Does Technology Lead to Better Financial Performance? A Study of Indian Commercial Banks

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It has been a matter of debate whether Technology provides better financial results and improves productivity. The present paper attempts to study the inter-group comparison of financial performance of Indian banks by classifying the banks on the basis of usage of Technology. Further, for the purpose of temporal comparison, the period for the study has been divided into two parts, i. e. low technology induction period and high technology induction period. Findings of the paper show that the fully IT oriented banks are financially better off than the partially IT oriented banks. Moreover, the performance of almost all the banks under study has tremendously improved in the high technology induction period. However, for the Indian banking industry, the correlation between Technology induction and financial productivity is negative though statistically insignificant and low.

Key Words: IT productivity paradox, information technology, financial performance, indian banks, spread and burden ratios
JEL *Classification:* O33, G21, M15

Introduction

For decades, it has been a matter of debate whether Technology/Information Technology (IT) provides better financial results. To date there is no conclusive evidence that spending on IT improves financial performance. The scholars call it the 'IT Productivity Paradox.' The term 'paradox' indicates a negative correlation between IT investments and productivity. Morrison and Berndt (1990) found that additional IT investments contributed negatively to financial productivity. They concluded that the estimated marginal benefits of investment in IT are less than the estimated marginal costs. On similar lines, studies by Strassman (1990) and Dos Santos, Peffers and Mauer (1993) have also concluded that there is an insignificant correlation between IT spending and profitability measures, which means IT spending is unproductive.

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There are, on the other hand, studies which show that there is no correlation between IT investment and financial productivity (Loveman 1994; Barua et al. 1991). Jordan and Katz (1999) found that even the most successful banks offering Internet banking were able to serve only a relatively small share of their customer base with IT channels. Thus, it was difficult to determine whether Internet banking has a significant impact on bank performance. And there are studies which have found significant contributions from IT toward financial growth (Lichtenberg 1995; Brynjolfsson and Hitt 1996). Most of these firm-level studies have been restricted to the manufacturing sector (that too, outside India), in large part owing to lack of firm-level data from the service sector.

There are studies which have drawn on the statistical correlation between IT spending and profitability or stock value for their analyses and they have concluded that the impact of IT on productivity is positive ((Brynjolfsson 1993; Wilson 1993). It is apparent that most of the studies relating to the contribution of IT towards productivity have been restricted to the manufacturing industry. The problem is particularly relevant to the banking industry, which is the focus of the present study. In India, there are not many studies that have focused on IT contribution in the banking sector. Mariappan (2006) found that the IT revolution has brought stunning changes in the business environment. No other sector has been influenced by advances in technology as much as banking and finance, as a result, the Indian banking has a totally new face today. Similarly, Kamakodi (2007) examines how computerization has influenced the banking habits and preferences of Indian bank customers and what factors influence these preferences. He found that change of residence, salary account and non-availability of the technology based services were the three main reasons for shifting to another bank. Further in the technology direction, Patnaik (2004) found that shared ATMs are taking place and they are mutually beneficial. This mushrooming new dimension of shared ATMs has increased the non-interest income of the banks. This is the most popular e-channel and widely used in all the bank groups. Paul and Mukherjee (2007) explained that cash management in ATMs is a new concept which facilitates the banks to source cheaper funds and serve its clients more efficiently.

Many studies have also highlighted the importance of customer satisfaction and the management of customer relations in the success of banking business (Singh 2004; Krishnaveni, Prabha and Divya 2006; Mishra and Jain 2007; Raveendra 2007; Sharma, Kaur and Sharma 2007;

Sharma and Dhanda 2007; Singh and Kabirai 2007; Thakur 2007; Uppal and Kaur 2007; Uppal 2008; Vanniarajan and Nathan 2008). The process of economic liberalization and financial sector reforms has underlined the importance of customer-focus by the banks (Shanker 2004). The main bottlenecks to the superior services are the untrained human resource and the lagging technology (Thakur 2007).

Yet, there have been a number of studies which have focused on the financial performance and efficiency of the banks in the recent past. The studies reveal that the profitability of Indian banks has increased since the second generation banking reforms and, among the several bank groups, the foreign and private sector banks are performing well as compared to the public and nationalized banks in India (Sarkar, Sarkar and Bhaumik 1998; Muniappan 2002; Sooden and Bali 2004; Aggarwal 2005; Arora and Verma 2005; Bhaskar 2005; Madhavankutty 2007; Uppal and Kaur 2007; Kumar and Sreeramulu 2008).

Another significant area which has emerged recently and been explored by the researchers is that of risk management in the banks. Madhavankutty (2007) concludes that the banking system in India has attained enough maturity and is ready to address prudential management practices as comprehensively as possible. Similarly, Mohan (2003) highlights the need for each bank to have in place the technical systems and managements processes necessary not only to identify the risks associated with its activities, but also to effectively measure, monitor and control NPA (Non Performing Asset) levels. While operations, capital and risk management, technological innovations and customer satisfaction will be the drivers of growth, it is going to be the corporate governance which will lead Indian banking to match best business practices on the global level (Aggarwal 2007; Lal 2007). Padwal (2004) stresses the need of integrating business development planning with a clear IT/IS road map. Malhotra and Singh (2005) describe the key risks associated with the adoption of banking technology. IT allows the banking industry to establish a direct link to the customers. Similarly, Habbar (2004) emphasizes that managing technology is a key challenge for the Indian banking industry. Banks have enhanced their networks and communication infrastructure to reap the full benefits of computerization. E-banking is fast catching up. There is a great need for trust, privacy and confidentiality. Only sound corporate governance would lead to effective and meaningful banking (Lakhsmi Narayan 2004). Narayanasami (2005) states that Indian banking is in a better position with respect to technology, capital

adequacy, credit management, risk bearing capacity, international competitiveness and contribution to the national economy. For global competition, Indian banks will have to gear up to meet stringent prudential capital adequacy norms under Basel i and ii accords (Subbaroo 2007).

