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**THE IMPACT OF TECHNOLOGY ON THE
PERFORMANCE OF INDIAN BANKING
INDUSTRY: AN EMPIRICAL STUDY**

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List of Abbreviations used in the Study

IT	INFORMATION TECHNOLOGY
ECS	ELECTRONIC CLEARING SERVICES
INFINET	INDIAN FINANCIAL NETWORK
EFT	ELECTRONIC FUNDS TRANSFER
ATM	AUTOMATED TELLER MACHINE
RTGS	REAL-TIME GROSS SETTLEMENT
CFMS	CENTRALIZED FUNDS MANAGEMENT SYSTEM
NDS	NEGOTIATED DEALING SYSTEM
SFMS	STRUCTURED FINANCIAL MESSAGING SYSTEM
ICT	INFORMATION AND COMMUNICATION TECHNOLOGY
ALPM	ADVANCED LEDGER POSTING MACHINES
TBA	TOTAL BANK AUTOMATION
MICR	MAGNETIC INK CHARACTER RECOGNITION
ROA	RETURN ON ASSETS
ROE	RETURN ON EQUITY
DEA	DATA ENVELOPMENT ANALYSIS
TFP	TOTAL FACTOR PRODUCTIVITY
BSC	BALANCED SCORE CARD
NIM	NET INTEREST MARGIN
SBBJ	STATE BANK OF BIKANER AND JAIPUR
SBI	STATE BANK OF INDIA
SBH	STATE BANK OF HYDRABAD
SBP	STATE BANK OF PATIALA
SBT	STATE BANK OF TRAVANCORE
CBI	CANARA BANK
BOB	BANK OF BARODA
BOI	BANK OF INDIA
PNB	PUNJAB NATIONAL BANK
PSB	PUNJAB & SIND BANK
UBI	UNION BANK OF INDIA
AB	ALLAHABAD BANK
IOB	INDIAN OVERSEAS BANK
OBC	ORIENTAL BANK OF COMMERCE
CBI	CENTRAL BANK OF INDIA
FB	FEDERAL BANK
JKB	J & K BANK
ING	ING VYASA BANK
KB	KARNATKA BANK

SIB	SOUTH INDIAN BANK
AXIS	AXIS BANK
ICICI	ICICI BANK
HDFC	HDFC BANK
IIB	INDUSIND BANK
KMB	KOTAK MAHINDRA BANK
SCB	STANDARD CHARTERED BANK
RBS	ROYAL BANK OF SCOTLAND
DB	DEUTSCHE BANK
HSBC	HSBC LTD.
CITIB	CITI BANK
SB	STATE BANK GROUP
NB	NATIONALISED BANK GROUP
OPS	OLD PRIVATE SECTOR BANK GROUP
NPS	NEW PRIVATE SECTOR BANK GROUP
FB	FOREIGN BANK GROUP
DMU	DECISION MAKING UNIT
VRS	VARIABLE RETURNS TO SCALE
TE	TECHNICAL EFFICIENCY
PTE	PURE TECHNICAL EFFICIENCY
SE	SCALE EFFICIENCY
LPP	LINEAR PROGRAMMING PROBLEM
PI	PERFORMANCE INDEX

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Summary

With intense competition both from domestic sector and international players and explosive growth in information technology, the way in which commercial banks conduct business has changed considerably. In order to survive and adapt to the changing environment, the banks are putting in more efforts on understanding the drivers to generate better financial performance. The role of information technology in performance of an organization is still a paradox. The technology is not a panacea rather it is a tool to enhance efficiency and its implementation requires prudent planning, organizational capabilities, managerial skills, and entrepreneurship. In the age of competition, the contribution of information technology to the performance of an organization is being questioned. In this context, the study is an attempt to analyze the effect of information technology on the performance of Indian banking industry.

Review of Literature

The enduring magnitudes of investment in information technology have drawn attention of researchers and policy makers to analyze the impact of information technology on growth and productivity. The expectation was that increased investment in information technology would naturally lead to an increase in performance of organization but despite massive investment in information technology, its impact on performance continued to be questioned. Despite hundreds of studies carried out, opinion of the experts is solidly divided on the information technology-productivity debate. The debate is divided into two groups: (a) productivity paradox; and (b) productivity pays-offs. A good quantum of literature defends the idea of 'Solow Paradox' in concluding that information technology may affect negatively on bank's efficiency and may reduce productivity. Conversely there are many works, approving the positive impact of information technology on business value.

Such studies have used firm level evidence and have concluded that productivity paradox has disappeared. The difficulty in measuring and evaluating the benefits

of information technology has generated an extensive literature, both on quantitative and qualitative plane. There are very few studies that quantitatively index both, 'information technology' and the 'performance' of a service organization and relate the two. In this respect, the lack of good quantitative measure for the output and value created by information technology has made the studies on justifying information technology investment, particularly difficult. In this setting of argument, this work is an attempt to fill this research gap by investigating the relationship between information technology investments and performance in the Indian banking sector.

Objectives of the Study

The present study has the following objectives:

1. To evaluate the status of technology implementation in Indian banking sector.
2. To analyze the impact of Information technology adoption on the performance of Indian banking sector.
3. To estimate the relative efficiency and productivity of Indian banking sector in pre and post e banking revolution period.
4. To draw some policy implications based on the findings emanated from the study

Data and Methodology

The present study is based upon the time-series data from 1999-2000 to 2014-15. The time period has been deliberately selected because the information technology has been introduced only during this time period and many private sector banks have got their licenses from RBI only during this period. The data have been obtained from the public data sources on bank's financial statements and income expenses reports. The secondary data and information have been collected from the publications of the Reserve Bank of India: 'Report on Trend and Progress of Banking in India', 'Handbook of Statistics on Indian Economy',

'RBI Bulletin (monthly)', Annual Reports of respective banks and other valuable publications of public sector banks, private and foreign banks in India. Various websites have also been used for the data mining. Data published by Indian Banking Association in monthly bulletins, in special issues and annual publications on 'Performance Highlights of Banks' have also been used. For present research work, various journals, magazines and newspapers like 'Indian Journal of Commerce', 'Economic Survey of India', 'Economic and Political Weekly', 'Financial Express', 'Economic Times' have also been considered.

To make the work manageable and effective, it has been confined to 31 banks only. The sample represents all categories of banks: State Bank of India and its associates; nationalized banks; old private banks; new private banks; and foreign banks. By using a meaningful denominator, technology parameters have been normalized. To derive the overall technology parameter, a technology index has been derived using the discrete technology parameters. Performance analysis has been done by computing a performance index which takes into consideration different variables. The relation of technology index and performance index has been analyzed by using correlation and regression technique on both time series and panel data. Wherever needed, appropriate price adjustments have been made. The study makes an attempt to study the efficiency and productivity aspects of Indian banking industry at a disaggregated level. To measure efficiency of bank groups and individual banks, DEA has been used and to measure the productivity, Malmquist index has been used.

Main Conclusion of the Study

The overall conclusion that emerges from the analysis is that in banking industry, performance is a positive function of information technology. The findings confirm that contribution of technology to bank's performance has a differential behavior. Information technology led performance is a promising strategy for many banks to accelerate the development process. However it does not guarantee success for all banks, as their backgrounds and capabilities to produce and use

information technology differs. This is what explains the productivity paradox in service sector in general, and in banking sector in particular.

Main Recommendation of the Study

The information technology expenditure data for new private banks suggest that banking industry has been engaged in arbitrary information technology budgeting during the period under study. Over budgeting of information technology spending is noticeable among banks, suggesting managements' eagerness to approve information technology budget irrespective of its contribution to performance. The results of current study show that there is no relationship between information technology budget and performance of new private sector banks and foreign banks. The banks' management and information technology practitioners need to focus on higher information technology resources utilization and efficiency. Information technology budgeting should focus on planning, monitoring and controlling future operation. The results of current study suggest evidence of information technology productivity paradox in the Indian banking industry, evidence that could fade if information technology solution aligns well with business strategies. The existence of productivity paradox indicates the need for information technology managers and organization leaders to justify their information technology spending in terms of performance.

1.1 INTRODUCTION

In recent times, Indian banking industry is consistently working towards implementing technological changes in the banking operations. Indian banks are continuously encouraging investment in information technology, i.e. ATMs, internet banking, mobile and tele-banking, computerization in banks, plastic money, establishment of call centers, etc. RBI has also adopted IT in endorsing the payment system's functionality and modernization on an ongoing basis through Electronic Clearing Services (ECS), Electronic Funds Transfer (EFT), Indian Financial Network (INFINET), Real-Time Gross Settlement (RTGS) System, Centralized Funds Management System (CFMS), Negotiated Dealing System (NDS), Structured Financial Messaging System (SFMS) and India Card. Consequently, Indian banking environment has become more compatible as compared to the standards of international financial system. This explosive growth in information technology has considerably changed the way in which commercial banks conduct business. In order to survive and adapt to the changing environment, the banks are putting more stress on understanding the drivers of success to generate superior financial performance. The impact of information technology on the performance of an organization is still a paradox. Hence, the present study makes an attempt to map the impact of IT on the performance of banking sector for scheduled commercial banks operating in India including public, private and foreign sector banks.

1.2 TECHNOLOGY TRENDS IN INDIAN BANKING SECTOR

Information and Communication Technology (ICT) has changed the functioning of banks worldwide. The foremost breakthrough started with the use of Advanced Ledger Posting Machines (ALPM) in 1980s. The enormous automation at branch level reduced errors which resulted in customers receiving error free services. In late 1980s Total Bank Automation (TBA) was introduced both for the front-end and back-end operations within the same branch followed by the establishment of mechanized cheque processing systems which used the Magnetic Ink

Character Recognition (MICR) technology. Financial sector reforms and the emergence of internet facilitated banks in opting for centralized database for all their branches which resulted in low cost networks. New private sector banks and foreign banks employed ATMs, phone banking and internet banking pretty early followed enthusiastically by the public sector banks.

Technology adoption helped banks in crafting their own web pages which customers can access through the web browsers from their homes/workplaces. This kicked off online banking way back in 1996, however, the usage rate increased subsequent to 1999 due to lower ISP online charges, increased PC penetration and technology stabilization (Shroff, 2004). Some of the important electronic delivery channels include the ATMs, debit/credit cards, mobile banking, and tele-banking where banking facilities are available on 24/7 basis across the world. Establishment of the INFINET in 1999 resulted in introduction of Real Time Gross Settlement (RTGS) system. Internet has thus ushered the concept of anytime - anywhere banking. It resulted in compliance with the core principles for systemically important payment systems of the Bank of International settlements (BIS), and has also provided the way for risk free, credit push-based fund transfers settled on a real time basis. Data warehousing is another development which effectively generates strategic information required by the management for continuous strategic decision making like branch expansion, product line expansion, market strengthening, credit risk assessment etc. (Paulraj, 2001).

