The impact of technology on bank cost and efficiency

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Abstract

This paper examines the impact of early technology adoption on banking performance, focusing on intermediation costs, net interest margins (NIM), cost efficiency, and credit disbursement, using data from India—a global leader in technological change. This study constructs a novel database that combines supervisory metadata on bank account-level intermediation, and multiple indicators for technology adoption with bank balance sheet. A disaggregated panel regression framework reveals that technology adoption leads to increased intermediation costs due to investments in IT, cash management, payment infrastructure, and security -- despite which, technology has significantly enhanced efficiency and facilitated the provision of a broader range of services at competitive prices. Importantly, technological adoption has not resulted in staff displacement; instead, it has improved bank efficiency, with reduced operational costs per credit account and increased operating profits per employee. The study also uncovers the critical role of business models in managing the rising costs associated with technology adoption. These findings offer insights in the dynamic relationship between technology, efficiency, and financial performance in rapidly digitalizing economies.

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Keywords: Technology adoption, Banking, Intermediation Costs, India

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1. Introduction

The role of technology in shaping the performance of banks has gained increasing attention in recent years, particularly in the context of operational efficiency and profitability. As technological innovations have transformed banking processes, institutions leading in tech adoption are expected to experience both challenges and opportunities. This paper investigates the causal impact of early technology adoption on key aspects of bank performance, focusing on intermediation costs, net interest margins (NIM), cost efficiency, and credit disbursement. By identifying technology leader banks, we aim to analyze how these institutions have adapted to the costs and benefits of technological advancements over the past decade.

The main contribution of this paper is its empirical analysis of the dual effects of technology adoption on bank costs and profitability, as well as its examination of the role of efficiency in moderating the relationship between technology and credit disbursement. By identifying the specific effects of technology leadership on intermediation costs, NIM, ROA, and total credit, the paper provides valuable evidence on how the costs and benefits of technological change play out in different dimensions of banking performance. This study is among the first to simultaneously consider these multiple aspects, offering a comprehensive view of how technology impacts not only profitability but also the ability of banks to extend credit, particularly in an environment where technological advancements are continuously evolving.

Our analysis is based on a disaggregated panel regression framework that explores the effect of technology leadership on various balance sheet parameters while controlling for bank-specific characteristics and fixed effects. The main explanatory variable is a dummy for technology leader banks, which captures whether a bank is an early adopter of new technology. Additionally, we include a dummy for retail business-oriented banks and other control variables such as size, capital adequacy, and ownership to isolate the effects of technology adoption on bank performance.

India has been a leader in leveraging technology for financial inclusion, aiming to provide banking services to underserved populations. Initiatives like the Unified Payments Interface (UPI) have significantly expanded access to digital financial services, demonstrating the transformative potential of technology (G. Cornelli et al., 2024). Studying India's banking sector thus offers insights into how technology promotes financial inclusion, particularly for previously excluded segments of society.

This paper contributes to the growing body of literature on the impact of technological advancements in banking, offering new insights into how early adoption of technology influences both bank performance and credit disbursement. While existing research has focused primarily on the efficiency gains from technological innovation, this study provides a nuanced understanding by highlighting the trade-off between higher operational costs and improved profitability. Specifically, the paper shows that while technology leader banks incur higher intermediation costs due to the continuous nature of technological investment, they achieve significant gains in terms of net interest margins (NIM) and return on assets (ROA).

Additionally, the paper adds to the literature on credit expansion by demonstrating that technology adoption has a positive and significant impact on total credit growth, particularly for banks with higher cost efficiency. This finding emphasizes the importance of operational efficiency in maximizing the benefits of technology for credit disbursement, a factor that has received limited attention in previous studies.

Main results reveal that technology leader banks have incurred higher intermediation costs but have also achieved superior profitability, as measured by net interest margins and return on assets (ROA). Specifically, technology adoption is associated with a 0.29 standard deviation increase in intermediation costs, likely due to the ongoing investment required for integrating new technologies. However, this higher cost is offset by a substantial increase in net interest margin (1.21 standard deviations) and ROA (0.61 standard deviations), suggesting that technological leadership is rewarded by improved profitability.