OBJECTIVES AND SCOPE OF THE STUDY

The specific objective of the present paper is to study the inter-group comparison of the financial performance of Indian commercial banks by classifying the banks on the basis of usage of Technology. The study of the financial performance of banks has been carried out from the year 1996 to the year 2008. The total time period for the study has been divided into two periods: Low Technology Induction Period and High Technology Induction Period. The period from the years 1997–1998 to 2000–2001 has been taken as India's Low-technology Era while the High-technology Era is considered to have been be effectively started from 2001 afterwards. During the period 1996–1997 to 2000–2001, the technological applications in the Indian banking sector were not very developed and mature. Moreover, new private sector banks started entering the Indian banking industry in a big way from the year 1996. The technological boost only came after the implementation of the IT Act. The Indian government gave its assent to the Act in October 2000 but the Information Technology Act, which is a comprehensive legislation for IT applications in the business, became effective only after 2001. The Act has brought the structure, legal validity and authenticity for transacting and making payments online. Hence, the period after 2001 has been termed as the High Technology Induction Period. Another reason for assuming such a period as the High Technology Period is that in India e-banking services started in full-swing only from 2001 onwards.

RESEARCH METHODOLOGY

The financial performance of a bank can be measured in a number of ways. The Operational Profitability is the most widely used indicator to judge the financial position of a business. For measuring the profitability of commercial banks, various banking and financial ratios have been computed. To measure the extent of a technology induction quantitatively, technology index was formulated for each bank group. An average figure based on ATMs, Fully Computerised Branches, Internet Banking Branches, Mobile Banking Branches and Tele-banking Branches for each bank for each year starting from 1996–1997 till 2007–2008 has been com-

puted and averaged for each bank group. The numbers so arrived at represent, in percentage as a score, the extent of technology induction for each bank group.

Thus, Technology Index of a Bank = [(Number of ATMs/Total Branches) + (Number of Fully Computerised Branches/Total Branches) + (Number of Internet Banking Branches/Total Branches) + (Number of Mobile Banking Branches/Total Branches) + (Number of Tele-Banking Branches/Total Branches)] × 100.

SAMPLE DESIGN AND SAMPLE UNIT

On the basis of usage of technology RBI (Reserve Bank of India – India's Central Bank) recognizes different bank groups as 'Partially IT-oriented Banks' or 'Fully IT-oriented Banks.' 'Fully IT-oriented Banks' are 100 per cent automated banks that are providing their customers with access to all the technological channels, such as ATMs, Credit Cards, E-banking, Mobile Banking etc., whereas 'Partially IT-oriented Banks' are those banks which are still in the process of automation and are not providing their customers with all the technological channels to perform banking operations. The four major bank groups relevant for the study are outlined as below.

- Partially IT-oriented Banks: Group I – Public Sector Banks (excluding State Bank of India and its Associates) (20 Banks); Group II – State Bank of India and its 7 Associates (08 Banks)
- Fully IT-oriented Banks: Group III – Private Sector Banks (25 Banks); Group IV – Foreign Banks (29 Banks)

From each group of banks, the top five banks (in terms of highest business per employee in the year 2007) have been taken as the sample for the present study. Table 1 shows the selected bank groups for the present study on the basis of usage of technology.

Results and Discussion

The study uses Ratio analysis to compare profitability and productivity of different categories of banks. The following is the analysis of major ratios that have been employed for assessing the financial performance of the banks under study.

SPREAD RATIOS ANALYSIS

Spread, which is the difference between interests earned (on loans and advances) and interest paid (on deposits and borrowings) by the banks,

TABLE 1   Selected Bank Groups on the basis of usage of technology

Partially IT-oriented Banks		Fully IT-oriented Banks	
Group I Public Sector Banks	Group II State Bank of India and Associates	Group III Private Sector Banks	Group IV Foreign Banks
Punjab National-Bank (PNB)	State Bank of India (SBI)	HDFC Bank	Standard Chartered Bank
Canara Bank (CB)	State Bank of Hyderabad (SBOH)	ICICI Bank	Citi Bank
Bank of India (BOI)	State Bank of Patiala (SBOP)	UTI Bank (Now Axis Bank)	HSBC Bank
Union Bank of India (UBI)	State Bank of Travancore (SBOT)	Jammu & Kashmir Bank	ABN Amro Bank
Bank of Baroda (BOB)	State Bank of Bikaner & Jaipur (SBOBJ)	Federal Bank	Deutsche Bank

plays a major role in determining the operational profitability of banks. Table 2 reveals the Spread Ratios of the Indian Commercial Banks. Interest rates in Indian banking sector has declined from the low to high technology period.

Thus, the spread of banks have declined because of lower interest rates in the recent years. In the low-technology era, the maximum average interest earned as a percentage of average assets was 9.74% in the case of Group IV banks, and in the high-technology era, the maximum average interest earned as a percentage of average assets was 7.62% in the case of Group II banks.