The year 2006-07 witnessed the consolidation of IT based efforts by the financial sector in general and by the commercial banks in particular. The major developments during this year include the establishment of data centers, a shift towards centralized systems and large scale implementation of core banking systems across bank branches. The Payment and Settlement Systems Act, 2007 (PSS Act) was also legislated in December 2007. Reserve Bank has since authorized payment system operators of pre-paid payment instruments, card

schemes, cross-border in-bound money transfers, Automated Teller Machine (ATM) networks and centralized clearing arrangements. The payment system initiatives taken by the Reserve Bank of India have resulted in deeper acceptance and penetration of non-cash payment modes. In the present study, the year 2006-07 is taken as the reference year for dividing the total study period into two parts i.e. Pre e banking revolution period (1999-2000 to 2006-07) and Post e banking revolution period (2006-07 to 2014-15). These periods are referred to as Period-I and Period-II respectively in the present study.

1.3 OBJECTIVES OF THE STUDY

The present study has the following objectives:

1. To evaluate the status of technology implementation in Indian banking sector.
2. To analyze the impact of Information technology adoption on the performance of Indian banking sector.
3. To estimate the relative efficiency and productivity of Indian banking sector in pre and post e banking revolution period.
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1.4 REVIEW OF THEORY AND EMPIRICS

Worldwide, in the last few years, a massive investment has been done in the banking sector and its impact on performance is still a paradox. Numerous studies, using alternative methodologies, have been done on different country banking systems. Following section is a synoptic view of some representative banking sector related studies.

Negative/No relationship in profitability and IT

Beccalli (2006) used data from 737 banks covering the period from 1993 through 2000 to study the impact of increased information technology investment on the profitability performance of banks in France, Germany, Italy, Spain and United

Kingdom. The study used balance sheet and income statement data, giving a pooled total of 4414 observations. ROA and ROE have been used as performance variables and hardware cost, software costs and services cost as the investment variables. The study found no significant relationship between total information technology expenditure and improvement in profitability. Carlson (2001) reached the same conclusion after investigating the same issue in the US banking market by regressing a bank's ROE on a set of controlled variables including an explanatory binary variable for the presence or absence of internet banking. Shirley and Mallick (2008) tested the cost effect and network effect of IT by applying a differentiated model in 68 US banks using 20 years data and concluded that bank profits decline due to adoption and diffusion of IT investment, reflecting negative network effects in this industry. Mittal and Dhingra (2007) evaluated the impact of computerization on the performance of Indian banks using Data Envelopment Analysis (DEA) and found that the benefits of computerization in boosting productivity and performance of banks is difficult to quantify. Some researchers have used correlation to study the impact of IT expenditure on the banking sector performance (Dos Santos et al. 1993) and found that IT spending is unproductive. Another researcher also found the same insignificant contribution of IT expenditure to the output in banks (Loveman, 1994). Similarly, Prasad & Harker (1997) studied US retail banking sector to assess the effect of IT and concluded that no real benefits have accrued due to additional investment in IT.

Positive relationship in profitability and IT

A lot of studies have found positive impact of IT on the performance of banking sector. Shaukat (2009) examined the impact of IT investments on profitability and employee productivity in Pakistani banking sector over a period of 1994-2005. They found that IT has a positive impact on performance of the banking sector. Parsons, Gotlieb and Denny (1993) reached at the same conclusion after studying the impact of IT on banking productivity in Canadian banking industry.

Using data from 1974-1988, a trans-log cost model has been estimated. The research found a 17-23 percent increase in productivity with the use of IT. Cooke (1998) studied some new and fast growing financial innovations linked to IT investment, e.g., assets securitization and derivatives in US banking sector. The study found that IT has enabled the banks to offer new products, expand into nontraditional areas, operate more efficiently and minimize risks. Deyoung, R. (2006), analyzed the impact of investment in information technology (IT) systems on bank's profitability in UK. Using panel data the study supported the view that IT has a positive impact on bank's profitability through several factors such as reducing the labour costs and transactions costs. Claudia et al. (2002), empirically examined Italian banks based on univariate and multivariate regression models and found a significant relationship between offering of internet banking activities and bank's profitability. Betterymarch (2003) used a panel of 600 Italian banks over the period 1989-2000 and stochastic cost and profit functions have been estimated. The results show that both cost and profit frontier shifts are strongly correlated with IT capital accumulation. Banks adopting information technology capital intensive techniques are also more efficient. Nurwani Amaratunga and Mukrima (2003) examined Sri Lankan banks and found that the strategic use of IT plays a vital role in retaining the existing customers and attracting new customers. Jun, S. (2006) investigated the impact of information technology expenditure on business performance in Korean banking using a BSC model. The results indicated a significant association between the levels of information technology adoption and the financial performance of the banks. Eyadat and Kozak (2005) investigated the impact of IT on the profit and cost efficiencies in U.S. banking sector during 1992-2003. They found a positive and significant correlation between the levels of implemented IT and both, profitability and cost savings. Hung Viet Ngugen (2005) studied Vietnamese commercial banks in terms of their efficiency change, productivity growth and technological change during the period 2001-03. The Study used Data

Envelopment Analysis (DEA) and Malmquist Index with four inputs (labour, capital, technology and deposits) and two outputs (interest income and noninterest income). It shows that total factor productivity increased by 5.7 percent in 2003 relative to 2001. Aghdassi, M. (2008) analyzed the strategic value of e-banking for Iranian banks and revealed that bank manager's performance through e-banking is quite positive and effective. They also concluded that information technology stock contributes to value added growth significantly and use of information network shows positive impacts on TFP. Rahman, I.U. (2007) analyzed the financial statements for 26 banks from 1991 through 2001. They used ROA, ROE and net profit as performance variables, and computer budget ratio and capital budget ratio as the information technology investment variables. The results revealed the strongest relationship between computer budget ratio and ROE/ROA. Similarly Malhotra and Singh (2006), M. Chandrasekhar (2010) analyzed the implications of internet banking for the Indian banking industry for the period 1998-2005 and found that internet banks are larger banks and have better operating efficiency and profitability as compared to non-internet banks. Casolaro and Gobbi (2007) analyzed the relationship between information technology investment and productivity in Italian banking industry using unbalanced panel data from 618 banks collected for 1989 through 2000. With information technology use and total factor productivity as output, the researcher employed stochastic cost and profit frontier techniques. They used hardware capital stock, software capital stock, information technology capital stock for an employee, and the number of ATMs as the information technology investment measures. For the performance measures, the authors used the ratio of services to gross income and capital, and the ratio of reserves to total assets. The results revealed that banks with higher information technology investment were more efficient. Agboola (2007) used Likert-type ratings to measure and analyze the degree of utilization of identified technologies and the variations in their adoption rate in Nigerian banks. The study revealed

that the adoption of ICT in banks has improved customer services, facilitated accurate records, provided home and office banking services and enhanced faster services. Illyas-Ur Rahman (2007) examined the role of information technology in banks and studied the perception of bank employees towards the implementation of information technology. The study considered different information technology variables like net banking, credit cards, mobile banking, electronic funds transfer, phone banking, card to card funds transfer. The study found a positive relation between implementation of information technology and delivery of services. Ahmad Mashnour (2009) investigated the way in which information technology investment created value in the Jordanian banks. The study measured some variables which determine financial information system performance i.e. (a) IT integrated in IS; (b) software quality; (c) investment in training; (d) customer services; (e) productivity; (f) user satisfaction; and (g) cost benefit analysis. The study concluded that information system provides a competitive advantage to the banking industry and the effectiveness of information systems has a positive impact on Jordan banks. Ombati and Magutu (2010), analyzed the relationship between technology and service quality in the banking industry in Kenya. The research is a cross-sectional survey and the respondents of the study are customers of banks using e-banking services (internet banking, mobile banking and ATM). The findings revealed that e banking has improved the service quality of banks. Madume Stella (2010) analysed the impact of information and communication technology on the productivity of the Nigerian banking sector using CAMEL and the transcendental logarithmic production function also called Translog. The study found that bank output such as loans and other assets increase significantly due to increase in expenditure on information and communication technologies. Leckson and Leckey (2011) ascertained and documented the extent to which investment in information technology may affect profitability in Ghana banking sector. The study used an enhanced Balanced Score Card (BSC) approach proposed by

Kaplan and Norton and used the extensive panel data set of 15 banks over a 10 year period (1998-2007). The study found that higher IT level banks have the tendencies of increased profitability. Alpar and Kim (1990) studied 759 US banks during 1979-1986 to analyze the impact of IT on economic performance. Applying cost function approach they found that IT was able to reduce operating costs, increase capital expenditures of banks, save personnel costs, reduce demand deposits, and increase time deposits. Ekata, G.E. (2012), examined technological change, its relationship to firm size, and its impact on the efficient scale of output and product mix for large US commercial banks. The results suggest that technological change lowered real costs by about 1 percent per year, increased the cost minimizing scale of outputs, and affected product mix. To study the efficiency and productivity of banks, many researchers used DEA model. Das et al., (2000) used DEA approach for all the three types of ownership— public, private and foreign. Kamakura & Ratchford, (1996) used DEA with translog cost function to measure efficiency of multiple retail stores. While applying DEA, different IT related input specifications have been noticed. Some studies used computer (hardware) as input measure (Oral and Yolalan, 1990; Vassiloglon & Giokas, 1990) whereas some others have taken Number of ATMs (Zenios et al., 1999). Choudhari & Tripathy, (2004) used DEA with a lot of variables like profitability, financial management, growth, productivity, and liquidity. Many other users of this approach were Mukherjee et al. 2002; Kumar & Verma 2003; Sathye 2003; Gunjan M.Sanjeev; 2006; Gupta et al., 2008; Rezvanian et al., 2008; Awdeh & Moussawi, 2009; Sunil & Rachita, 2010 etc. Review of studies is indicative of the fact that the relation of information technology input and performance is a tricky one. It needs proper metrics or quantification of the two prime variables, the IT and performance. There are very few studies that quantitatively indexed both the information technology and the performance of banks. This work is a step ahead to fill this gap.