Furthermore, we examine the impact of technology adoption on total credit disbursement. The analysis shows that tech-adopting banks experience a significant increase in total credit by 0.14 standard deviations. Notably, the interaction between the technology dummy and cost efficiency is positive and significant, indicating that more efficient banks benefit even further from tech adoption in terms of credit growth. However, interactions with intermediation cost, NIM, and ROA do not significantly affect the relationship between technology adoption and credit disbursement. These findings highlight the crucial role of efficiency in enhancing the benefits of early technology adoption in the banking sector. Additionally, we ask whether the adoption of new technologies has been labour displacing.

While concerns about job displacement due to technology exist, direct employment in the Indian banking sector has remained stable at approximately 4.5% annual growth despite increasing technology investments. This suggests that technology is primarily enhancing efficiency rather than replacing jobs within the sector. This trend aligns with the Reserve Bank of India's (RBI) increased focus on bank IT systems and encouragement of technology spending. Notably, many commercial banks highlighted increased technology expenditures during their 2023-24 Q4 earnings calls.

Moreover, the Reserve Bank of India (RBI) has fostered a regulatory environment that encourages technological innovation while managing associated risks. This evolving landscape provides a valuable context to explore the interaction between regulation and technological adoption in banking, ensuring financial system stability. Despite the rising importance of technology in banking, few studies have examined its disaggregated impact. To the best of our knowledge, this paper is the first to provide a detailed analysis of technology's effects on banking, offering crucial insights for rapidly digitalizing economies like India.

Technology significantly affects economic and organizational performance, with its benefits amplified when integrated into governance and organizational culture (Nguyen & Hambur, 2023). Firms with technically proficient board members and skilled staff see greater profitability from technology adoption. Chhaidar, Abdelhedi, & Abdelkafi (2023)

find that Fintech investments positively impact profitability in European banks. Data envelopment analysis (DEA) by Das, Nag, & Ray (2005) and Ghosh & Parida (2024) shows that Indian banks, particularly public sector banks, have improved efficiency and productivity over time, despite some declines in private sector and foreign banks. Chakrabarty (2013) notes that while Indian banks have adopted new technologies, their financial performance has not fully reflected these advancements. Khan & Abdulla (2023) demonstrate that information technology positively affects bank performance in India. Ahnert et al. (2022) find that IT adoption fosters job creation and supports startups in the U.S., while Alves (2024) highlights how internet access reshapes credit distribution in Brazil. Sensarma (2005) reveals that private banks in India were less cost-efficient compared to public sector banks. Dadoukis et al. (2021) show that banks with early IT investments fared better during the COVID-19 pandemic, and Ren et al. (2024) confirm that digital transformation enhances profit efficiency in Chinese banks. Mohan (2005) suggests that while technology upgrades increased intermediation costs for Indian banks, they also boosted labor and capital productivity.

By examining trends in technology spending, intermediation costs, profitability, and employment, this paper aims to provide a comprehensive understanding of how technology is transforming the banking industry in India. The findings will be valuable for policymakers, banking professionals, and researchers studying the interplay between technology, efficiency, and employment dynamics within the financial sector.

The study is organized as follows: Section 2 presents the data and methodology used in the analysis. Section 3 provides a comprehensive overview of technology in banking, covering its definitions and scope. Section 4 examines trends on both a bank-wise and bank-group-wise basis. Section 5 conducts an empirical analysis using regression techniques to assess the impact of technology on banking system. Finally, Section 6 offers concluding insights and implications.

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2. Data and Methodology

The data used in the study are drawn from i) Statistical Tables relating to Banks in India (DBIE, 2013-2023), ii) Basic Statistical Returns (2013-2023), iii) Ad-hock Supervisory Return of DoS and iv) the World Bank Database. The study uses a mix of descriptive and regression analysis for drawing inferences. Basis ownership and business mix, the Indian banking system is divided into public sector banks, private sector banks (PvSBs), foreign banks (FBs), small finance banks (SFBs), and payment banks (PBs), etc. The study has predominantly, however, used data of public and private sector banks for examination, as the share of these two is ~94 per cent in the Indian banks' assets.

