003*	−0.01	−0.003**	−0.06***	−0.07***
	(0.02)	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)
Statutory reserve ratio (SLR)	−0.11***	0.001	0.01***	0.001	−0.01***	−0.02*
	(0.03)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
Repo rate (RR)	0.01*	0.002***	0.004*	0.004***	0.01**	0.00
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Bank rate (BR)	0.08***	0.004***	0.001	0.00	0.00	−0.02***
	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Treasury bill rate (TBR)	−0.07***	−0.004***	−0.01**	−0.002**	−0.01	0.01
	(0.03)	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Intercept	3.81***	0.31***	0.85***	0.25***	0.73***	1.89***
	(0.87)	(0.02)	(0.31)	(0.02)	(0.10)	(0.41)
R-squared	0.72	0.78	0.84	0.87	0.82	0.83
Adj *R*-squared	0.69	0.75	0.82	0.86	0.79	0.81
D-W stat	1.08	0.90	1.22	0.91	0.68	1.17
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Cross sections	65	65	65	65	65	65
Observations	715	715	715	715	715	715

Note(s): We report the results of the linear models using the NNPA and BPE of the bank groups, based on ownership structures, as the dependent variables. We present the results of the Panel Least Squares (PLS) with fixed effects (cross-section weights (PCSE) standard errors and covariance) with the coefficient values marked with significance levels in the first row, followed by the standard errors (in parenthesis) in the second row. Asterisks ***, ** and * indicate significance levels at 1, 5 and 10%, respectively
Source(s): Authors' own calculations

4.5 Estimating causality

The paired panel Granger causality test determines the causation and direction between monetary policy and performance indicators. Table 13 shows the panel Granger causality testing findings for the policy variables and the ROA, ROA, and ROE. The direction of causation runs from CRR ROA, BR ROA and TBR ROA. However, in the ROE-related analysis case, a bidirectional causality runs between RR ROE and TBR ROE. We notice unidirectional causation with CRR ROE and BR ROE. Nevertheless, we overlook causation from SLR to ROA or ROE. Table 14 displays the panel Granger causality test findings for the policy variables ROADV and ROI. We notice bi-directional causation running

Table 13. Panel Granger causality analysis for ROA and ROE

ROA					ROE				
Null hypothesis:	Obs	Lags	*F*-statistic	Prob.	Null hypothesis:	Obs	Lags	*F*-statistic	Prob.
CDR ROA	650	2	1.62	0.20	CDR ROE	650	2	1.54	0.22
ROA CDR			10.94	0.00	ROE CDR			0.64	0.53
RD ROA	650	2	23.28	0.00	RD ROE	650	2	7.14	0.00
ROA RD			1.35	0.26	ROE RD			0.64	0.53
PSR ROA	650	2	4.05	0.02	PSR ROE	650	2	1.62	0.20
ROA PSR			3.90	0.02	ROE PSR			0.84	0.43
CAR ROA	650	2	11.58	0.00	CAR ROE	650	2	4.52	0.01
ROA CAR			4.73	0.01	ROE CAR			3.93	0.02
NITA ROA	650	2	1.56	0.21	NITA ROE	650	2	1.65	0.19
ROA NITA			11.68	0.00	ROE NITA			3.08	0.05
OICTA ROA	650	2	0.98	0.37	OICTA ROE	650	2	0.10	0.90
ROA OICTA			3.94	0.02	ROE OICTA			3.09	0.05
OPPTA ROA	650	2	13.53	0.00	OPPTA ROE	650	2	5.97	0.00
ROA OPPTA			1.54	0.21	ROE OPPTA			4.84	0.01
GDPGR ROA	650	2	6.97	0.00	GDPGR ROE	650	2	15.79	0.00
ROA GDPGR			0.09	0.92	ROE GDPGR			2.59	0.08
INFL ROA	650	2	0.46	0.63	INFL ROE	650	2	7.38	0.00
ROA INFL			2.82	0.06	ROE INFL			15.11	0.00
CRR ROA	650	2	8.65	0.00	CRR ROE	650	2	22.71	0.00
ROA CRR			0.53	0.59	ROE CRR			1.41	0.25
SLR ROA	585	2	1.24	0.29	SLR ROE	585	2	2.15	0.12
ROA SLR			4.23	0.01	ROE SLR			13.02	0.00
RR ROA	650	2	0.83	0.43	RR ROE	650	2	7.37	0.00
ROA RR			0.75	0.47	ROE RR			4.23	0.02
BR ROA	585	2	2.78	0.06	BR ROE	585	2	4.78	0.01
ROA DBR			0.90	0.41	ROE DBR			1.45	0.24
TBR ROA	650	2	4.45	0.01	TBR ROE	650	2	11.15	0.00
ROA TBR			2.17	0.12	ROE TBR			13.04	0.00