In the low technology era, the maximum average spread as a percentage of average assets was 3.43% in the case of Group IV (foreign) banks, and in the high-technology era the maximum average spread as a percentage of average assets was 3.34% again in the case of Group IV banks. Overall, the *t*-test exhibits insignificant difference in the means of the two periods for the Indian banking industry.

BURDEN RATIOS ANALYSIS

Burden is defined as the difference between non-interest expenditure and non-interest income of the banks. Burden is usually taken in the negative sense since non-interest expenses tend to exceed non-interest income in the banking industry.

TABLE 2   Spread Ratios of Indian commercial banks

Group	Average	Spread Ratios		
		IE%AAS	IP%AAS	S%AAS
Group I	X_1	9.24	6.36	2.87
	X_2	7.30	4.44	2.85
	Mean Gap	1.94	1.92	0.02
	SE	0.80	0.75	0.19
	t-value	3.89	4.09	0.13
	LOS	**	**	—
Group II	X_1	8.90	6.01	2.91
	X_2	7.62	4.59	3.04
	Mean Gap	1.28	1.41	0.13
	SE	0.58	0.68	0.28
	t-value	3.50	3.30	0.72
	LOS	**	**	—

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Table 3 reveals the Burden Ratios of Indian Commercial Banks. Like the Spread, the average burden has also decreased from 2.14% to 1.81 % for the Indian banking industry. In the low-technology era, the maximum Burden as a % of Average Total Assets was 2.80% in the case of Group IV banks, and the minimum average Burden as a% of Average Assets was 0.99% in the case of Group III banks. In the high-technology era, the maximum Burden as a Percentage of Average Assets was 2.18% in the case of Group II banks, and the minimum Burden as a Percentage of Average Assets was 1.06% in the case of Group III banks. There is a decline in the Burden as a Percentage of Average Assets of Indian banks, which is a positive sign. Overall, the t-test exhibits significant difference in the means of the two periods at 1 % LOS for the Indian banking industry.

PROFITABILITY RATIOS ANALYSIS

Profitability ratios measure the bank's use of its assets and control of its expenses to generate an acceptable rate of return. In other words, profitability ratios reveal the operational profitability of the banks under study. As per table 4, the profits of Indian banks have increased significantly from the low technology era to the high technology era.

TABLE 2   *Continued from the previous page*

Group	Average	Spread Ratios		
		IE%AAS	IP%AAS	S%AAS
Group III	X_1	8.69	6.59	2.08
	X_2	6.25	4.12	2.11
	Mean Gap	2.44	2.47	0.03
	SE	1.09	1.04	0.49
	t-value	3.58	3.77	0.09
	LOS	**	**	—
Group IV	X_1	9.74	6.31	3.43
	X_2	6.69	3.34	3.34
	Mean Gap	3.05	2.97	0.09
	SE	1.00	1.11	0.54
	t-value	4.88	4.27	0.27
	LOS	**	**	—
Banking Industry Average	X_1	9.14	6.31	2.83
	X_2	6.96	4.12	2.81
	Mean Gap	2.17	2.19	0.02
	SE	0.71	0.75	0.11
	t-value	4.40	4.03	0.77
	LOS	**	**	—

NOTES   IE%AAS – Interest Earned as percent of Average Assets, IP%AAS – Interest Paid as percent of Average Assets, S%AAS – Spread as percent of Average Assets, X_1 – Average in Low-technology induction period, X_2 – Average in High-technology induction period, SE – Standard Error, LOS – Level of Significance; * mean is significant at the 0.05 level, ** mean is significant at the 0.01 level. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

The *t*-test exhibits significant difference in the means of two periods at 1 % LOS for the Indian banking industry. When we compare profits to average assets, the winners again are Foreign banks. The analysis of Average Profitability Gap among various bank groups indicates that there is little change in Group I to Group III banks, but there is a huge change in Group IV banks (Foreign Banks).

Technology and Financial Performance

This section highlights the impact of technology and its various channels on banks' performance and productivity.

TABLE 3 Burden Ratios of Indian commercial banks

Group	Average	Burden Ratios		
		NIE%AAS	NII%AAS	B%AAS
Group I	X_1	3.55	1.07	2.48
	X_2	3.24	1.25	1.99
	Mean Gap	0.31	0.18	0.49
	SE	0.41	0.39	0.15
	t-value	1.22	0.73	5.28
	LOS	—	—	**
Group II	X_1	3.68	1.37	2.31
	X_2	3.58	1.40	2.18
	Mean Gap	0.10	0.03	0.13
	SE	0.20	0.32	0.35
	t-value	0.80	0.14	0.60
	LOS	—	—	—

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FULLY COMPUTERIZED BRANCHES AS A PERCENTAGE OF TOTAL BRANCHES

The ratio of computerized branches as a Percentage of total branches in the new private sector and foreign banks is 100 % in both the Low-technology induction period and the High-technology induction period (table 5).

But this ratio was lowest in the case of Group I banks in the low technology era, i. e. 18.16%; however this ratio increased to 81.42% on an average at the end of the high technology period. In the case of SBI group banks this ratio increased to 97.14% from 76.75% average in the Low-technology induction period. In the high-technology induction period this ratio is more consistent in Group II banks (where CV is only 2.67 %).