1.5 Research Design

The present study is based upon the time-series data from 1999-2000 to 2014-15. The time period has been purposely selected because the information technology has been introduced only during this time period and many private sector banks have got their licenses from RBI only during this period. The data have been obtained from the public data sources on bank's financial statements and income expenses reports. The secondary data and information have been collected from the publications of the Reserve Bank of India: 'Report on Trend and Progress of Banking in India', 'Handbook of Statistics on Indian Economy', 'RBI Bulletin (monthly)', Annual Reports of respective banks and other valuable publications of public sector banks, private and foreign banks in India. Various websites have also been used for data mining. Data published by Indian Banking Association in monthly bulletins, in special issues and annual publications on 'Performance Highlights of Banks' have also been used. For present research work, various journals, magazines and newspapers like 'Indian Journal of Commerce', 'Economic Survey of India', 'Economic and Political Weekly', 'Financial Express', 'Economic Times' have also been considered.

The population of this study comprises of all the commercial banks listed in RBI directory. Out of this, 31 banks turn out to be the sample of the study over the period 1999-2000 to 2014-15. These 31 banks represent all categories of banks. They are State Bank of India and its associates, nationalized banks, old private banks, new private banks and foreign banks. Banks have been selected on the basis of their consistent record. First category consists of State Bank of India and its associates. They are State Bank of India, State Bank of Patiala, State Bank of Hyderabad, State Bank of Bikaner & Jaipur and State Bank of Travancore. Second category consists of eleven nationalized banks. They are Canara Bank, Bank of Baroda, Bank of India, Punjab National Bank, Dena Bank, Punjab and Sind Bank, Union Bank of India, Allahabad Bank, Indian Overseas Bank, Oriental

Bank of Commerce and Central Bank of India. In the same way, old generation private sector banks are banks with their reasonable large branch network and stable performance over the years. They are Federal Bank, Jammu & Kashmir Bank, Karnataka Bank, South Indian Bank and ING Vysya Bank. In 1994-95, RBI issued banking license to ten new private banks. Five new private sector banks have been selected for this study whose branch work and profits are continuously increasing. They are ICICI Bank, HDFC Bank, IndusInd Bank, Axis Bank (erstwhile UTI Bank) and Kotak Mahindra Bank. Foreign banks with a long association/ presence in India and with highest branch network have been selected for study. They are Standard Chartered Bank, Citibank, HSBC, Deutsche Bank and Royal Bank of Scotland (erstwhile Amro Bank). Since many of the foreign banks operate with a single branch in India or with only a representative office as a result of which, their performance is not comparable to that of Indian banks and hence they are not chosen for study though the data speaks volumes about their exemplary performance. The regional rural banks have also been excluded from the present study as their operations are confined to target groups in rural and semi-urban areas. Private Banks with data gaps have also been excluded. For analysis, data have been used both in time series and panel data format.

By using a meaningful denominator, technology parameters have been normalized. To obtain the overall technology parameter, a technology index has been derived using the discrete technology parameters. These are:

1. Number of ATMs
2. Number of Computerised Branches
3. Number of Credit Cards
4. Number of Internet Bank branches
5. Number of Mobile Bank branches
6. Number of tele Bank branches

Performance analysis has been done by computing a performance index which takes into consideration different variables. These are:

1. Credit deposit ratio,
2. Business per branch,
3. Profit per branch,
4. Profit per employee,
5. NIM to total assets,
6. Non-interest income to total assets,
7. Operating profits to total assets ,
8. Return on assets
9. Return on equity

1.6 Measurement Issues

As already said, the main objective of the work is to explore the relationship of technology input with performance output at a disaggregate level in Indian banking sector. For both technology and performance, a variety of discrete non-comparable parameters are available with different scales and origins. Before setting up a model to explore the relation, the pre-requisite is to arrive at the technology index and performance index that combines all such variables in an objective way. Following is the methodological brief relating to derivation of technology and performance indices.

Technology Index: To develop an overall technology parameter, a technology index has been derived using the discrete technology parameters for 5 bank groups i.e. SB, NB, OPS, NPS and FB group as well as for 31 banks for the period 1999-2000 to 2014-15. These are number of ATMs, number of credit cards, number of computerized branches, number of mobile banking branches, number of internet banking branches and number of tele banking branches. Since absolute values may not provide meaningful standards until and unless

they are related to some other relevant information, therefore different ratios are used while constructing the technology index. Ratios, due to their conciseness and comparability help to summarize large data. The selected ratios are: (a) number of ATMs per Branch; (b) number of credit cards per branch; (c) number of computerized branches as a percentage to total branches; (d) number of internet banking branches as a percentage to total branches; (e) number of mobile banking branches as a percentage to total branches; and (f) number of tele-banking branches as a percentage to total branches. By using a meaningful denominator, above technology parameters have been used to arrive at normalized technology variables. Normalization is required prior to any data aggregation, as indicators in a data set tend to have different measurement units. Normalization refers to the division of multiple sets of data by a common variable in order to negate variable's effect on the data, thus allowing underlying characteristics of the data set to be compared. Normalization through rescaling is considered as the best option because it makes all the elements to lie between zero and one. It uses all the available information and is easy to express and communicate.

Performance index: The performance of the banks has become more market driven with the growing emphasis on better efficiency. Many studies have attempted to evaluate the overall economic performance of banking sector by applying the profitability criteria but the Indian banking industry dominated by public sector banks is not operated by profitability objective alone. Some of the studies done so far on Indian banking have analyzed only productivity by taking time series data and others have evaluated the economic efficiency. Since banks are partners in development and financing programme of the country, it has led to increase in their branches. Hence, in addition to profitability parameter, efficiency and productivity needs to be judged by developing some comprehensive index of performance. Initially ten performance variables such as

credit deposit ratio, business per branch, return on assets, return on equity, profit per branch, profit per employee, spread per branch, spread per employee, business per employee, burden per branch, NIM to total assets, Non interest income to total assets, capital adequacy ratio, overhead ratio, Non-interest expenses to total income ratio, liquid assets to total deposits ratio. On the basis of sensitivity analysis, 9 indicators have been shortlisted to construct the performance index. The selected parameters have been standardized to generate variables for constructing the performance index. The selected variables are credit deposit ratio, business per branch, profit per branch, profit per employee, NIM to total assets, Non interest income to total assets, operating profits to total assets, return on assets and return on equity.

By using these discrete variables, an index has been framed by following a two step procedure. First step is to arrive at the sub-indices by normalizing the raw data variables, so as to take care of differences of scale and origin. Second step is to arrive at the average index. If VLU_j is the number of discrete raw variables for an index, then I_j is the normalized value of such variables which can be calculated as follows.

$$I_j = VLU_j / VLU_{\max}$$

Where VLU_j is value in the series and VLU_{\max} is the maximum value in the series. It is done to wipe out the differences in the scale of banks as normalization allows data on different scales to be compared by bringing them to a common scale. Then an index can be generated by computing the simple average of normalized variables as:

$$NDX = (\sum I_j / N),$$

Where j varies from 1 to N . Using this methodology, technology index and performance index have been computed.

1.7 Tools of Analysis

1.7.1 Correlation and Regression Analysis

Empirical exploration of the relation between technology index and performance index has been done by using time series and cross section correlation analysis which is a statistical tool to describe the degree to which one variable is linearly related to another. In the present study, to better investigate the above preliminary evidences and to gain a deeper understanding of the relationship between technology index and performance index, the set of regressions have been estimated. Technology index is treated as independent (exogenous) variable and performance index is treated as dependent (endogenous) variable. The mathematical representation of regression equation is written as follows.

$$Y = a + bx + \varepsilon$$

Where Y is the performance index; a is the constant intercept; b is the regression coefficient that represents the estimated change in the value of dependent variable for each unit change in independent variable values; and X is the technology index. To further refine the relationship, technology is taken in conjunction with other inputs: labour and capital. Performance is studied collectively through multi-variate regression analysis. The following multiple regression model has been used:

$$Y_i = a + b_1x_1 + b_2x_2 + b_3x_3 + \varepsilon$$

Where Y_i is the performance of bank group i;

X_1 is the capital;

X_2 is the labour; and

X_3 is the technology index.

Further b_1 to b_3 are the regression coefficients that represent the estimated change in the value of dependent variable for each unit change in independent variable values. The regression coefficients have been computed by ordinary least square method. This analysis has been carried out in cross section, time series and panel data dimensions. The regression model used to measure this relationship is the joint regression (pooled data regression). Significance of regression is tested at five percent and one percent level of significance. All these results are derived by using SPSS 20 version.

1.7.2 Measuring Efficiency with IT as an Input

Data envelopment analysis (DEA) is a non-parametric method of measuring efficiency of a decision making unit (DMU) such as bank / firm. DEA employs mathematical programming to construct a best practice frontier from the observed data and to measure efficiency relative to the constructed frontier. The DEA frontier is formed by connecting the set of best practice observations (the piece-wise linear combination). Thus, the DEA efficiency score for a DMU or bank is not defined by an absolute standard but is defined relative to other banks. For an industry where one output is produced using two inputs, it can also be represented by a unit isoquant.

The best way to explain DEA is by way of ratio form. For each DMU, we would like to obtain a measure of the ratio of all outputs (y) over all inputs (x), such as $u'y/v'x$, where u is output weight and v is input weight. To select optimal weights, we specify the mathematical programming problem:

$$\begin{aligned} & \text{Max } (u'y/v'x) \\ & \text{s.t. } u'y/v'x < 1, \quad j=1,2,\dots,N \\ & u, v > 0 \end{aligned}$$

This involves finding values for u and v , such that the efficiency measure of the i th DMU is maximized, subject to the constraint that all efficiency measures must be less than or equal to one. One problem with this particular ratio formulation is that it has an infinite number of solutions. To avoid this, an equivalent envelopment form of this problem is estimated, i.e.,

Minimize E_n with respect to $w_1, w_2, \dots, w_N, E_n$

Subject to:

$$\sum_{j=1}^N w_j y_{ij} - y_{in} \geq 0 \quad i = 1, \dots, I$$

$$\sum_{j=1}^N w_j x_{kj} - E_n x_{kn} \leq 0 \quad k = 1, \dots, K$$

$$w_j \geq 0 \quad j = 1, \dots, N$$

Where there are N organizations in the sample producing I different outputs (y_{in} denotes the observed amount of output i for organization n) and using K different inputs (x_{kn} denotes the observed amount of input k for organization n). w_j are the weights applied across the N organizations. When the n th linear program is solved, these weights allow the most efficient method of producing organization n 's outputs. The efficiency score for the n th organization, E_n^* , is the smallest number E_n which satisfies the three sets of constraints listed above. For a full set of efficiency scores, this problem has to be solved N times — once for each organization in the sample.