Note(s): means does not Granger cause
Source(s): Authors' own calculations

from CRR ROADV, SLR ROADV, RR ROADV, BR ROADV and TBR ROADV.

Similarly, we notice bi-directional causation running from CRR , SLR and RR ROI. In contrast, no causality exists between BR to ROI and TBR to ROI. Finally, in Table 15, we present the panel Granger causality test results using the policy variables and the NNPA and BPE. Bi-directional causality runs from CRR NNPA, SLR NNPA, RR NPA, BR NNPA and TBR NNPA. Similarly, we notice bi-directional causality running from CRR BPE, SLR BPE, RR BPE and TBR NNPA.

5. Discussions

This section delves into the interpretation and implications of the study's findings, comparing them with existing literature, evaluating the robustness of the results and exploring the practical and theoretical contributions to the literature on monetary policy's impact on bank performance.

This study examined the influence of monetary policy rates on the performance measures of banks, such as profitability metrics (ROA and ROE), return on advances and investments (ROADV and ROI), nonperforming assets (NNPA) and employee business performance (BPE).

Table 14. Panel Granger causality analysis for ROADV and ROI

ROADV					ROI				
Null hypothesis:	Obs	Lags	*F*-statistic	Prob.	Null hypothesis:	Obs	Lags	*F*-statistic	Prob.
CDR ROADV	650	2	7.44	0.00	CDR ROI	650	2	1.56	0.21
ROADV CDR			0.92	0.40	ROI CDR			3.91	0.02
RD ROADV	650	2	12.15	0.00	RD ROI	650	2	0.60	0.55
ROADV RD			4.01	0.02	ROI RD			1.18	0.31
PSR ROADV	650	2	3.25	0.04	PSR ROI	650	2	7.58	0.00
ROADV PSR			4.29	0.01	ROI PSR			1.89	0.15
CAR ROADV	650	2	4.50	0.01	CAR ROI	650	2	8.62	0.00
ROADV CAR			1.71	0.18	ROI CAR			1.91	0.15
NITA ROADV	650	2	12.48	0.00	NITA ROI	650	2	2.67	0.07
ROADV NITA			18.11	0.00	ROI NITA			1.80	0.17
OICTA ROADV	650	2	9.44	0.00	OICTA ROI	650	2	6.13	0.00
ROADV OICTA			3.80	0.02	ROI OICTA			0.91	0.40
OPPTA ROADV	650	2	13.63	0.00	OPPTA ROI	650	2	1.84	0.16
ROADV OPPTA			21.65	0.00	ROI OPPTA			0.23	0.79
GDPGR ROADV	650	2	44.54	0.00	GDPGR ROI	650	2	19.86	0.00
ROADV GDPGR			6.15	0.00	ROI GDPGR			0.13	0.87
INFL ROADV	650	2	6.64	0.00	INFL ROI	650	2	37.64	0.00
ROADV INFL			22.45	0.00	ROI INFL			4.28	0.01
CRR ROADV	650	2	19.20	0.00	CRR ROI	650	2	37.42	0.00
ROADV CRR			6.35	0.00	ROI CRR			9.36	0.00
SLR ROADV	585	2	12.30	0.00	SLR ROI	585	2	10.51	0.00
ROADV DSLR			2.85	0.06	ROI DSLR			3.70	0.03
RR ROADV	650	2	6.22	0.00	RR ROI	650	2	54.33	0.00
ROADV RR			12.43	0.00	ROI RR			4.09	0.02
BR ROADV	585	2	2.37	0.09	BR ROI	585	2	0.23	0.79
ROADV DBR			5.21	0.01	ROI DBR			29.16	0.00
TBR ROADV	650	2	22.43	0.00	TBR ROI	650	2	42.94	0.00
ROADV TBR			24.10	0.00	ROI TBR			0.66	0.52