ATMS AS A PERCENTAGE OF TOTAL BRANCHES

ATM is the most popular e-channel and the maximum bank customers use this e-channel. The ratio of ATMs as a Percentage of Total Branches increased very sharply in all the bank groups in the high-technology induction period (table 6). In the high-technology induction period this ratio is more consistent in Group I banks (where CV is only 11.90 %). However, the maximum rise is observed in Group IV banks and similar

TABLE 3   *Continued from the previous page*

Group	Average	Burden Ratios		
		NIE%AAS	NII%AAS	B%AAS
Group III	X_1	2.71	1.73	0.99
	X_2	2.92	1.86	1.06
	Mean Gap	0.21	0.13	0.07
	SE	0.42	0.43	0.26
	t-value	0.78	0.50	0.45
	LOS	—	—	—
Group IV	X_1	5.39	2.59	2.80
	X_2	4.79	2.77	2.02
	Mean Gap	0.60	0.18	0.79
	SE	0.35	0.21	0.22
	t-value	2.72	1.34	5.69
	LOS	*	—	**
Banking Industry Average	X_1	3.83	1.69	2.14
	X_2	3.63	1.82	1.81
	Mean Gap	0.20	0.13	0.33
	SE	0.16	0.23	0.11
	t-value	1.73	1.27	4.95
	LOS	—	—	**

NOTES   NIE%AAS – Non-Interest Expenditure as percent of Average Assets, NII%AAS – Non-Interest Income as percent of Average Assets, B%AAS – Burden as percent of Average Assets, X_1 – Average in Low-technology induction period, X_2 – Average in High-technology induction period, SE – Standard Error, LOS Level of Significance; * mean is significant at the 0.05 level, ** mean is significant at the 0.01 level. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

is the case of Group III banks. Overall, in the Indian Banking Industry, this ratio has increased from average 44.82% in the low-technology induction period to 82.63 % in the High-technology induction period.

INTERNET BANKING BRANCHES AS A PERCENTAGE OF TOTAL BRANCHES

In India, after ATMs, Internet banking is the biggest and most popular technological channel for banking operations. This ratio represents the extent of branches providing internet banking services.

Table 7 shows that Group III banks have an average of 36.64 pc against

TABLE 4   Profitability Ratios of Indian commercial banks

Group	Average	Profitability Ratios		
		NP%TI	NP%TD	NP%AAS
Group I	X_1	3.75	0.44	0.39
	X_2	10.21	1.01	0.86
	Mean Gap	6.46	0.57	0.48
	SE	1.49	0.16	0.14
	t-value	6.93	5.67	5.29
	LOS	**	**	**
Group II	X_1	5.86	0.77	0.60
	X_2	9.50	1.00	0.86
	Mean Gap	3.64	0.24	0.26
	SE	1.29	0.16	0.12
	t-value	4.50	2.39	3.41
	LOS	**	*	**

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industry's meager 3.31 pc, 12 times lesser in the low-technology induction period having numerous variations. In the High-technology induction period also, bank groups have gained this ratio to a great extent, and Group III banks have the highest 74.68 pc average, whereas industry records just 14.87 pc average. Quite clearly, partially IT-oriented banks have the biggest distance from fully IT-oriented banks, nearly 6 to 7 times, which is noteworthy. The huge gap confirms an impressive growth in internet banking all through the high-technology induction period, where Group III banks tops with 38.09 pc expansion and Group IV follows. Although partially IT-oriented banks witness an 11 to 15 pc growth, this is still not enough, since fully IT-oriented banks are 6 to 7 times ahead of these banks and this gap is quite high. Overall, the high-technology induction period has lesser variations and is more stable statistically.

MOBILE BANKING BRANCHES AS A PERCENTAGE OF TOTAL BRANCHES

In India, Mobile banking – also known as SMS Banking – is used mainly for balance checking, billing and other account related information by the customers. Table 8 clearly reveals that Group III banks are far ahead of other bank groups in terms of Mobile banking branches in both the

TABLE 4   *Continued from the previous page*

Group	Average	Profitability Ratios		
		NP%TI	NP%TD	NP%AAS
Group III	X_1	10.48	1.46	0.64
	X_2	13.00	1.52	0.78
	Mean Gap	2.52	0.06	0.14
	SE	3.41	0.44	0.31
	t-value	1.18	0.22	0.71
	LOS	—	—	—
Group IV	X_1	4.60	1.00	0.62
	X_2	14.46	2.37	1.32
	Mean Gap	9.86	1.36	0.70
	SE	6.56	1.17	0.68
	t-value	2.40	1.87	1.63
	LOS	*	—	—
Banking Industry Average	X_1	6.17	0.91	0.56
	X_2	11.79	1.47	0.95
	Mean Gap	5.62	0.56	0.39
	SE	1.72	0.25	0.17
	t-value	4.31	2.84	2.79
	LOS	**	*	*

NOTES   NP%TI – Net Profit as percent of Total Income, NP%TD – Net Profit as percent of Total Deposits, NP%AAS – Net Profit as percent of Average Assets, X_1 – Average in Low-technology induction period, X_2 – Average in High-technology induction period, SE – Standard Error, LOS Level of Significance; * mean is significant at the 0.05 level, ** mean is significant at the 0.01 level. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

low and the high technology induction period. The high technology induction period shows improvement in the case of all bank groups, where the winners are fully IT oriented banks (Group III and Group IV banks). The growth is also statistically consistent and steadier in the case of fully IT oriented banks.