DEA analysis is usually undertaken with absolute numerical data, which among other things reflect the size of the units. There are some cases reported in the literature (Emrouznejad et al 2008; Hollingsworth and Smith 2003) that the

authors used ratio variables rather than absolute numbers as input (input-ratio) and/or output (output-ratio).

One simple addition to the DEA formulae above enables the change to variable returns scale (VRS). This change relaxes the simplistic assumption that inputs normally will move in exact proportions to the scale of operations: it allows for the existence of economies and diseconomies of scale. The additional constraint is that the weights in the DEA formula must sum to one. The variable returns to scale DEA linear program is given by:

Minimize S_n with respect to w_1, \dots, w_N, S_n

Subject to:

$$\sum_{j=1}^N w_j y_{ij} - y_{in} \geq 0 \quad i = 1, \dots, I$$

$$\sum_{j=1}^N w_j x_{kj} - S_n x_{kn} \leq 0 \quad k = 1, \dots, K$$

$$\sum_{j=1}^N w_j = 1$$

$$w_j \geq 0 \quad j = 1, \dots, N$$

The estimation of technical efficiency with CRS assumptions allows the overall technical efficiency (TE) to be decomposed into two collectively exhaustive components: pure technical efficiency (PTE) and scale efficiency (SE) i.e., $O TE = PT \times SE$. The former relates to the capability of managers to utilize firms' given resources, whereas the latter refers to exploiting scale economies by operating at a point where the production frontier exhibits constant returns to

scale. DEA assigns values between 0 and 1 to each efficiency measure. A DMU receiving score 1, is regarded as 100 per cent efficient.

Specification of Inputs and Outputs

In the present study the following inputs and outputs are taken both for bank group wise analysis and individual bank level analysis.

Inputs

Deposits

Number of Employees

Number of ATMs

Number of Computerised Branches

Number of Credit Cards

Number of Internet Bank branches

Number of Mobile Bank branches

Number of tele Bank branches

Outputs

Credit deposit ratio,

Business per branch,

Profit per branch,

Profit per employee,

NIM to total assets,

Non-interest income to total assets,

Operating profits to total assets ,

Return on assets

Return on equity

1.7.3 Total Factor Productivity Analysis – Malmquist Index Approach

Malmquist Total Factor Productivity is a technique depending on The Data Envelopment Analysis (DEA). It measures the productivity change of a specific value (increase/decrease rate) between two timeframe (Berg et.al., 1992:213). Change indexes in total factor productivity for the banks are calculated separately for both banks and bank groups via applying panel data for the period 1999-2014. Temporal development of banks' productivity and its sources are presented by Malmquist total factor productivity index. DEAP 2.1 program produced by Coelli (1996) is employed for the measurement of indexes. Constant returns to scale hypothesis is applied over technology in order to estimate the distance functions that are used in the measurement of Malmquist total factor productivity index. For that reason, constant returns to scale hypothesis is deemed.

This index that is defined in terms of distance functions developed by Malmquist (1953) measures the change in the total factor productivity between two variables by calculating each variable's relative distance rate to common technology. Distance functions might be seen as both input and output based distance functions (Deliktas, 2002). In input based approach, the least input amount used for the production of output (input minimization); as for output based approach, the maximum production of output with a definite input (output maximization) should be predicated on. The solution of the two optimization problem is able to give effective edge; notwithstanding, differences occasionally would emanate in nonimpact units. The present study seize upon input based approach.

By means of Malmquist total productivity change index the change in the bank's productivity from the (t) period to (t+1) is measured. Malmquist total productivity change index which belongs to the input between (t) period and the following

(t+1) period is measured via the below formula (Worthington, 2000, Oncu and Aktas, 2007).

$$M_o(\mathbf{x}^{t+1}, \mathbf{y}^{t+1}, \mathbf{x}^t, \mathbf{y}^t) = \left[\left(\frac{D_o^t(\mathbf{x}^{t+1}, \mathbf{y}^{t+1})}{D_o^t(\mathbf{x}^t, \mathbf{y}^t)} \right) \left(\frac{D_o^{t+1}(\mathbf{x}^{t+1}, \mathbf{y}^{t+1})}{D_o^{t+1}(\mathbf{x}^t, \mathbf{y}^t)} \right) \right]^{\frac{1}{2}} \quad (1)$$

$$Mo(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right) \right]^{\frac{1}{2}} \quad (2)$$

The ratio written outside of the square brackets in the second formula measures the change in the input-based technical efficiency between (t) and (t+1) years. The efficiency change is the ratio of efficiency in (t+1) period in proportion to efficiency in (t) period. Geometric average of the two ratios in square brackets delineates the change in technology between two periods. That is to say; the changes in total factor productivity and components are measured as the geometrical average of Malmquist productivity indexes (Fare et. al., 1994).

Malmquist total productivity index might be divided into two as the change in technical efficiency and technological change. When we split the equation (2) into two by this way, we can measure the change in efficiency and technological change asunder.

$$\text{Where, Efficiency change} = \frac{D_o^{t+1}(x^{t+1}, y^{t+1})}{D_o^t(x^t, y^t)} \quad (3)$$

$$\text{Technical change} = \left[\left(\frac{D_o^t(x^{t+1}, y^{t+1})}{D_o^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_o^t(x^t, y^t)}{D_o^{t+1}(x^t, y^t)} \right) \right]^{1/2} \quad (4)$$

The change in technical efficiency is described as the efficiency in reaching to the production limit and technological change as the curve shift in productivity limit (Mahadevan, 2002). On the other hand, multiplication of the change in technical efficiency and technological change yields the change in the total factor productivity. Total factor productivity index's being more than 1 shows that total factor productivity increased during the period between (t) and (t+1). Its being less than 1 asserts the contrary (Coelli, 1996a:28).

In order to measure Malmquist total factor productivity change index, a range of linear programming problem (LPP) should be measured. The LPP; which is used in Malmquist total factor productivity change index depended on the constant returns to scale hypothesis and input-based approach, is given (Worthington; 2000).

$$\begin{aligned}
 [D_I^t(y_t, x_t)]^{-1} &= \min_{\theta, \lambda} \theta \\
 \text{s.t} & \\
 -y_{it} + Y_t \lambda &\geq 0 \\
 \theta x_{it} - X_t \lambda &\geq 0 \\
 \lambda &\geq 0
 \end{aligned} \tag{1}$$

$$\begin{aligned}
 [D_I^{t+1}(y_{t+1}, x_{t+1})]^{-1} &= \min_{\theta, \lambda} \theta \\
 \text{s.t} & \\
 -y_{i,t+1} + Y_{t+1} \lambda &\geq 0 \\
 \theta x_{i,t+1} - X_{t+1} \lambda &\geq 0 \\
 \lambda &\geq 0
 \end{aligned} \tag{2}$$

$$\begin{aligned}
 [D_I^{t+1}(y_t, x_t)]^{-1} &= \min_{\theta, \lambda} \theta \\
 \text{s.t} & \\
 -y_{it} + Y_{t+1} \lambda &\geq 0 \\
 \theta x_{it} - X_{t+1} \lambda &\geq 0 \\
 \lambda &\geq 0
 \end{aligned} \tag{3}$$

$$\begin{aligned}
 [D_I^t(y_{t+1}, x_{t+1})]^{-1} &= \min_{\theta, \lambda} \theta \\
 \text{s.t} & \\
 -y_{i,t+1} + Y_t \lambda &\geq 0 \\
 \theta x_{i,t+1} - X_t \lambda &\geq 0
 \end{aligned} \tag{4}$$

$$\lambda \geq 0$$

The first two linear programming models are evaluated by using the efficient limit of the given period as the base. While Model (3) compares the datum of (t) period with the efficient limit of (t+1) period; model (4) compares the datum of (t+1) period with (t) period's efficient limit.

Each of the four linear programming models should be solved for each period and observation in the example so as to measure the Malmquist total factor productivity. Thus; $N \times (3T-2)$ number of problem should be solved to depict the T period number and N observation number.

1.8 Analysis, Results and Discussion

The present study explores the relation of information technology and performance in Indian banking industry at a bank group level as well as individual bank level of disaggregation. It is divided into five sections. First section delineates the main trends in information technology in different bank groups/banks and develops an information technology index. Next section covers the performance of commercial banks at disaggregate level of bank groups/banks and develops a performance index. Third section explores the nature and dynamics of relationship between information technology and performance. Fourth section and fifth section deals with efficiency measurement and productivity analysis respectively.

1.8.1 Technology Index

This section analyzes various forms of technological innovations or electronic delivery channels adopted by banks. The entire approach towards technology based banking has shown significant improvement since the year 1999-2000 and it has resulted into a paradigm shift in Indian banking industry. There are many indicators of technology adoption but given the objective and data availability considerations, the following electronic delivery channels have been identified to form variables for framing a comprehensive technology index for various bank

groups/banks under consideration. These electronic delivery channels are: (a) number of ATMs per branch (b) computerized branches to total branches (c) number of credit cards per branch (d) internet banking branches to total branches (e) mobile banking branches to total branches (f) tele - banking branches to total branches.

To draw some meaningful conclusions about the impact of information technology on the banking sector performance, the study period has been divided into two parts (1999-2000 to 2006-07 and 2006-07 to 2014-15) taking 2007 as the dividing year. In India, the payment and settlement systems are regulated by the Payment and Settlement Systems Act, 2007 (PSS Act) which was legislated in December 2007. Reserve Bank has since authorized payment system operators of pre-paid payment instruments, card schemes, cross-border in-bound money transfers, Automated Teller Machine (ATM) networks and centralized clearing arrangements. The payment system initiatives taken by the Reserve Bank of India have resulted in deeper acceptance and penetration of non-cash payment modes. Following is the spatial and temporal analysis of electronic delivery channels.

1. Computerized Branches to total branches

Narasimahm Committee-II has recommended full computerization of the branches in 1998. Table 1.1 depicts that in period-I, the percentage of computerized branches was quite low however commendable growth in these branches is recorded in Period-II. FB group has taken the lead followed by NPS and SB group in period-II as is evident from the average productivity gap figures. The significant paired t values also support these results. The analysis at three different points of time reveals that SB and NB group made significant progress from 2006-2014 as against OPS, NPS and FB group which started early computerization and hence heavy growth is noticed during 1999-2006.