3. Technology in Banking

Starting with the computerization and the proliferation of Automated Teller Machines (ATMs) in the late 1980s², to the recent surge in the provision of digital banking services - technology has altered the scale and scope of banking services. Banking technology investments aim to improve efficiency in decision-making, risk assessment, reducing costs and enhancing profits. Apart from bringing benefits to the service providers in the form of enhanced scale of business operations and/or reduced operational costs, financial technology also benefits customers through higher value-added and innovative services. The emergence of technology-driven financial services players has increased the financial choices for customers. In a natural consequence, total technology expenditure incurred by scheduled commercial banks increased on a year-on-year basis by 20.11 per cent in FY 2020-21, 25.97 per cent in FY 2022-23, and 29.4 per cent in FY 2023-24, respectively (Table 1).

Table 1: Technological expenditure by SCBs*								
i+ii. Total expenditure on Technology (in ₹ crore)								
Period	2020-21	2021-22	2022-23	2023-24				
FBs	2,478.56	3,513.29	3,880.91	4,656.09				
PvSBs	8,073.21	10,836.59	13,909.95	18,529.34				
PSBs	9,018.98	9,186.61	11,615.51	14,851.54				
SFBs	1,444.44	1,705.46	2,391.03	3,118.84				

² The first ATM in India was set up in 1987 by HSBC in Mumbai.

Grand Total	21,015.20	25,241.95	31,797.40	41,155.81					
i. Capital expenditure on Technology (in ₹ crore)									
FBs	322.51	947.02	668.31	715.22					
PvSBs	3,750.48	5,279.23	6,579.51	8,541.29					
PSBs	3,046.95	2,205.47	2,861.33	3,883.81					
SFBs	249.05	396.78	652.81	530.18					
Total	7,368.99	8,828.51	10,761.96	13,670.50					
ii. Revenue	expenditure or	n Technology (in ₹ crore)						
FBs	2,156.05	2,566.27	3,212.59	3,940.87					
PvSBs	4,322.65	5,557.36	7,330.43	9,987.85					
PSBs	5,972.03	6,980.81	8,754.16	10,967.70					
SFBs	1,195.40	1,308.68	1,738.23	2,056.84					
Total	13,646.13	16,413.12	21,035.42	26,953.26					

*: Based on a sample banks representing ~90% per cent of all SCBs asset size. Source: DoS survey.

Banking operations primarily use four types of technologies, viz., i) information technology (data and software procurement), ii) cash management services (currency management and ATMs), iii) payment infrastructure, and iv) security-related technologies (primarily, cyber security). Key features of these are outlined briefly:

a. **Information Technology**: Finance is a business of risk-taking, therefore, banks are increasingly harnessing data analytics to glean valuable insights into customer behaviour and preferences, facilitating personalized services and targeted product offerings. Moreover, the proliferation of digital banking platforms has revolutionised customer interactions, enabling convenient and secure transactions through mobile apps and web portals.

As of March 2023, banks' expenditure on information technology in total operating expense was 8.7 per cent for public sector banks and 11.2 per cent for private sector banks. The share of information technology expenditure in total operational expenditure was the highest for the small finance banks, followed by private sector banks, and public sector banks. The adoption of digital tools, viz, cloud computing and artificial intelligence

(AI), are increasingly being used to help streamline back and middle-office operations apart from enhancing the effectiveness of front offices.

b. **Cash Management**: Over the years, the adoption of ATM infrastructure has expanded the reach and coverage of banking. The introduction of off-site ATMs and white-label ATMs (WLAs) has further enhanced the accessibility and cost-effectiveness of banking. In the past decade, the number of ATMs increased more than three times from 75,645 in April 2011 to 2.58 lakhs in January 2024. The expansion of ATM infrastructure has plateaued in recent years. This has been augmented by a surge in the installation of micro-ATMs. While onsite and offsite ATMs were predominantly installed by large universal banks [share of top-10 banks is 80 per cent], micro-ATMs have been installed by payment banks. ~80 per cent of micro-ATMs have been installed by payment banks. (Chart 1).