TELE-BANKING BRANCHES AS A PERCENTAGE OF TOTAL BRANCHES

Tele-banking provides the access to limited banking operations through telephone. Table 9 reveals that the average share of tele-banking branches

TABLE 5   Fully computerized branches as a percentage of total branches

Period	Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period						
	1996–1997	5.50	18.90	100.00	100.00	56.10
	1997–1998	9.91	36.12	100.00	100.00	61.50
	1998–1999	13.12	87.91	100.00	100.00	75.25
	1999–2000	16.82	90.67	100.00	100.00	76.87
	2000–2001	32.82	92.30	100.00	100.00	81.28
	Average	18.16	76.75	100.00	100.00	73.72
	SD	10.16	27.14	0.00	0.00	8.53
	CV	55.94	35.36	0.00	0.00	11.57
High-technology induction period						
	2001–2002	63.23	93.25	100.00	100.00	89.12
	2002–2003	74.72	94.27	100.00	100.00	92.24
	2003–2004	88.13	96.92	100.00	100.00	96.26
	2004–2005	92.24	98.11	100.00	100.00	97.58
	2005–2006	92.12	100.00	100.00	100.00	98.03
	2006–2007	97.74	100.00	100.00	100.00	99.43
	2007–2008	81.42	97.43	100.00	100.00	94.71
	Average	84.22	97.14	100.00	100.00	95.34
	SD	11.99	2.60	0.00	0.00	3.61
	CV	14.23	2.67	0.00	0.00	3.78

NOTES   BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

as a percentage of total branches is more than that of fully IT-oriented banks in both the low and high technology induction periods. The coefficient of variations (CV) is also less in the case of fully IT-oriented banks in both the low and high technology induction periods, which denotes steadier growth.

TECHNOLOGY INDEX

The values as given in table 10 represent in percentage the extent of technology induction for each bank group. The IT index provides in terms of a score or a number the usage of technological channels such as ATMs, Mobile banking, Tele banking and Internet banking by various

TABLE 6 ATMS as a percentage of total branches

Period	Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period						
	1996–1997	2.20	2.80	25.00	41.74	17.93
	1997–1998	4.65	4.98	40.33	79.12	32.27
	1998–1999	14.19	6.91	84.29	83.52	47.22
	1999–2000	21.22	9.15	64.13	99.41	48.47
	2000–2001	22.90	10.75	42.35	129.49	51.37
	Average	15.74	7.94	57.75	97.88	44.82
	SD	8.30	2.52	20.70	22.80	8.55
	CV	52.73	31.73	35.84	23.29	19.07
High-technology induction period						
	2001–2002	35.11	12.41	52.19	117.24	54.23
	2002–2003	36.52	14.28	51.65	175.64	69.52
	2003–2004	37.45	15.25	82.15	274.13	102.24
	2004–2005	40.01	20.45	88.35	170.31	79.78
	2005–2006	46.88	26.65	85.66	199.10	89.57
	2006–2007	47.21	28.90	80.33	231.27	96.92
	2007–2008	40.92	20.77	72.65	210.21	86.13
	Average	40.58	19.81	73.28	196.84	82.63
	SD	4.83	6.28	15.39	49.72	16.51
	CV	11.90	31.70	21.00	25.25	19.98

NOTES BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

bank groups. In the Technology index the maximum score is obtained by Group III (Fully IT oriented banks) banks in the Low-technology induction period, and in the High-technology induction period the highest Technology Index goes to foreign banks. The lowest technology index, in both the periods, is of partially IT oriented banks (Group I and Group II banks).

Impact of Technology Index on Banks' Productivity

Productivity is a ratio of input and output. A bank's productivity is based on employees', branch and financial productivity. Employee productivity is an important part of total productivity, which comprises per employee

TABLE 7 Internet banking branches as percentage of total branches

Period	Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period						
	2001–2002	7.90	8.14	72.98	45.58	7.58
	2002–2003	15.09	15.62	80.81	47.22	8.59
	2003–2004	16.11	16.47	77.90	51.94	9.82
	2004–2005	17.38	17.99	62.88	70.01	12.37
	2005–2006	20.74	18.39	74.23	77.37	14.81
	2006–2007	23.70	25.27	79.25	80.54	36.07
	2007–2008	25.07	39.40	82.45	84.10	57.75
	Average	17.99	20.18	75.78	62.25	44.05
	SD	5.75	6.15	6.50	13.27	10.71
	CV (%)	33.82	45.66	8.70	25.14	72.02
High-technology induction period						
	2001–2002	35.11	12.41	52.19	117.24	54.23
	2002–2003	36.52	14.28	51.65	175.64	69.52
	2003–2004	37.45	15.25	82.15	274.13	102.24
	2004–2005	40.01	20.45	88.35	170.31	79.78
	2005–2006	46.88	26.65	85.66	199.10	89.57
	2006–2007	47.21	28.90	80.33	231.27	96.92
	2007–2008	40.92	20.77	72.65	210.21	86.13
	Average	40.58	19.81	73.28	196.84	82.63
	SD	4.83	6.28	15.39	49.72	16.51
	CV	11.90	31.70	21.00	25.25	19.98

NOTES BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

productivity means units of production by an individual in terms of deposits and credits. A Bank Employee's productivity will be judged from Business per Employee. [Business per Employee = (Deposits per Employee + Credit per Employee)] and a bank branch's productivity can be calculated through Business per Branch. [Business per Branch = (Deposits per Branch + Credit per Branch)]. Branch productivity, a crucial factor of total productivity, evaluates branch level productivity means proportionate production of the bank's per branch deposits and credits. Financial Productivity is depicted by the Spread (Interest earned less