Table 1.1
Computerised Branches to Total Branches (Bank Group Wise)

Bank	1999-	2006-	2014-	Growth	Growth	Pre E-Banking	Pre E-Banking	Average	t-
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Group	2000	07	15	Rate (from 1999- 2006) %	Rate (from 2007- 2014) %	Revolution Period Average (1999-2006)	Revolution Period Average (2007-2014)	Productivity Gap	Value
NB	0.008	0.049	0.692	512.50	1312.24	0.167	0.195	0.049	- 3.732*
SBI	0.011	0.086	0.992	681.82	1053.49	0.254	0.290	0.132	- 3.062*
OPS	0.002	0.054	0.737	2600.00	1264.81	0.189	0.211	0.054	- 2.672*
NPS	0.019	0.178	0.989	836.84	455.62	0.281	0.318	0.178	- 2.431*
FB	0.055	0.375	0.995	581.82	165.33	0.290	0.323	0.147	- 3.990*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.2 shows that on the basis of computerization of branches the first 3 ranks are captured by Deutsche, HSBC and Citi Bank respectively. Four out of the five selected new private sector banks are also among the top 10 computerized banks. One bank from the state bank group i.e. State Bank of Patiala and 1 from the Nationalised banks i.e. Punjab & Sind bank also finds rank among the top 10. During Period-II also all the selected foreign banks are the top rankers. One significant trend reversal is noticed in Period-II with 5 nationalized banks i.e. OBC, Dena bank, Allahabad Bank, CBI and PSB claimed positions among top 10. The significant paired t values indicate that most of the selected banks specifically from the public sector banks started increasing computerization of branches in Period-II. 4 banks from SB group, 10 from NB, 5 from OPS, 1 from NPS and 1 from FB group recorded higher growth in computerized branches during 2006-2014 as compared to 1999-2006. Hence it may be concluded that computerized branches increased significantly in most of the selected banks and bank groups during Period-II.

Table 1.2
Computerised Branches to Total Branches (Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.000	0.457	1.552	Na	239.85	0.266	0.978	0.712	-9.22*
SBI	0.046	0.233	1.514	406.52	549.96	0.274	1.053	0.779	-33.42*
SBH	0.000	0.707	1.378	Na	94.83	0.265	0.920	0.655	-14.36*
SBP	0.426	0.957	1.607	124.76	67.93	0.723	1.052	0.329	-5.39*
SBT	0.453	0.742	1.539	63.80	107.47	0.480	1.038	0.558	-15.52*
CB	0.575	0.940	1.566	63.54	66.55	0.658	1.054	0.396	-7.07*
BOB	0.534	0.962	1.459	80.00	51.69	0.626	1.038	0.412	-8.63*
BOI	0.155	0.342	1.225	120.46	258.09	0.416	0.831	0.415	-8.16*
PNB	0.064	0.338	1.873	428.13	454.14	0.556	1.039	0.483	-4.12*
DenaB	0.000	0.954	1.783	Na	86.80	0.581	1.184	0.603	-6.65*
PSB	0.000	1.034	1.546	Na	49.53	0.634	1.112	0.479	-3.60*
UBI	0.208	0.348	1.471	67.44	322.57	0.435	0.957	0.522	-13.29*
AB	0.000	0.849	1.754	Na	106.65	0.270	1.138	0.867	-42.79*
IOB	0.000	0.795	1.406	Na	76.84	0.366	0.979	0.613	-8.37*
OBC	0.175	0.525	1.681	199.64	220.27	0.233	1.237	1.004	-6.31*
CBI	0.000	0.515	1.833	Na	255.81	0.189	1.116	0.927	-13.95*
FB	0.000	0.616	1.156	Na	87.63	0.322	0.796	0.473	-7.41*
JKB	0.000	0.857	1.494	Na	74.33	0.380	1.044	0.664	-10.64*
INGVB	0.000	0.368	1.568	Na	326.16	0.181	0.867	0.686	-6.98*
KB	0.000	0.374	1.407	Na	276.39	0.192	0.879	0.687	-10.36*
SIB	0.000	0.552	1.699	Na	207.93	0.231	1.036	0.806	-12.26*
Axis	0.429	0.709	0.967	65.34	36.54	0.706	0.798	0.092	-0.64
ICICI	0.184	0.792	1.231	330.75	55.39	0.690	0.906	0.216	-1.30
HDFC	0.446	0.803	1.052	80.20	30.91	0.716	0.832	0.116	-1.26
IIB	0.064	0.741	0.874	1057.09	18.02	0.775	0.667	-0.107	2.03
KMB	0.000	0.700	0.804	Na	14.85	0.239	0.715	0.476	-3.28*
SCB	0.787	0.988	2.312	25.53	134.01	0.633	1.328	0.695	-6.89*
RBS	0.000	0.920	7.699	Na	736.88	0.579	2.505	1.926	-2.08
DB	0.879	1.500	1.794	70.65	19.58	1.266	1.228	-0.038	-0.70
HSBC	0.652	1.243	2.335	90.64	87.82	0.997	1.302	0.305	-1.92
Citib	0.342	0.975	1.968	185.09	101.86	0.811	1.246	0.435	-4.07*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

2 ATMs per Branch

ATMs are the most compassionate and speedy tool of IT for banking transactions especially for cash withdrawal and mini statement of account. Table 1.3 shows that during Pre e banking period FB group and NPS group have taken the lead in

establishing maximum number of ATMs per branch followed by SB, OPS and NB group. During 2006-2014, the growth rate of ATMs is higher in NB, SB and OPS group. The average productivity gap is also found highest in FB group although this gap has been found positive for all the bank groups. Post e banking period, with greater variations highlights that whole banking industry has gained excellent improvement in ATMs' installation. The significant t values also reveal a comparatively better scenario during period II for all the bank groups.

Table 1.3
Number of ATMs Per Branch ((Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.030	0.215	1.562	606.35	626.51	0.188	0.630	0.441	-6.03*
SB	0.081	0.340	1.785	319.26	425.12	0.309	1.300	0.990	-6.80*
OPS	0.085	0.336	1.537	295.46	357.17	0.197	0.974	0.777	-6.63*
NPS	1.317	3.026	3.123	129.79	3.20	2.022	3.046	1.024	-3.72*
FB	0.329	3.313	4.274	906.49	29.02	2.365	4.019	1.654	-4.94*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.4 shows that in Period-I foreign banks are among the top ten banks having largest number of ATMs. Citibank tops the list of all 31 selected banks in the study followed by Deutsche Bank. NPS banks are the second one to claim 4 places in the top ten. Axis Bank and IndusInd Bank are the top performers among NPS banks. No bank from SB and NB group finds a place in top ten performers. More specifically nationalized banks exists at the tail of the list in Period-I. In Period-II, again the foreign banks take the lead by claiming 5 places in the top 6 banks. Further all the selected new private sector banks are among the top ten banks. The paired sample t values are found significant for all the selected banks except Deutsche Bank, RBS and Indusind Bank as the average productivity gap figures in these 3 banks are quite low. It may be concluded that in ATMs installations, foreign banks and new private sector banks are better

performers as compared to other banks. The growth of ATMs during 2006-2014 as compared to 1999-2006 is found quite high for almost all the selected banks.

Table 1.4
Number of ATMs Per Branch ((Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.000	0.342	3.986	na	1063.99	0.13	1.71	1.58	-3.73*
SBI	0.014	0.520	2.806	3598.69	439.40	0.19	1.54	1.35	-5.61*
SBH	0.000	0.347	1.924	na	453.79	0.19	0.87	0.68	-4.05*
SBP	0.000	0.379	2.162	na	470.78	0.16	0.95	0.79	-4.18*
SBT	0.000	0.418	2.037	na	387.46	0.13	0.92	0.79	-5.41*
CB	0.000	0.459	2.401	na	423.14	0.14	1.08	0.93	-5.02*
BOB	0.022	0.143	1.424	545.99	898.87	0.07	0.62	0.56	-3.88*
BOI	0.000	0.109	0.588	na	441.21	0.04	0.26	0.22	-4.70*
PNB	0.000	0.432	1.874	na	334.00	0.10	0.83	0.74	-5.15*
DenaB	0.000	0.224	1.401	na	525.39	0.06	0.63	0.57	-4.53*
PSB	0.000	0.006	0.196	na	3271.31	0.00	0.08	0.08	-3.28*
UBI	0.000	0.411	2.478	na	502.55	0.13	1.08	0.95	-4.51*
AB	0.000	0.087	0.384	na	339.23	0.03	0.17	0.15	-4.71*
IOB	0.000	0.158	1.261	na	700.13	0.07	0.55	0.48	-4.26*
OBC	0.000	0.397	2.427	na	510.82	0.12	1.26	1.15	-3.64*
CBI	0.000	0.059	0.510	na	759.46	0.01	0.21	0.20	-4.09*
FB	0.000	0.665	3.092	na	365.01	0.22	1.46	1.24	-5.83*
JKB	0.000	0.423	1.705	na	303.00	0.21	0.80	0.59	-4.45*
INGVB	0.000	0.230	3.139	na	1264.48	0.11	1.25	1.14	-3.26*
KB	0.000	0.093	1.795	na	1820.69	0.04	0.77	0.72	-3.57*
SIB	0.000	0.343	2.646	na	671.37	0.15	1.09	0.94	-3.61*
Axis	0.589	3.192	9.671	441.61	203.01	1.34	5.14	3.79	-7.46*
ICICI	0.245	0.743	7.416	203.12	898.14	0.56	3.40	2.83	-3.70*
HDFC	0.482	0.616	6.006	27.74	875.68	0.55	2.97	2.42	-3.80*
IIB	2.049	0.768	2.982	-62.54	288.48	1.29	1.80	0.51	-1.47
KMB	0.000	0.573	3.267	na	470.45	0.21	1.69	1.48	-5.10*
SCB	0.328	1.878	14.599	472.80	677.33	0.68	5.69	5.01	-3.49*
RBS	0.000	0.800	50.883	na	6260.40	0.48	13.29	12.81	-1.91*
DB	0.800	2.875	10.279	259.38	257.55	2.70	4.43	1.73	-1.44*
HSBC	0.733	0.787	17.347	7.35	2103.48	0.76	6.24	5.47	-2.61*
Citib	1.111	3.450	28.147	210.50	715.86	3.21	12.11	8.90	-2.74*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

3 Credit Cards per Branch

Credit cards, an excellent version of IT for banking and shopping in market, has gained momentum among all IT channels. Table 1.5 shows that during Period-I, FB group is the most admired one for credit cards, as revealed by its highest

average (nearly 1857 cards per branch) whereas OPS group and NB group record an awkward figure of average 2 cards per branch only. Same is the position in Period-II where also FB group takes a lead with an average of 8973 credit cards per branch. OPS group and NB group record 18 and 17 credit cards per branch. Postbanking period confirms excellent growth in credit cards' strength. Even though post-ebanking period confirms an improved strength of credit cards but still OPS and NB groups are not harmonized with fully IT-oriented banks more particularly FB group. Here again the increase in number of credit cards per branch in all the bank groups has been found highly significant as revealed by the t values.