Chart 1: ATM Infrastructure in India





Source: RBI and CEIC.

c. **Payment and Settlement Infrastructure**: Efficient payment and settlement systems foster economic development, promote financial stability, and support financial inclusion. Over the years, India's payment infrastructure has evolved as safe, secure, reliable, accessible, affordable, and efficient with the availability of a multitude of instruments viz., real-time gross settlement system (RTGS), national electronic fund transfer (NEFT), and retail-fast payment mechanism – UPI, Aadhar-enabled payment

system, and IMPS, etc. Prepaid Payment Instruments (PPIs) are emerging as a popular alternative to cash, and a greater number of banks have switched to digitalized platforms to carry out their banking operations. The introduction of the Unified Payments Interface (UPI) has revolutionized retail payments. The efforts of the banking and finance industry have received a push from regulatory initiatives as well, which have focused on expanding technological boundaries. The Reserve Bank of India (RBI) issued guidelines and frameworks to safeguard against cyber threats. Consumer protection measures, including the implementation of ombudsman schemes, underscore the sector's commitment to improve customer service and grievance redressal.

The impact of the above is visible in the trend of digital and paper-based payment instruments' time series movement (Table 2). It has become even more revealing through cash usage behaviour of economic agents. The volume and value of cash withdrawal from ATMs have remained stable through 2020-2023.

	Volume (in crores)			Value (in lakh crores)		
Year	Paper based	Digital	ATM	Paper-based	Digital	ATM
loui	instruments	payments	withdrawals	Instruments	Payments	withdrawals
2010	1,037.9	405.8		750.8	6,689.1	
2011	1,345.2	4,424.3		997.6	10,049.5	
2012	1,321.2	6,208.1		1,000.4	11,787.7	
2013	1,287.1	7,103.3		956.4	9,102.8	
2014	1,211.2	8,479.6		867.9	9,411.8	
2015	1,116.9	10,307.2		833.5	10,262.1	
2016	1,112.9	12,795.7		791.0	12,265.2	
2017	1,240.1	16,628.3		828.8	14,480.9	
2018	1,140.9	19,857.8		829.2	16,743.6	
2019	1,074.4	24,639.8	127.6	803.2	18,258.7	5.7
2020	708.7	39,977.9	617.2	569.4	13,875.2	29.1
2021	721.7	63,645.2	657.2	660.3	16,752.4	31.2
2022	722.1	1,03,611.9	691.4	719.8	20,042.6	32.9

Table 2: Instrument-wise evolution of payment transactions

2023	672.8	1,49,628.9	673.6	718.0	23,208.5	32.7
2024*(Q1)	54.7	15,089.4	53.0	58.4	2,102.9	2.6

d. **Security**: The primary job of a bank is the safekeeping of monies of its customers. Therefore, investment in technologies relating to the safety and security of its premises, infrastructure, and network is paramount. Facilities such as biometric authentication, blockchain technology, and distributed ledger technologies are increasingly being adopted to fortify the banking ecosystem against cyber threats, ensuring the integrity of transactions and safeguarding sensitive customer data. Furthermore, firewalls, encryption techniques, and regular audits have become imperative for fortifying the banking infrastructure against ever-evolving cyber threats and other criminal activities. Concurrently, compliance with regulatory standards, such as those set forth by the RBI, ensures adherence to data protection and privacy guidelines.

4. Bank-wise and bank-group-wise trend analyses: Movement of average intermediation cost ratio and net interest margin

a. The intermediation cost ratio is the share of total operating expenses³ in total assets of a bank. The Indian Banks' intermediation cost ratio was above 2.0 per cent before FY 2009. It dipped to 1.7 per cent in 2012 and hovered around that number since then. It has increased marginally in the recent period (Chart 2).

³ https://rbi.org.in/scripts/PublicationsView.aspx?id=15466



Source: RBI and The World Bank.

b. Chart 3 provides a comparative view of how intermediation costs have evolved across G-20 countries to highlight trends of increasing, decreasing, or stable costs in financial transactions. The chart depicts the movement of intermediation cost ratios for G-20 countries over two time periods: from 2000 to 2005 on the x-axis and from 2016 to 2021 on the y-axis. The marginal dip in India's intermediation cost ratio is in line with global peers (Chart 3).