TABLE 8   Mobile banking branches as percentage of total branches

Period Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period					
1996–1997	0.00	0.21	4.99	9.81	3.75
1997–1998	0.00	0.64	8.20	13.89	5.68
1998–1999	0.00	1.37	34.78	20.45	14.15
1999–2000	2.28	2.31	46.71	22.65	18.48
2000–2001	6.92	3.49	64.59	40.71	28.92
Average	1.84	1.60	31.85	21.50	14.19
SD	3.01	1.32	25.41	11.90	14.93
CV (%)	163.59	82.50	79.78	55.35	49.50
High-technology induction period					
2001–2002	7.17	4.14	69.64	40.14	30.27
2002–2003	12.56	5.48	72.73	45.00	33.94
2003–2004	13.57	7.68	71.21	64.24	39.17
2004–2005	13.45	11.52	56.60	75.89	39.36
2005–2006	17.80	15.84	69.26	66.96	42.46
2006–2007	24.94	24.91	82.32	77.31	52.37
2007–2008	26.20	34.70	85.20	79.10	56.30
Average	16.52	14.89	72.42	64.09	41.98
SD	5.97	7.79	8.25	13.22	7.84
CV (%)	40.01	67.16	11.74	25.63	76.19

NOTES   BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations.
Computed from the data published by Performance Highlights of Indian Banks, Indian
Bank Association, 1996–2008.

Interest paid). Table 11 highlights the Employee, Branch and Financial
Productivity ratios of Indian commercial banks.

Here, an attempt has been made to judge the impact of the Technology
Index on the Employee productivity, Branch productivity and Financial
productivity of various bank groups.

IMPACT ON EMPLOYEE PRODUCTIVITY

As shown in table 12, in the case of Group I there is a positive but mod-
erate (0.54) correlation between employee productivity and the Technol-
ogy index, but, it is significant at 5 pc LOS. At the same time R^2 shows
29 pc variations in the employee productivity by the Technology index.

TABLE 9 Tele banking branches as percentage of total branches

Period Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period					
1996–1997	0.00	0.01	5.77	10.71	0.97
1997–1998	0.00	0.33	9.18	16.67	1.62
1998–1999	0.00	0.63	23.19	27.27	1.77
1999–2000	2.78	1.26	42.89	28.18	1.85
2000–2001	5.74	1.75	38.28	42.14	2.14
Average	1.70	0.80	23.86	24.99	1.67
SD	2.56	0.70	16.68	12.07	0.43
CV (%)	150.59	87.50	69.91	48.30	25.75
High-technology induction period					
2001–2002	8.84	2.27	46.26	45.58	3.29
2002–2003	10.91	4.05	65.86	43.89	3.63
2003–2004	11.44	5.28	57.58	40.09	5.48
2004–2005	13.32	6.29	49.75	63.83	7.41
2005–2006	18.48	8.24	41.92	44.53	10.31
2006–2007	22.84	16.50	47.93	58.46	22.93
2007–2008	23.30	20.80	50.20	61.70	31.34
Average	15.59	9.06	51.35	51.15	18.84
SD	5.31	5.03	8.70	9.44	7.38
CV (%)	37.11	70.75	16.88	19.11	83.48

NOTES BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

In Group II there is a high positive correlation (0.95) between employee productivity and the Technology index, and it is also significant at 1 pc LOS. R^2 shows 90 pc variations in the dependent variable due to the Technology index. In Group III banks there is a moderate correlation of 0.59 between the independent variable and dependent variable. But it is significant at 1 pc LOS. R^2 (0.34) shows that others factor have more impact on Group III productivity than that of the Technology index. In the modern era, Group IV has a high correlation between employee productivity and the Technology index. Coefficient of determination shows 57 pc variations in employee productivity index. Overall, the Technology index of the Indian banking industry has a positive correlation of 0.97

TABLE 10   IT Index

Period	Year	Group I	Group II	Group III	Group IV	BI
Low-technology induction period						
	1996–1997	22.00	30.29	40.45	48.41	38.29
	1997–1998	38.73	38.94	46.79	49.40	41.51
	1998–1999	39.05	40.80	53.48	51.62	41.65
	1999–2000	39.98	41.25	55.52	52.83	42.14
	2000–2001	41.34	42.03	57.58	57.29	43.20
	Average	36.22	38.66	50.83	51.91	41.36
	SD	8.01	4.82	7.08	3.48	1.84
	CV (%)	22.11	12.47	13.93	6.70	4.45
High-technology induction period						
	2001–2002	42.01	43.89	58.61	57.69	43.97
	2002–2003	44.31	44.88	61.51	60.76	44.39
	2003–2004	44.60	45.75	60.29	59.10	44.72
	2004–2005	45.86	46.66	58.44	69.60	45.40
	2005–2006	48.08	47.70	59.73	59.52	45.96
	2006–2007	49.11	48.80	62.72	65.55	46.98
	2007–2008	50.22	49.10	64.40	66.23	48.30
	Average	46.31	46.68	60.81	62.63	45.24
	SD	2.61	2.10	1.73	4.58	1.11
	CV (%)	5.72	4.62	2.87	7.38	2.45

NOTES   BI – Banking Industry, SD – Standard Deviation, CV – Coefficient of Variations. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

with employee productivity and it is significant at 1 pc LOS. R^2 indicates 0.94 pc impact of IT on employee productivity. If we compare the impact of IT with all the groups we conclude that Group II banks (Fully IT oriented banks) are more influenced by technology induction.