Table 1.5
Number of Credit Cards Per Branch ((Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.71	3.42	17.87	379.80	422.32	2.24	11.46	9.22	5.42*
SBI	4.58	17.92	105.80	291.38	490.35	10.97	77.90	66.92	4.24*
OPS	0.66	3.31	18.59	402.02	461.75	2.05	9.85	7.79	2.89*
NPS	47.05	211.89	850.80	350.33	301.53	131.64	649.9	518.32	3.97*
FB	1021.26	2513.15	12571.18	146.08	400.22	1857.24	8973.62	7116.37	4.15*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

In Period-I all 5 selected foreign banks and 4 of the 5 selected new private sector banks get 9 out of first 10 ranks (Table 1.6). Most of the old private sector banks are rallying much behind other banks. In Period-II also foreign banks are on the top followed by new private sector banks. One bank each from the state bank group and nationalized bank group found place in the top 10. OPS and NB group banks were struggling hard to meet the standards set by FB and NPS group banks, however 5 banks from SB, 10 from NB, 5 from OPS, 1 from NPS and 3 from FB group record huge growth in credit cards during 2006-2014. The significant paired t values for almost all of the banks reveal the improved efforts

on the part of selected banks in improving the credit card component of electronic delivery channels.

Table 1.6
Number of Credit Cards Per Branch ((Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.00	26.31	110.47	na	319.81	13.59	78.94	65.35	-6.02*
SBI	45.57	101.85	625.17	123.48	513.82	71.01	379.14	308.13	-3.83*
SBH	0.00	2.12	6.13	na	188.82	1.24	4.50	3.26	-7.17*
SBP	0.00	44.44	219.60	na	394.10	8.84	159.25	150.41	-7.57*
SBT	0.00	381.68	1341.01	na	251.35	119.44	1002.13	882.69	-8.64*
CB	0.00	23.51	49.98	na	112.58	10.08	39.44	29.36	-13.54*
BOB	0.84	2.48	56.77	194.62	2190.46	1.33	37.80	36.47	-4.19*
BOI	0.00	13.35	43.08	Na	222.72	6.31	32.10	25.79	-9.39*
PNB	0.00	15.56	19.87	Na	27.73	6.84	16.51	9.67	-6.20*
DenaB	0.00	19.06	43.74	Na	129.44	8.53	35.61	27.08	-12.94*
PSB	0.00	20.81	35.15	Na	68.94	14.40	29.90	15.49	-7.78*
UBI	1.57	12.05	99.40	665.91	724.89	6.84	67.92	61.08	-5.28*
AB	0.00	42.16	330.88	Na	684.79	11.47	254.71	243.25	-8.27*
IOB	0.00	280.49	859.75	0	206.52	81.39	645.95	564.56	-8.32*
OBC	320.44	735.38	829.28	129.49	12.77	504.73	825.35	320.62	-3.99*
CBI	0.00	5.88	15.43	Na	162.45	2.26	11.35	9.09	-10.95*
FB	0.00	6.01	85.18	Na	1316.17	3.24	55.84	52.59	-4.27*
JKB	0.00	9.85	58.28	Na	491.81	6.12	41.71	35.59	-5.13*
INGVB	0.00	10.27	383.59	Na	3635.49	5.41	248.53	243.12	-4.54*
KB	0.00	7.80	159.20	Na	1940.00	4.61	102.43	97.82	-3.91*
SIB	0.00	9.38	37.77	Na	302.69	4.46	25.50	21.04	-6.97*
Axis	370.27	1678.91	4012.72	353.42	139.01	509.68	3512.44	3002.76	-7.63*
ICICI	487.09	1370.52	837.91	181.37	-38.86	1204.42	812.88	-391.54	3.09*
HDFC	1132.87	1382.96	883.44	22.08	-36.12	1813.29	967.32	-845.97	5.51*
IIB	427.45	346.77	546.41	-18.87	57.57	512.37	588.27	75.90	-0.90
KMB	0.00	42.76	154.78	Na	261.94	16.70	133.18	116.48	-5.00*
SCB	5049.62	11702.56	35201.78	131.75	200.80	8292.27	23186.15	14893.88	-4.95*
RBS	0.00	26858.84	174817.09	Na	550.87	490.40	68142.77	67652.37	-2.17*
DB	810.67	655.00	1068.29	-19.20	63.10	726.52	805.40	78.88	-0.42
HSBC	23294.13	20448.89	38797.71	-12.21	89.73	21057.40	27519.29	6461.88	-2.62
Citib	16428.22	20525.28	49303.82	24.94	140.21	20875.11	38185.61	17310.50	-3.69*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

4 Internet Banking Branches

Internet banking is also a much popular approach of banking today. Table 1.7 demonstrates that on an average FB group takes the lead followed by NPS group. During post-e-banking period, SB Group tops the list with an average of 37 percent followed by NPS and FB group. NB and OPS group show a very dismal comparative picture in this regard. The average productivity gap in all the

bank groups is found positive with SB group showing remarkable increase in internet branches. The t values are found significant for all the bank groups thereby revealing the positive approach of banks towards technology adoption. In particular NB and SB group are growing more internet branches as revealed by the growth rate during 2006-2014.

Table 1.7
Internet Branches to Total Branches ((Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.000	0.011	0.328	2612.40	2828.57	0.006	0.064	0.058	2.76*
SBI	0.002	0.038	0.997	2067.64	2504.26	0.016	0.370	0.354	2.98*
OPS	0.001	0.022	0.228	4277.88	938.57	0.012	0.078	0.065	2.80*
NPS	0.007	0.065	0.596	834.78	811.23	0.039	0.223	0.184	3.06*
FB	0.021	0.074	0.186	248.53	152.96	0.048	0.129	0.081	8.33*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.8 reveals the growth of internet branches at the disaggregated bank level. The top 10 rank holders constitute all the 5 selected foreign banks, 3 new private sector banks and 1 each from SB and NB group. During period-II exemplary performance has been shown by the SB group with 4 of the 5 selected banks of this group, 4 foreign banks and 1 each from OPS and NB group find rank among the top 10. Most of the selected banks are opening more and more internet branches only during 2006-2014 as revealed by the huge growth rate figures. The paired t values of most of the 31 selected banks is highly significant which indicates that banks in the modern world have no choice but to adopt and implement technology and innovation to stay in business.

Table 1.8

Internet Branches to Total Branches ((Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.00	0.46	0.63	Na	35.74	0.15	0.56	0.41	-11.29*
SBI	0.02	0.13	1.34	614.64	964.11	0.05	0.94	0.88	-7.66*
SBH	0.00	0.52	1.02	Na	97.72	0.15	0.81	0.66	-12.80*
SBP	0.00	0.36	1.19	na	234.40	0.11	0.90	0.79	-8.99*
SBT	0.00	0.56	1.09	na	95.20	0.26	0.89	0.62	-35.56*
CB	0.00	0.20	0.37	na	80.28	0.06	0.32	0.26	-14.95*
BOB	0.09	0.27	0.97	200.00	259.38	0.23	0.80	0.57	-14.69*
BOI	0.00	0.09	0.48	na	423.52	0.03	0.32	0.30	-5.81*
PNB	0.00	0.37	0.56	na	49.85	0.12	0.46	0.34	-12.68*
DenaB	0.00	0.10	0.20	na	99.66	0.04	0.17	0.12	-20.28*
PSB	0.00	0.00	0.00	na	Na	0.00	0.00	0.00	-4.79*
UBI	0.00	0.07	0.63	na	849.94	0.03	0.41	0.38	-6.39*
AB	0.00	0.19	0.81	na	321.95	0.07	0.57	0.50	-14.57*
IOB	0.00	0.23	0.63	na	170.91	0.08	0.52	0.44	-5.93*
OBC	0.00	0.22	0.92	na	307.17	0.11	0.84	0.73	-21.02*
CBI	0.00	0.15	0.35	na	127.46	0.03	0.27	0.24	-4.20*
FB	0.00	0.20	0.24	na	19.84	0.11	0.22	0.11	-22.15*
JKB	0.00	0.23	0.48	na	109.58	0.11	0.41	0.30	-7.30*
INGVB	0.00	0.25	1.45	na	469.91	0.14	1.02	0.88	-11.90*
KB	0.00	0.24	0.41	na	74.02	0.13	0.34	0.21	-9.29*
SIB	0.00	0.25	0.42	na	65.64	0.13	0.35	0.22	-3.99*
Axis	0.12	0.15	0.56	26.41	270.01	0.20	0.46	0.26	-10.14*
ICICI	0.12	0.43	0.78	276.05	79.12	0.34	0.65	0.31	-3.68*
HDFC	0.14	0.47	0.41	240.89	-11.41	0.26	0.43	0.18	2.74*
IIB	0.36	0.49	0.26	37.51	-47.59	0.58	0.39	-0.19	-1.61
KMB	0.00	0.45	0.28	na	-36.13	0.16	0.34	0.18	-8.10*
SCB	0.17	0.35	0.80	102.25	126.65	0.23	0.57	0.34	-2.42*
RBS	0.00	0.64	4.23	na	561.25	0.38	1.65	1.27	0.25
DB	0.80	0.75	1.02	-6.25	36.30	0.81	0.84	0.03	-9.99*
HSBC	0.27	0.60	1.21	123.40	103.85	0.42	0.87	0.44	-5.40*
Citib	0.37	0.55	1.04	48.50	89.37	0.48	0.84	0.36	-3.69*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

5. Mobile Banking Branches

Mobile-banking is also trendy even prior to the internet-banking which is mainly availed for balance checking, billing and giving other account related instructions to the banks. Table 1.9 highlights the major findings where FB group was at the top in period I followed by NPS and SB groups. Post-e-banking period shows improvement in case of all bank groups where SB group takes a lead followed by NPS group. Gap between pre and post e banking period signifies growth in mobile banking services in post-e banking period, where also SB group captures top position reporting an average figure of 35 percent. Again OPS and NB groups are reflecting below average performance. The significant t values indicate the healthy growth of mobile banking during period II.