Source(s): Authors' own calculations

To address potential endogeneity concerns, we use IVs that enhance the reliability of our causal estimates. Specifically, we use policy instruments and institutional factors. IVs are crucial in econometric models, particularly within the GMM framework, as they help to get unbiased and consistent estimates of the parameters of interest.

In our analysis, policy instruments are hypothesized to influence bank performance indirectly by impacting the economic environment in which banks operate. These instruments are exogenous to banks' decision-making processes, allowing us to isolate the impacts of monetary policy from other confounding factors. Institutional factors, on the other hand, capture underlying characteristics that may affect bank performance independently of monetary policy actions.

By incorporating these IVs, we strengthen the robustness of our GMM analysis, enabling more reliable estimates of the causal effects of monetary policy on bank profitability. This approach effectively mitigates biases arising from endogeneity, ensuring that the estimated impacts of monetary policy are not confounded by other variables. In this context, variables

Table 15. Panel Granger causality analysis for NNPA and BPE

NNPA					BPE				
Null hypothesis	Obs	Lags	*F*-statistic	Prob.	Null hypothesis	Obs	Lags	*F*-statistic	Prob.
CDR NNPA	650	2	0.42	0.66	CDR DBPE	585	2	6.74	0.00
NNPA CDR			0.33	0.72	DBPE CDR			2.64	0.07
RD NNPA	650	2	0.67	0.51					
NNPA RD			3.35	0.04					
PSR NNPA	650	2	0.07	0.93	PSR DBPE	585	2	0.42	0.66
NNPA PSR			3.09	0.05	DBPE PSR			0.70	0.50
CAR NNPA	650	2	0.98	0.38	CAR DBPE	585	2	0.07	0.93
NNPA CAR			13.89	0.00	DBPE CAR			3.42	0.03
NITA NNPA	650	2	0.26	0.77	NITA DBPE	585	2	1.99	0.14
NNPA NITA			9.13	0.00	DBPE NITA			4.92	0.01
OICTA	650	2	3.40	0.03	OICTA	585	2	0.93	0.39
NNPA					DBPE				
NNPA			4.99	0.01	DBPE			6.65	0.00
OICTA					OICTA				
OPPTA	650	2	0.88	0.42	OPPTA	585	2	4.16	0.02
NNPA					DBPE				
NNPA			11.56	0.00	DBPE			0.19	0.83
OPPTA					OPPTA				
GDPGR	650	2	8.85	0.00	GDPGR	585	2	2.08	0.13
NNPA					DBPE				
NNPA			1.94	0.14	DBPE			1.79	0.17
GDPGR					GDPGR				
INFL NNPA	650	2	0.57	0.56	INFL DBPE	585	2	1.22	0.30
NNPA INFL			4.64	0.01	DBPE INFL			1.44	0.24
CRR NNPA	650	2	12.21	0.00	CRR DBPE	585	2	2.95	0.05
NNPA CRR			2.54	0.08	DBPE CRR			1.50	0.22
SLR NNPA	650	2	27.29	0.00	DSLR DBPE	585	2	2.84	0.06
NNPA SLR			0.32	0.73	DBPE DSLR			3.45	0.03
RR NNPA	650	2	15.90	0.00	RR DBPE	585	2	3.79	0.02
NNPA RR			6.05	0.00	DBPE RR			3.37	0.04
BR NNPA	650	2	15.00	0.00	DBR DBPE	585	2	2.57	0.08
NNPA BR			0.50	0.61	DBPE DBR			3.83	0.02
TBR NNPA	650	2	17.40	0.00	TBR DBPE	585	2	3.94	0.02
NNPA TBR			3.83	0.02	DBPE TBR			0.89	0.41

Source(s): Authors' own calculations

such as the repo rate (RR), bank rate (BR) and treasury bill rate (TBR) are considered policy instruments, while capital adequacy ratio (CAR), statutory liquidity ratio (SLR) and cash reserve ratio (CRR) are institutional factors.