Note: The 45-degree line represents whether the intermediation cost ratio remains the same or changes between two

periods. Countries positioned below the line have seen a decrease in their intermediation cost ratio from 2000-05 to 2016-21.

Source: Staff estimates using the World Bank data.

c. The bank group-wise intermediation cost ratio is given in Table 3. In FY-2023, the average intermediation cost ratios for PSBs, PvSBs, FBs, SFBs and PBs are 1.9 per cent, 2.8 per cent, 2.7 per cent, 5.7 per cent, and 34.9 per cent, respectively. The distribution of intermediation cost ratios of public and private sector banks is symmetrical around mean values. Those of foreign banks are positively skewed. The average intermediation cost ratio of small finance banks at 5.7 per cent is more than three times higher than that of public sector banks revealing the higher operational cost incurred by these banks due to their smaller scale. At the same time, at 34.9 per cent, the average intermediation cost ratio of payment banks is significantly higher than those of other banks groups, suggesting their high expenditure on initial technological infrastructure.

Table 3: Intermediation cost ratio in FY 2023: Bank group-wise (%)					
Bank group	Mean	Median	Min	Max	
PSB	1.9	1.8	1.6	2.2	
PvSB	2.8	2.6	1.8	5.7	
FB	2.7	1.8	0.5	17.5	
PB	34.9	37.4	10.7	53.9	
SFB	5.7	5.7	2.9	7.5	

Source: Staff estimates based on the DBIE data.

d. The intermediation cost simply refers to the average cost of operations or the expenses incurred by banks to gather funds from investors and depositors and lend out to borrowers. These costs can broadly be divided into finance costs and operational costs. While financial cost (i.e., interest cost) is incurred by the real economy, the operational cost is incurred by the banks. In analytical parlance, the former is proxied by the net interest margin (NIM) and the latter by the intermediation cost ratio. It may be emphasized that technological transformation in banking is expected to have a first-order effect on both indicators – i) intermediation costs, and ii) net interest margin, as a proportion of their

total assets. This effect of technology on critical bank performance indicators warrants a deeper analysis, as presented in Chart 4.



Chart 4: Intermediation and net interest margin of PSBs and PvSBs

e. Chart 4 depicts the intermediation costs ratio and net interest margin. During 2013-2023, the average intermediation cost ratio of public sector banks was between 1.5 per cent to 1.8 per cent with a marginal rising trend in recent years. On the other hand, in the case of private sector banks, it moved between 1.9 per cent and 2.6 per cent with a slight rise in the latter part. Dispersion of intermediation cost ratio around median values was higher in private banks vis-à-vis public sector banks. In 2023, among public sector banks, the intermediation cost ratio of the Bank of Maharashtra at 1.6 per cent was the lowest and that of the Central Bank of India at 2.2 per cent was the highest. In the case of private sector banks, the intermediation cost ratio of City Union Bank (1.8 per cent) was the lowest and IDFC First Bank (5.7 per cent) was the highest.

f. The median NIM for public sector banks moved in a range of 2.1 per cent (2017) to 2.6 per cent (2023). At the same time, NIM for private sector banks increased steadily from 2.8 per cent in 2013 to 3.6 per cent in 2023. Similar to the intermediation cost ratio, dispersion in NIMs of private banks was higher than public sector banks. Higher NIMs represent the productivity of the assets of the banks.

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g. Average values of intermediation cost ratio and net interest margin are an outcome of the business mix of the banks, which is heavily dependent on the underlying technology. To further understand it, the operational cost structure of banks is decomposed. However, before the decomposition of the operational expenditure, an analysis of trends of marginal expenditures and profitability is outlined.

h. The average values of intermediation cost ratio and profitability are stable over time. The marginal values of cost are expected to decline or grow at a relatively slower pace vis-à-vis the rise in total cost. Panel (a) in Chart 5 reveals that bank operating expenses (scaled to 2013) have increased steadily in the past decade. Aggregate values of operating expenditure of public sector banks and private sector banks in 2023 were around five times higher than those in 2013.