IMPACT ON BRANCH PRODUCTIVITY

In the case of Group I banks, there is a positive and very high correlation (0.99) between branch productivity and the Technology index (table 12). The coefficient of determination also shows 98 pc variations in the dependent variable due to the Technology index and it is significant at 1 pc LOS.

Similarly, in Group 11 banks the correlation between the dependent variable and independent variable is also very high (0.98) and is also significant at 1 pc los. R^2 shows 96 pc variations in the dependent variable due to the independent variable. The correlation between employee productivity and the Technology index in Group 111 banks is positive but moderate (0.56). The effect of other factors is 69 pc. The correlation is significant at 5 pc los. In Group 1v banks there is high correlation (0.91) and it is also significant at 1 pc los. The coefficient of determination indicates that 82 pc variations have been caused by the Technology index. Overall, the Indian banking industry also has a very high coefficient of correlation and determination i. e. 0.98 and 0.96. In conclusion, we can see that the effect of 1t on branch productivity is highest on Group 1 and Group 11 banks (Partially 1t oriented banks) and lowest on Group 111 banks (Fully 1t oriented banks).

IMPACT ON FINANCIAL PRODUCTIVITY

Group 1 has a positive but very low correlation (0.11) between the dependent variable and independent variable. The coefficient of correlation is also statistically not significant (table 12). R^2 shows positive but negligible variations in the financial productivity. In Group 11 banks there is a negative but low correlation (−0.05) between financial productivity and the Technology index. The coefficient of determination is also negligible (0.02) in this group and R is insignificant. In the same manner, in Group 111 banks the coefficient of correlation between two variables is also negative but low (−0.24). The coefficient of determination shows only 5 pc variations in the financial productivity of banks due to technology. Foreign banks like private sector banks have almost the same coefficient of correlation – negative but low (−0.27). The coefficient of determination shows only 7 pc variations in the financial productivity of banks due to technology.

Overall, for the banking industry, the correlation between financial productivity and Technology index is low and negative (−0.45) and it is insignificant. The coefficient of determination indicates that the effect of other factors is more than the effect of Technology in financial productivity. These factors may be liberalization of interest rates, managerial effectiveness, internal and external policies of the banks, and so on. Finally, we can conclude that the effect of 1t on financial productivity of banks is negative, though not much. Only in the case of Group 1 banks is it positive, but that too is very low.

TABLE 11   Productivity ratios of Indian commercial banks

Group	Variable	Employee Productivity			Branch Productivity			Financial Productivity		
	Average	D/E	C/E	BUS/E	D/B	C/B	BUS/B	IE%AAS	IP%AAS	S%AAS
Group I	X_1	0.83	0.39	1.22	13.88	6.48	20.36	9.24	6.36	2.87
	X_2	2.60	1.55	4.15	27.80	17.06	44.86	7.30	4.44	2.85
	Mean Gap	1.77	1.16	2.93	13.91	10.58	24.50	1.94	1.92	0.02
	SE	1.19	0.65	1.82	6.25	5.63	11.85	0.80	0.75	0.19
	t-value	2.37	2.83	2.56	3.55	2.99	3.30	3.89	4.09	0.13
	LOS	*	*	*	**	*	**	**	**	—
Group II	X_1	0.79	0.39	1.18	18.16	8.86	27.02	8.90	6.01	2.91
	X_2	1.91	1.18	3.09	38.13	23.36	61.50	7.62	4.59	3.04
	Mean Gap	1.12	0.79	1.91	19.98	14.50	34.48	1.28	1.41	0.13
	SE	0.41	0.47	0.76	7.02	8.79	13.03	0.58	0.68	0.28
	t-value	4.37	2.68	4.02	4.07	2.63	3.98	3.50	3.30	0.72
	LOS	**	*	**	**	*	**	**	**	—
Group III	X_1	5.22	2.69	7.92	76.03	38.82	144.85	8.69	6.59	2.08
	X_2	5.31	4.17	9.48	141.15	111.14	252.29	6.25	4.12	2.11
	Mean Gap	0.09	1.48	1.57	65.12	72.32	137.44	2.44	2.47	0.03
	SE	0.75	0.38	1.05	35.50	27.01	62.08	1.09	1.04	0.49
	t-value	0.18	6.32	2.38	2.93	4.14	3.49	3.58	3.77	0.09
	LOS	—	**	*	*	**	**	**	**	—
Group IV	X_1	3.78	2.44	6.23	299.49	193.66	493.15	9.74	6.31	3.43
	X_2	5.62	4.44	10.06	493.99	394.25	888.24	6.69	3.34	3.34

	D/E	C/E	BUS/E	D/B	C/B	BUS/B	IE%AAS	IP%AAS	S%AAS
Mean Gap	1.84	2.00	3.83	194.50	200.63	395.09	3.05	2.97	0.09
SE	0.73	0.53	1.22	101.69	91.98	191.67	1.00	1.11	0.54
t-value	4.04	6.02	5.02	3.05	3.49	3.29	4.88	4.27	0.27
LOS	**	**	**	*	**	**	**	**	—
Banking Industry Average									
X_1	2.65	1.47	4.13	101.84	61.95	171.34	9.14	6.31	2.83
X_2	3.86	2.83	6.69	143.51	136.45	311.72	6.96	4.12	2.81
Mean Gap	1.21	1.36	2.56	41.67	74.50	140.38	2.17	2.19	0.02
SE	0.62	0.55	1.17	9.90	8.79	18.67	0.71	0.75	0.11
t-value	3.52	3.05	3.31	3.22	2.87	3.06	4.40	4.03	0.77
LOS	**	*	**	*	*	*	**	**	—