The findings are discussed further below.

5.1 Effects on bank profitability

According to the findings, monetary policy variables significantly influence ROA and ROE of banks. The graphs in Figures 3 and 4 depict the link between monetary policy variables and ROA and ROE, respectively. Table 7 shows panel regressions using PLS and generalized GMM that validate these findings.

The repo rate has a positive and significant association with ROA, indicating that rising interest rates boost bank profits. On the other hand, the repo rate shows a substantial negative relationship with ROE, showing that higher interest rates reduce bank returns on equity. This conclusion implies that, while higher interest rates might enhance short-term profitability, they can also reduce long-term shareholder returns.

ROA and ROE are positively and strongly related to CRR and SLR, implying that maintaining more significant reserve requirements benefits bank profitability. These reserve requirements buffer during economic downturns and improve financial stability, promoting bank profitability.

5.2 Effects on return on advances and investments

The findings confirm that rising monetary policy rates reduce bank earnings on lending and investments (Table 8, Figures 5 and 6). The negative relationship between policy variables (RR, CRR and SLR) and ROADV and ROI suggests that higher interest rates reduce the return on loans and investments, reducing NII.

The concave connection between policy rates, ROADV and ROI supports the hypothesis that the effect on bank returns grows as policy rates rise. This conclusion emphasizes the significance of adequately regulating interest rate policy to balance short-term benefits and long-term profitability for banks.

5.3 Effects on nonperforming assets and employee business performance

The study found substantial correlations between policy factors and nonperforming assets (NNPA) and employee business performance (BPE) (Table 9, Figures 7 and 8). The repo rate (RR) shows a significant positive link with NNPA and BPE, meaning that higher interest rates may increase nonperforming assets and have a negative impact on employee business performance.

CRR and SLR, in contrast, have a negative association with NNPA and BPE, showing that enhanced reserve requirements stabilize bank asset quality and employee business performance. This conclusion emphasizes the importance of reserve requirements in risk management and overall bank performance.

5.4 Effects on the performance of bank groups

The study also examined how monetary policy factors affected bank groupings depending on ownership patterns (public, private and foreign banks). The repo rate (RR), according to the data (Table 10), has a substantial positive link with the profitability (ROA) of all three bank groups. However, the impacts of CRR and SLR differ depending on the bank's ownership.

CRR has a sizeable positive link with ROA for public banks but a significant negative relationship with private and international banks. This demonstrates that, while rising reserve requirements benefit public banks more, private and international banks are more responsive to the impact on their profitability.

Similarly, for public banks, SLR shows a strong positive connection with ROA but a sizeable negative association for private banks. This suggests that private banks are more affected by changes in SLR than public banks, underlining the importance of tailoring policy measures to diverse bank groupings.

The findings also demonstrate that the short-term policy rate (RR) considerably influences public bank ROE but negatively impacts private and international banks. This shows that public banks may be better positioned to capitalize on short-term interest rate adjustments to boost equity returns, but private and foreign banks may struggle to maintain comparable ROE levels under the same conditions.

5.5 Estimating causality

Panel Granger causality tests were used to investigate causal links among monetary policy variables and bank performance indicators. The findings (Tables 13–15) show causal solid linkages in several directions.

The causal links in the case of bank profitability (ROA and ROE) flow from policy variables (CRR, BR and TBR) to profitability indicators, implying that changes in these policy

rates precede changes in bank profitability. However, evidence of bidirectional causation between some policy variables (RR, TBR and ROE) shows that these variables are in a feedback loop.

The causation between policy variables (CRR, SLR, RR, BR and TBR) and performance indicators is bidirectional for return on advances and investments (ROADV and ROI), implying that changes in both policy rates and bank performance impact each other over time.

The findings for nonperforming assets (NNPA) and employee business performance (BPE) reveal bidirectional causation between policy variables (CRR, SLR, RR, BR and TBR) and performance indicators for all three bank groups. This suggests that monetary policy actions are dynamic with the quality of bank assets and employee business performance.