Table 1.9
Mobile Banking Branches to Total Branches ((Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.000	0.010	0.181	2595.63	1647.88	0.004	0.058	0.054	- 2.74*
SBI	0.001	0.030	1.076	1917.99	3524.53	0.013	0.367	0.355	- 2.77*
OPS	0.000	0.018	0.174	7251.53	845.46	0.008	0.068	0.060	- 3.34*
NPS	0.007	0.049	0.461	640.02	834.83	0.023	0.172	0.149	- 3.17*
FB	0.017	0.066	0.154	292.10	133.10	0.041	0.109	0.068	- 10.8*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.10 reveals that as per mobile banking branches criterion, first 10 ranks are captured by all selected 5 foreign banks, 3 new private sector banks and 1 each from NB and SB group. The nationalized banks show very poor performance in adopting mobile banking delivery channel. In Period-II no new private sector bank finds a place among top 10, instead these are replaced by

SB group banks. However, most of the selected banks are making great efforts to adopt mobile banking as revealed by the healthy growth figures during 2006-2014. The significant t values further supports the fact that all the banks are making all round efforts in adoption of mobile banking technology.

Table 1.10
Mobile Banking Branches to Total Branches (Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.000	0.121	0.709	na		485.95	0.08	0.56	-9.45*
SBI	0.015	0.145	1.337	892.22		819.69	0.06	0.84	-5.31*
SBH	0.000	0.202	1.021	na		405.18	0.05	0.73	-6.62*
SBP	0.000	0.596	1.191	na		99.79	0.14	0.98	-16.48*
SBT	0.000	0.558	1.056	na		89.14	0.22	0.88	-25.90*
CB	0.000	0.223	0.377	na		68.83	0.08	0.33	-11.48*
BOB	0.072	0.339	1.005	369.48		196.90	0.17	0.80	-9.61*
BOI	0.000	0.088	0.435	na		391.75	0.03	0.29	-5.70*
PNB	0.000	0.245	0.390	na		59.40	0.05	0.32	-9.72*
DenaB	0.000	0.149	0.240	na		60.46	0.05	0.21	-13.12*
PSB	0.000	0.000	0.456	na	Na		0.00	0.15	-2.42*
UBI	0.000	0.083	0.573	na		589.72	0.04	0.38	-5.34*
AB	0.000	0.090	0.749	na		734.52	0.04	0.49	-5.14*
IOB	0.000	0.098	0.682	na		596.17	0.04	0.47	-5.75*
OBC	0.000	0.232	0.846	na		263.85	0.10	0.78	-6.76*
CBI	0.000	0.124	0.264	na		111.92	0.03	0.21	-24.50*
FB	0.000	0.190	0.290	na		52.30	0.07	0.25	-12.29*
JKB	0.000	0.174	0.417	na		140.07	0.08	0.34	-21.04*
INGVB	0.000	0.283	1.154	na		307.18	0.13	0.84	-10.57*
KB	0.000	0.199	0.369	na		85.56	0.07	0.31	-17.24*
SIB	0.000	0.190	0.347	na		82.64	0.10	0.28	-11.13*
Axis	0.167	0.158	0.163	-5.39		3.38	0.18	0.15	3.81*
ICICI	0.063	0.288	0.685	355.68		137.96	0.12	0.54	-6.99*
HDFC	0.145	0.317	0.396	119.13		24.88	0.18	0.39	-5.78*
IIB	0.195	0.443	0.258	127.16		-41.84	0.41	0.39	-0.01
KMB	0.000	0.264	0.279	na		5.90	0.10	0.31	-3.36*
SCB	0.087	0.293	0.674	234.76		130.30	0.17	0.47	-10.06*
RBS	0.000	0.640	4.232	na		561.25	0.35	1.64	-2.52*
DB	0.800	0.750	1.124	-6.25		49.93	0.83	0.90	-0.13
HSBC	0.133	0.404	1.251	203.19		209.51	0.24	0.86	-9.56*
Citib	0.519	0.575	1.180	10.89		105.28	0.55	0.95	-5.20*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

6 Tele-Banking Branches

Tele-banking encourages banking on telephones for limited operations. Table 1.11 represents comparative view where average share of tele-banking branches

of total branches is more in NB group in pre-e-banking period followed by NPS and SB group. Comparatively, post-e-banking period shows upgradation where SB group takes the lead followed by NPS and FB group. Post-e-banking period confirms striking improvement in telebanking services in all bank groups as revealed by the positive average productivity gap with significant t values as well as by the heavy growth rates during 2006-2014 with exception of FB group.

Table 1.11
Tele banking Branches to Total Branches ((Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.0002	0.0054	0.1676	2963.64	2990.79	0.0020	0.0535	0.0515	2.69*
SBI	0.0008	0.0231	0.8918	2787.50	3760.63	0.0123	0.3074	0.2951	2.83*
OPS	0.0006	0.0089	0.2021	1383.33	2170.97	0.0093	0.0779	0.0687	3.20*
NPS	0.0053	0.0450	0.4496	745.53	898.30	0.0280	0.1659	0.1380	2.98*
FB	0.0127	0.0772	0.1516	509.93	96.35	0.0442	0.1103	0.0661	10.9*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.12 contains the comparative scenario of tele banking technology adoption by various selected banks. It reveals that in Period-I the top 10 ranks are claimed by 5 foreign banks, 4 new private sector banks and 1 old private sector bank. This position gets changed in Period-II with 4 foreign banks, 3 nationalised banks, 2 state banks and 1 old private sector bank. The removal of new private sector banks from the Period-I list shows the changing priority of public sector banks in favour of new delivery channels. This fact is further supported by the huge growth of tele banking branches during 2006-2014. The highly significant paired t values also support these results.

Table 1.12
Tele banking Branches to Total Branches ((Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.000	0.136	0.416	na	205.99	0.08	0.31	0.23	-7.65*
SBI	0.006	0.208	1.109	3450.74	432.90	0.06	0.73	0.66	-6.30*
SBH	0.000	0.106	0.909	na	757.11	0.02	0.63	0.61	-5.59*
SBP	0.000	0.096	1.184	na	1134.06	0.02	0.99	0.97	-20.14*
SBT	0.000	0.279	0.655	na	135.31	0.13	0.54	0.41	-23.73*
CB	0.006	0.022	0.080	246.65	262.22	0.01	0.06	0.05	-7.51*
BOB	0.026	0.108	0.945	323.80	773.96	0.05	0.69	0.64	-5.92*
BOI	0.000	0.026	0.546	na	1992.58	0.01	0.36	0.35	-5.18*
PNB	0.000	0.035	0.112	na	223.57	0.01	0.08	0.07	-10.03*
DenaB	0.000	0.093	0.216	na	131.19	0.04	0.17	0.14	-21.86*
PSB	0.000	0.000	0.304	na	Na	0.00	0.11	0.11	-2.53*
UBI	0.000	0.049	0.702	na	1333.40	0.02	0.45	0.43	-4.72*
AB	0.000	0.190	0.916	na	382.74	0.05	0.69	0.64	-8.93*
IOB	0.000	0.178	0.816	na	358.66	0.05	0.66	0.61	-12.62*
OBC	0.000	0.232	0.793	na	241.30	0.09	0.74	0.65	-6.61*
CBI	0.000	0.122	0.239	na	95.81	0.03	0.18	0.15	-16.18*
FB	0.000	0.212	0.250	na	17.76	0.11	0.23	0.12	-4.10*
JKB	0.000	0.171	0.565	na	229.94	0.07	0.44	0.37	-11.00*
INGVB	0.000	0.368	1.058	na	187.39	0.18	0.76	0.58	-10.27*
KB	0.000	0.245	0.367	na	49.40	0.11	0.31	0.20	-9.85*
SIB	0.000	0.242	0.552	na	128.54	0.10	0.43	0.33	-40.80*
Axis	0.107	0.148	0.298	37.86	101.48	0.17	0.25	0.08	-4.99*
ICICI	0.074	0.281	0.682	277.93	142.87	0.21	0.54	0.33	-8.28*
HDFC	0.088	0.138	0.283	56.35	104.86	0.11	0.26	0.15	-6.00*
IIB	0.358	0.178	0.223	-50.14	25.14	0.29	0.29	0.00	-0.95
KMB	0.000	0.582	0.278	na	-52.27	0.18	0.34	0.16	-1.19
SCB	0.087	0.329	0.652	276.60	98.10	0.19	0.46	0.27	-10.94*
RBS	0.000	0.560	4.575	na	716.96	0.33	1.77	1.45	-2.55*
DB	0.533	0.750	1.322	40.63	76.22	0.67	1.05	0.37	-4.23*
HSBC	0.133	0.723	1.354	442.55	87.20	0.38	0.97	0.59	-9.47*
Citib	0.370	0.575	1.139	55.25	98.16	0.45	0.97	0.53	-7.55*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Information Technology Index

To derive the overall technology parameter a technology index is developed using the discrete technology parameters analyzed above. By using a meaningful denominator these technology parameters are used to arrive at normalized technology variables. These variables are then used for computation of

technology index. The variables are: number of ATMs per branch; number of credit card per branch; number of computerized branches to total branches; number of internet banking branches to total branches; number of mobile banking branches to total branches; and number of tele-banking branches to total branches. Bank group wise information technology index for different years is shown in table 1.13. On the whole, the table is indicative of the fact that information technology index of all bank groups has improved over a period of time.