Movement of per-account cost

Panels (b) and (c) of Chart 5 depict the scale of operating expenses per-credit account and deposits account. Panel (b) shows that operating expenses per-credit accounts for the private sector banks steadily declined, especially after 2015, while the same for public sector banks increased only marginally⁴. Trend of per-account operational expenses shows that while in credit the private sector banks have an advantage, in deposits the public sector banks have an advantage.

⁴ Adjusting for the consumer price inflation, real per account operational cost declined for both bank groups.





Movement of Employment, Per-employee output and Profitability

Not only the operational cost of banks for every new account has remained stable, but their output as measured by per-employee asset size, per-employee operating profit⁵ and growth in the number of employees has increased steadily (Chart 6). This suggests that banks' workforce efficiency has increased alongside the rise of technological adoption.

As shown in Chart 6, Panel (a), bank business per employee, measured as total assets per employee, has been on the rise for the banking sector, though the growth for public sector banks has been higher. For private sector banks, bank business per employee increased by 69.35 per cent over the decade (from Rs. 6.74 crores per employee in 2013 to Rs. 11.41 crores), while the same for public sector banks increased by 81.5 per cent (from Rs. 8.65 crores in 2013 to Rs. 15.7 crores in 2023). It is worth noting that the scale of public sector business has been consistently higher than private sector banks.

The average operating profit per employee, as shown in Chart 6, Panel (b) for private banks has been Rs. 0.07 crores (Rs 7 lakhs), while the same for public sector banks has

⁵ Per-employee operating profit declined in the aftermath of the asset quality review for a few years.

been Rs. 0.03 crores (Rs. 3 lakhs). However, in recent years, the trend in operating profits has narrowed across the two bank groups.

Panel (c) of Chart 6 reveals that employee strength in scheduled commercial banks has grown at an average rate of 4.42 per cent over the past decade in India. This is a crucial reflection of how technology adoption has not displaced employment in the banking sector in India.



Chart 6: Indicators of operational productivity



Decomposition of Operational Cost

Decomposition of the operational cost of public sector banks over the past decade reveals that the share of provisions on employee expenses has declined from 58.8 per cent in 2013 to 47.2 per cent in 2023. For private sector banks, it remained range-bound and moved from 33.9 per cent to 34.8 per cent (Chart 7). Share of 'other expenses' within operational expenses has increased steadily for both bank groups. As of the end of March 2023, the combined share of employee expenses and 'other expenses' was ~75 per cent. Share of remaining expenses, viz, rent, taxes & lighting; printing & stationary; advertisement & publicity; property depreciations; postages, telephone & telegrams; and repairs & maintenance, has come down steadily from 2013 to 2023. These items mostly represent the expenditure on materials, which could have been replaced by technology. Incidentally, the share of insurance expenses increased secularly from 2.6 per cent in 2013 to 5.2 per cent in 2022 before declining to 4.8 per cent in 2023.



Chart 7: Decomposition of operating expenses

For private sector banks, the average 'Other Expenditure⁶' component constituted 23.4 per cent of total operating expense. The share of 'Other Expenditure' for private sector banks increased by 16.7 per cent (from 20.2 per cent in 2013 to 23.5 per cent in 2023). In comparison, this share for public sector banks was an average of 15.4 per cent of the total operating expenses over the past decade, which increased by 26.8 per cent (from 13.9 per cent in 2013 to 17.6 per cent of total expenses in 2023).

Technically, the intermediation cost ratio represents the average cost incurred by the bank to manage one unit of the asset. The relatively higher intermediation cost recorded by private sector banks reflects the prevalence of retail advances in their portfolio along with the higher technological intensity, which increases the average cost of operations of these banks. Based on the share of retail loans in the total assets of banks, two distinct bank categories, i.e., retail-oriented banks and other banks, have been demarcated. From Table 4, it can be seen that the average intermediation cost ratio of retail business-oriented banks is on average 70 basis points higher.