NOTES X_1 – average in low-technology induction period, X_2 – average in high-technology induction period, D/E – Deposit per Employee, C/E – Credit per Employee, BUS/E – Business per Employee, D/B – Deposit per Branch, C/B – Credit per Branch, BUS/B – Business per Branch, IE%AAS – Interest Earned as percent of Average Assets, IP%AAS – Interest Paid as percent of Average Assets, S%AAS – Spread as percent of Average Assets, * Mean is significant at the 0.05 level, ** Mean is significant at the 0.01 level. Computed from the data published by Performance Highlights of Indian Banks, Indian Bank Association, 1996–2008.

TABLE 12   Impact of Technology Index on productivity of bank groups

Group	Employee Productivity		Branch Productivity		Financial Productivity		Total Productivity	
	R	R^2	R	R^2	R	R^2	R	R^2
Group I	0.54*	0.29	0.99**	0.98	0.11	0.01	0.68*	0.46
Group II	0.95**	0.90	0.98**	0.96	−0.05	0.02	0.80**	0.64
Group III	0.59*	0.34	0.56*	0.31	−0.24	0.05	0.58*	0.33
Group IV	0.76**	0.57	0.91**	0.82	−0.27	0.07	0.90**	0.81
Indian Banking Industry	0.97**	0.94	0.98**	0.96	−0.45	0.20	0.95**	0.90

NOTES   * Mean is significant at the 0.05 level (1-tailed), ** Mean is signif. at the 0.01 level (1-tailed). R – coefficient of correlation, R^2 coefficient of determination.

In the case of Group i banks, the coefficient of correlation between the Technology index and total productivity of banks is positive though not very high, but significant at 5 pc LOS (table 12). The coefficient of determination shows 46 pc variations in the total productivity due to technology. In Group ii, the correlation between the total productivity and the Technology index is high (0.80), but the variations in the total productivity are 64 pc, which are moderate. The coefficient of correlation is significant at 1 pc LOS. In the case of Group iii banks, the correlation between total productivity and the Technology index is moderate, and the impact of other factors on total productivity is more than the iT. The correlation is significant at 5 pc LOS. There is a high correlation between total productivity and the Technology index in the case of Group iv. The coefficient of determination indicates that there are 81 pc variations in total productivity due to Technology. The coefficient of correlation is significant at 5 pc LOS. Overall, the Indian banking industry is highly affected by the Technology index. The correlation between the dependent variable and iT is high. The Indian banking industry is only 10 pc affected by the other factors, which indicates that it is 90 pc affected by iT. The R is significant at 1 pc LOS. Finally, we can conclude that among all the bank groups the highest effect of iT is on Group ii and Group iv banks, and the lowest effect of iT is on Group iii banks.

Concluding Remarks

In the present study, it is found that the partially iT oriented banks are less profitable than the fully iT oriented banks. However, in terms of overall productivity and profitability their performance is gradually improving over the recent years. Foreign banks are on the top in terms of the overall productivity and profitability parameters (which supports the findings of Sarkar et al, 1998). Analyzing further, it is found that SBI and associate banks (Partially iT oriented banks) are ranked second after the foreign Banks (Fully iT oriented banks) in terms of the spread ratios, but they have higher Burden ratios, which makes them less profitable as compared to the Private Banks. The Private Banks (Fully iT oriented banks) are more profitable as they have the lowest financial burden in the two periods. Moreover, they have a high proportion of non-interest income and a comparatively low level of non-interest expenditure ratios as compared to the SBI group of banks. The Interest earned ratios are declining over the years for all groups of banks because over the last few years RBI

(Central bank) has pursued the policy of lowering the interest rates. Still, foreign Banks were able to have highest Interest earned ratios in the low technology era as compared to the Indian Banks. In the high technology period, the SBI group has the highest Interest earned ratio. The Interest earned ratio for the Indian Banks has almost been the same across all the categories. The Interest paid ratio is the lowest for the foreign Banks (followed by private sector banks) in the high technology era. This can be attributed to the effective and efficient fund management by these banks through which they were able to raise funds at lower costs and use them for profitable avenues. In terms of the financial performance analysis, the findings of the present study support, to a large extent, the findings of the studies by Sarkar, Sarkar and Bhaumik 1998; Shanmugam and Das 2004; Uppal and Kaur 2007; and Kumar and Sreeramulu 2008.

Overall, for the banking industry, the correlation between financial productivity and the Technology index is low and negative and statistically insignificant. The co-efficient of determination indicates that the effect of other factors is more than the effect of Technology on financial productivity. These factors may be liberalization of interest rates, managerial effectiveness, risk management, internal and external policies of the banks and so on. Finally, we can conclude that the effect of IT on financial productivity of banks is negative, though not much. Only in the case of Group 1 banks is it positive, but that too is very low. Therefore, there is no conclusive and coherent evidence that technology leads to better financial performance. However, it is safe to say that the various banking parameters of productivity and profitability have significantly improved in the high technology induction era. From the analysis, the winners emerging are Fully IT oriented banks. Foreign banks are at the top, followed by Private Banks. From the Partially IT oriented banks, SBI and its associates are performing better than other public sector banks. Overall, the Indian banking sector has performed well on various fronts in the recent years.

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