The study findings give insights into the intricate interplay among policy rates and bank performance indicators. The findings indicate that monetary policy decisions can have variable effects on many dimensions of bank performance, emphasizing the significance of adequately calibrating policy measures to achieve desired economic outcomes. The study findings add to current research on monetary policy transmission mechanisms and have practical consequences for policymakers and financial institutions making decisions. More research is needed, however, to evaluate the monetary policy's long-term impacts on bank performance and its implications for global financial stability.

We acknowledge the limitations that may affect the robustness of the findings. First, the analysis is constrained by the availability and quality of data, which may introduce biases in the results. Additionally, while we have included various control variables, there may be other relevant factors, such as regulatory changes and technological advancements that were not captured. Furthermore, the use of IVs while aimed at addressing endogeneity concerns relies on the validity of the selected instruments, which can be challenging to establish. Lastly, the focus on specific emerging markets may limit the generalizability of the findings to other contexts. Future research should aim to address these limitations for a more comprehensive understanding of this topic.

6. Conclusions

In this concluding section, we summarize the key findings of the study, highlight their significance for the banking sector and offer practical recommendations for policymakers and financial institutions based on the research results.

This study used a panel dataset of 65 scheduled commercial banks in India from 2005 to 2016 to assess the influence of monetary policy on bank performance. We accounted for both traditional bank variables as well as macroeconomic factors. We examine the influence of ownership patterns on the completely balanced panel of the entire sample first and subsequently on the bank categories (public, private and foreign).

Three goals guided this investigation. The initial goal was to examine the connection between monetary policy rates and bank performance indicators. The second goal was to determine how ownership patterns across various bank groups responded to changes in monetary policy. The third goal was to show evidence of monetary policy and bank performance causality. We show that a bank lending channel may affect the efficacy and distributional consequences of monetary policy and the information quality of various measures used by policymakers. We use the model's most relevant variables in the theoretical foundations of the monetary transmission channels. The correlation between interest rate levels and ROA is positive, and the panel Granger causality test results corroborate the same.

This study examines the macroeconomic consequences and concentrates on the effect of monetary policy on bank profitability indicators before and after the crisis. The short-term policy rate has risen significantly post-crisis, paralleling the growth in NPAs. As a result, banks' ROA and ROE have gradually declined since the crisis.

This research makes an essential addition by probing the effect of monetary policy variables on bank groups depending on ownership patterns – public, private and foreign.

Because private and international banks manage statutory reserves more efficiently, they are more vulnerable to changes in CRR and SLR. Private and international bank profitability is more susceptible to changes in repo rates than public bank profitability. However, public banks are more vulnerable to fluctuations in the bank rate since they use this bank rate window of accommodation more frequently than private and international banks.

6.1 Policy implications

The transmission of monetary policy is influenced by the bank lending channel, resulting in differing effects across bank ownership groups. Policymakers need to take into account these varying impacts when crafting policies.

Private and foreign banks, which are more responsive to changes in reserve requirements and repo rates, may need closer monitoring and specific policy interventions to ensure financial stability.

Public sector banks, reliant on the bank rate window, are more susceptible to fluctuations in this policy rate. Policymakers should ensure adequate liquidity support for these banks during periods of tight monetary policy.

The positive but concave relationship between policy rates and bank profitability suggests that excessively strict monetary policy may diminish bank earnings. Policymakers should strive for an optimal policy rate that balances inflation control and bank stability.

The adverse effects of increasing nonperforming assets on bank performance emphasize the importance of maintaining asset quality. Policymakers should promote prudent lending practices and create a supportive environment for banks to tackle distressed assets.

In summary, this study underscores the intricate and nuanced relationship between monetary policy and bank performance in India. Policymakers must carefully consider the ownership structure and business models of banks when evaluating the transmission and impact of monetary policy actions. Targeted policy measures may be necessary to uphold financial stability and foster sustainable credit growth.

Note

1. Flannery (1981) estimates the effect of interest rates on bank profits using the treasury bill rate as the market rate.

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