Table 4: Business model and intermediation cost ratio									
		Intermediation cost ratio (%)							
	Retail orien	ted banks	Other b	oanks					
Financial Year	Average	Median	Average	Median					
2013	2.42	2.45	1.56	1.64					
2014	2.39	2.41	1.62	1.66					
2015	2.45	2.38	1.65	1.75					
2016	2.53	2.55	1.70	1.73					
2017	2.56	2.46	1.75	1.75					
2018	2.45	2.35	1.77	1.77					
2019	2.55	2.41	1.78	1.76					
2020	2.51	2.32	1.88	1.92					

⁶ Banks report miscellaneous expenses that exceed 1 per cent of the total income as 'other expenditure' in their income statement. Bank expenses incurred under this category are technology-driven, such as i) expenses paid to network service providers (Mastercard/Visa), ii) cashback expenses, iii) cash management services expenses, iv) reward point program expenses, v) SMS & Email Transaction Charges; outsourcing expenses; and priority sector lending certificates.

2021	2.39	2.08	1.99	1.97
2022	2.63	2.35	1.97	1.91
2023	2.91	2.71	2.09	1.98

This relationship could also be seen in the scatter plot given in Chart 8. As the share of retail lending business increases in the total assets of banks, their intermediation cost also goes up.

Chart 8: Business model and intermediation cost ratio



Source: Staff estimates using the DBIE, RBI data.

5. Regression analysis

To establish the causal impact of technology on banking performance in terms of intermediation costs or business operations, we undertake a regression analysis using the following baseline specification:

$$Y_{b,t} = \beta_0 + \beta_1 TechDummy_{b,t} + \beta_2 Bankchar_{b,t} + YearFE_{b,t} + \epsilon_0$$

Where, $Y_{b,t}$ represents the outcome variable, i.e., banks' intermediation cost ratio or net interest margin. For the explanatory variables, we use a dummy for 'technology leader banks' which lead technology adoption among banks and take the value of '1', while the remaining banks are considered as 'follower' and take the value '0'. Basis the analysis of 'other operational expenses' and DoS survey data on technology expenses, the technology leader banks identified are: ICICI Bank, Axis Bank, HDFC Bank, IDFC First Bank, Kotak Mahindra Bank, IndusInd Bank, YES Bank (private sector) and State Bank of India (public sector).

A dummy variable for retail business-oriented banks has also been added in the regression as a proxy for their business model. Next, to isolate the effect of technology on bank costs, the model controls for bank-specific characteristics⁷ such as size, capital adequacy and ownership.

Results indicate that over the past decade, technology leader banks incurred higher average intermediation costs, however, they were able to earn higher net interest margin (Table 5). One possible explanation for the higher average intermediation cost is that the technological evolution is a continuous phenomenon rather than a discrete event and technology leader banks pay higher prices for the newer technologies. Technological leadership is rewarded by higher profitability.

Table 5 – Impact of lead technology adopting banks on bank balance sheet						
	1	2	3	4		
	Intermediation	Net Interest	Cost of	Return on		
	Cost	Margin	Efficiency	Assets		
Lead Technology dummy	0.29***	1.21***	0.66***	0.61***		
Bank FE	Yes	Yes	Yes	Yes		
Year FE	Yes	Yes	Yes	Yes		
Ν	455	328	390	390		
R ²	0.85	0.20	0.82	0.91		

Notes: *** p < 0.01, ** p < 0.05, * p < 0.10

Standard errors are in parentheses.

Table 5 presents the regression results examining the impact of the lead technology dummy on various performance metrics across different models: Intermediation Cost (IC), Net Interest Margin (NIM), Cost of Efficiency, and Return on Assets (ROA). Intermediation

⁷ Bank-specific controls are used here to address the possibility that different characteristics of banks might affect the outcome variable, i.e., cost of intermediation, and it is important to understand if/how their variation across banks may affect intermediation costs separately.

Cost (IC) coefficient for the lead technology dummy is 0.64 (p < 0.01). This statistically significant positive relationship indicates that the adoption of advanced technology is associated with a substantial increase in intermediation costs. This suggests that while technology may enhance operational capabilities, it might initially raise costs due to implementation and integration expenses. The impact of lead technology banks on Net Interest Margin (NIM) is 1.21 (p < 0.01) suggesting that technology adoption increases profitability as banks leveraging advanced technology can improve their interest income relative to their interest expenses, potentially due to more efficient lending and deposit processes. The impact of technology dummy on Cost of Efficiency is 0.66 (p < 0.01) implying that that while technology might improve overall efficiency, it also raises the associated costs. This could reflect the initial investment and ongoing maintenance costs of advanced technology. Finally, the coefficient for Return on Assets (ROA), another indicator of banks' (interest-based) profitability is 0.61 (p < 0.01). This significant positive coefficient suggests that technology adoption improves ROA. Banks implementing advanced technology are likely to see better returns on their assets, indicating that the benefits of technology, such as increased efficiency and enhanced financial performance, outweigh the costs.

Table 6 – Impact of lead tech adopting banks on total credit							
		Total Credit (Log)					
	1	2	3	4	5		
Technology dummy leader (lagged)	0.14***						
Technology dummy (lagged) x		-0.25					
Intermediation Cost		(0.198)					
Technology dummy (lagged) x NIM			0.14				
			(0.133)				
Technology dummy (lagged) x				0.0085**			
Efficiency Cost				(0.003)			
Technology dummy (lagged) x ROA					-0.018		
					(0.016)		
Bank FE	Yes	Yes	Yes	Yes	Yes		
Year FE	Yes	Yes	Yes	Yes	Yes		

Ν	359	296	328	359	328
R ²	0.97	0.97	0.97	0.97	0.97

Preliminary results in Table 6 examine the impact of early technology adoption by leading banks on total credit (logged), with five models incorporating interactions with various financial performance metrics. In the baseline model, the lagged technology dummy shows a significant and positive effect, indicating that tech-adopting banks experience an increase in total credit by 0.14 standard deviations, highlighting a strong and positive impact of early tech adoption on credit disbursement.

When interacting with other bank balance sheet indicators, the results suggest that efficiency cost plays a crucial role, as the interaction between the technology dummy and efficiency cost is positive and statistically significant (0.0085 standard deviation). This suggests that banks with higher cost efficiency benefit more from early technology adoption in terms of credit disbursement, with the impact increasing by 0.0085 standard deviations for each unit of improvement in efficiency cost. However, interactions with intermediation cost, net interest margin (NIM), and return on assets (ROA) are not statistically significant, indicating that these factors do not meaningfully alter the relationship between technology adoption and total credit.

6. Conclusion

This paper offers a detailed examination of how early technology adoption influences banking performance, focusing on data from India, a global leader in financial technology innovation. By combining supervisory metadata on bank-level intermediation with indicators of technology adoption, our analysis reveals several key insights.

First, while the integration of advanced technology leads to higher intermediation costs due to significant investments in IT, payment systems, and security, it also drives substantial gains in profitability. Specifically, technology-adopting banks experience enhanced net interest margins (NIM) and return on assets (ROA). Additionally, these

banks are better positioned to increase credit disbursement, especially when they demonstrate higher operational efficiency.

Contrary to concerns about job displacement, our findings show that technology adoption has not adversely affected employment in the sector. Instead, it has improved operational efficiency and profitability, as evidenced by reduced costs per credit account and higher operating profits per employee.

The paper makes a significant contribution by highlighting the nuanced effects of technology on banking performance. It not only balances the increased costs of technological investments with the benefits of enhanced profitability and credit growth but also emphasizes the importance of efficient business models in leveraging technology effectively. These insights are crucial for policymakers, banking professionals, and researchers, providing a clearer understanding of technology's role in shaping the future of banking in rapidly evolving financial landscapes.

This study should be read with some caveats. First, the analysis is based on data from a single country, India, which may limit the generalizability of the findings to other financial markets with different technological and regulatory environments. Second, while the study captures a broad range of technology-related investments, it may not account for all factors influencing technology adoption and its impact on banking performance. For instance, variations in technology types, implementation strategies, and external economic conditions might affect outcomes in ways not fully captured by the current analysis. Additionally, the fixed-effect panel regressions used in the study may not fully account for unobserved heterogeneity or dynamic effects of technology adoption over time.

Finally, this study is still a work in progress!

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