Table 1.13
Information Technology Index (Bank group Wise)

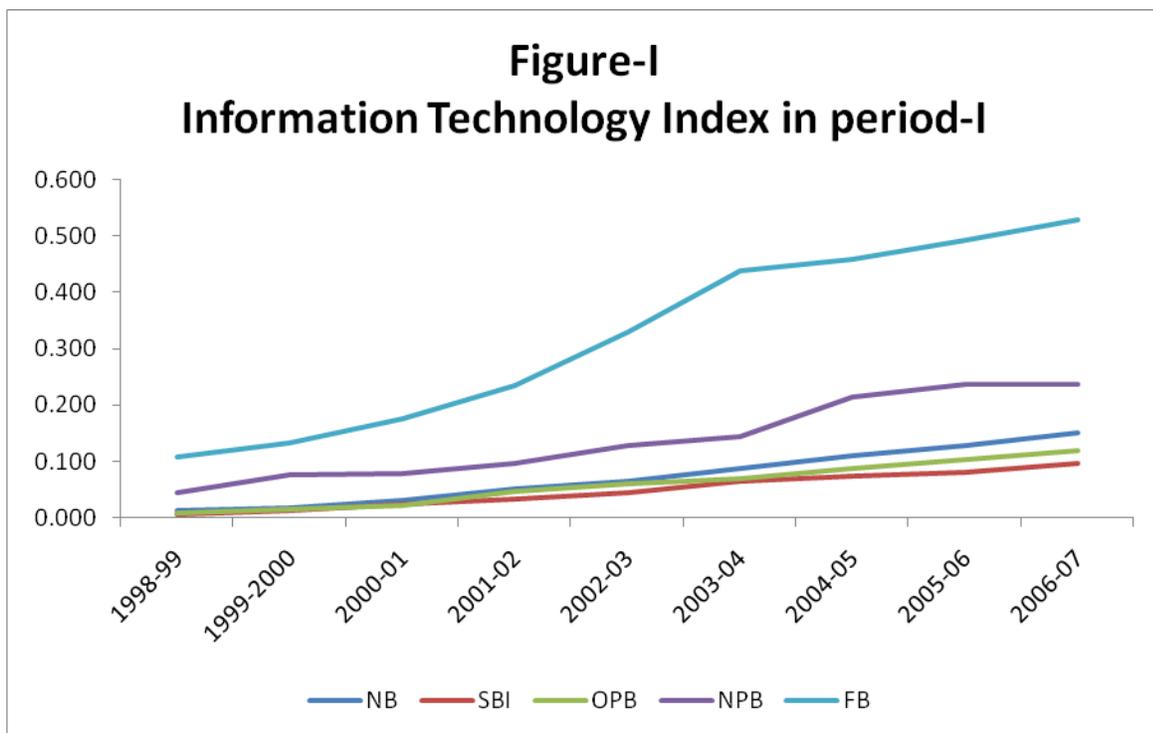
Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap
NB	0.017	0.150	1.000	785.57	566.73	0.072	0.430	0.358
SBI	0.015	0.097	0.956	546.72	886.81	0.050	0.446	0.396
OPS	0.015	0.119	0.951	701.47	701.85	0.059	0.408	0.349
NPS	0.076	0.237	0.922	211.26	288.39	0.140	0.472	0.332
FB	0.132	0.528	0.945	299.77	78.94	0.321	0.766	0.445

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Technology Index is the quantum of technology adoption and use by the banks. In pre e banking period the FB group was on the top with average IT index value of .321 followed by NPS, NB, OPS and SB group with average IT index values of .14, .07, .059 and .05 respectively. However in post e banking period this ranking changed to FB, NPS, SB, NB and OPS with the average IT index values of .766, .472, .446, .430 and .408 respectively. As reflected by figure-I no bank group was even nearer to the IT adoption performance of the FB group, however figure-II shows a complete transformation in the efforts of all bank groups to towards IT adoption and a clear convergence has been noticed during the end of the study period. It is an indication of the fact that IT adoption has become a

necessity and this truth has very well been received and understood by all the bankers. More specifically SB and NPS group recorded a relatively better growth during 2006-2014. The CAGR of SB, NB, NPS and OPS during Period-II was 32,30, 26 and 22 percent as against the Period-I CAGR of 4,2,3 and 6 percent. The CAGR of FB group during Period-I and II was 15 and 16 percent respectively, hence it may be concluded that FB group was the early starter in IT adoption and the rest of the groups made huge efforts only during period-II.



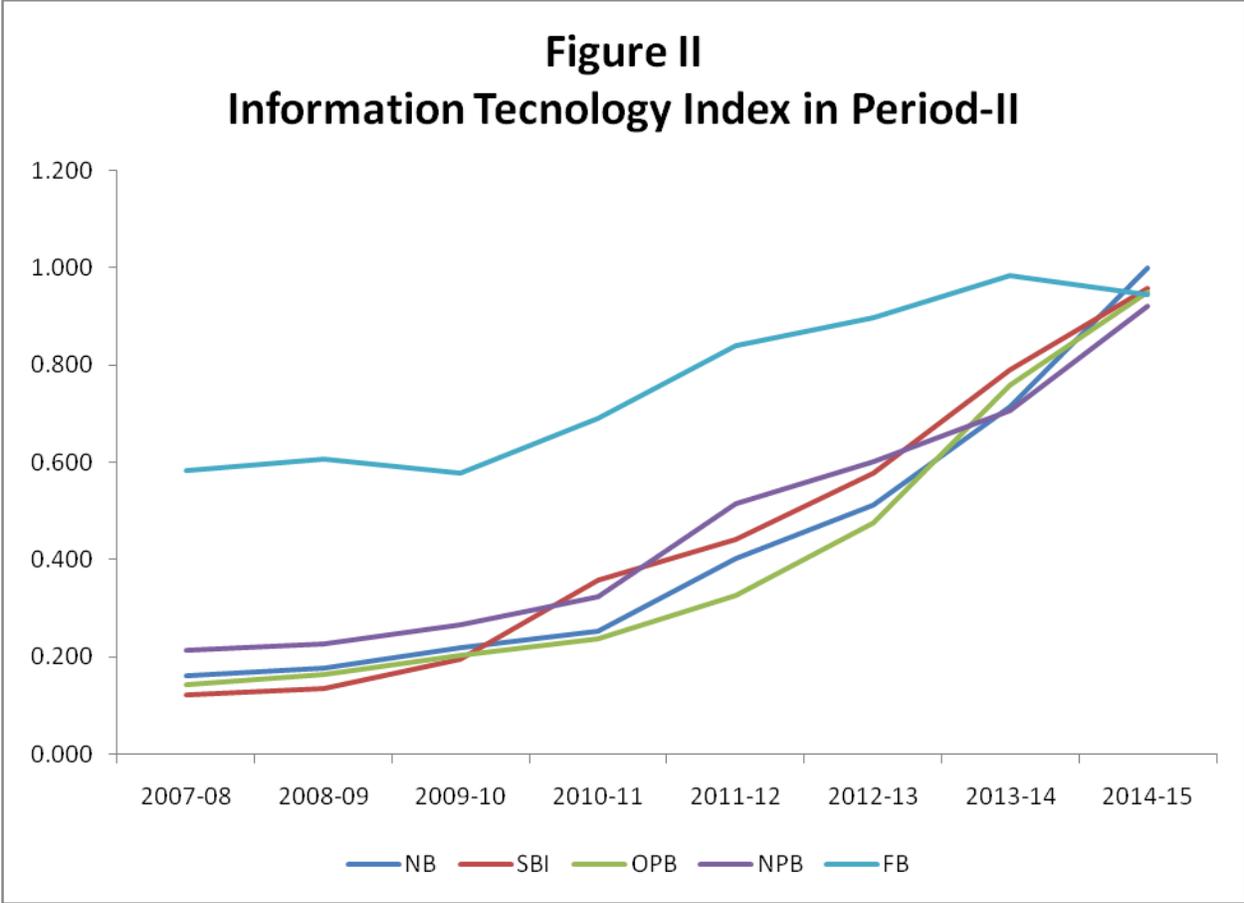


Table 1.14 contains the Technology Index at individual bank level. In Period-I the ranking as per average IT index value goes in favour of foreign banks with RBS, CITIB, HSBC and DB capturing first 4 ranks followed by SB group banks (SBT and SBI). Among the first 10 banks there are 5 foreign banks, 2 state banks, 1 old private sector bank and 2 nationalised banks. This trend continues during Period-II when the top ten rankers constitute 5 foreign banks, 3 state banks and 1 each from nationalized banks and old private sector banks. However as revealed by figures III to VII state banks, nationalized banks, new private sector banks and old private sector banks are making concerted efforts to adopt various electronic delivery channels in their operations. Foreign banks are slowing down in this regard as these already have a strong base of technology channels.

Table 1.14
Information Technology Index (Bank Wise)

Name of Bank	2000-01	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)
SBBJ	0.076	0.227	0.497	198.42	118.69	0.114	0.497
SBI	0.026	0.128	0.783	396.38	511.72	0.114	0.783
SBH	0.021	0.121	0.629	467.10	419.83	0.139	0.629
SBP	0.082	0.119	0.681	44.62	472.27	0.218	0.681
SBT	0.101	0.178	0.592	75.42	232.58	0.237	0.592
CB	0.055	0.106	0.392	91.05	269.81	0.142	0.392
BOB	0.123	0.199	0.599	62.19	201.01	0.203	0.599
BOI	0.049	0.124	0.375	151.48	203.37	0.074	0.375
PNB	0.060	0.178	0.326	197.25	83.15	0.145	0.326
DenaB	0.078	0.193	0.319	147.85	65.36	0.096	0.319
PSB	0.079	0.115	0.268	46.70	132.50	0.058	0.268
UBI	0.051	0.149	0.492	191.96	230.95	0.090	0.492
AB	0.026	0.204	0.512	694.51	151.41	0.102	0.512
IOB	0.029	0.211	0.499	617.99	136.91	0.105	0.499
OBC	0.080	0.235	0.549	193.27	133.30	0.129	0.549
CBI	0.004	0.089	0.329	2100.22	269.66	0.074	0.329
FB	0.087	0.174	0.267	99.65	53.45	0.117	0.167
JKB	0.089	0.243	0.289	173.08	18.95	0.124	0.289
INGVB	0.082	0.253	0.623	207.89	145.95	0.127	0.623
KB	0.061	0.197	0.323	225.75	63.80	0.099	0.323
SIB	0.000	0.230	0.385	0.00	67.13	0.115	0.385
Axis	0.243	0.345	0.455	42.12	31.92	0.268	0.455
ICICI	0.265	0.355	0.444	34.13	25.10	0.228	0.444
HDFC	0.223	0.332	0.387	49.07	16.53	0.256	0.387
IIB	0.275	0.369	0.342	34.17	-7.31	0.406	0.294
KMB	0.000	0.393	0.302	0.00	-23.07	0.196	0.302
SCB	0.189	0.490	0.214	159.46	-56.40	0.340	0.214
RBS	0.734	0.716	1.000	-2.40	39.58	0.358	1.000
DB	0.743	0.810	0.206	8.90	-74.50	0.825	0.206
HSBC	0.398	0.650	0.291	63.16	-55.18	0.558	0.291
Citib	0.666	0.780	0.311	17.19	-60.12	0.664	0.311

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Figure-V IT Index OPS Group

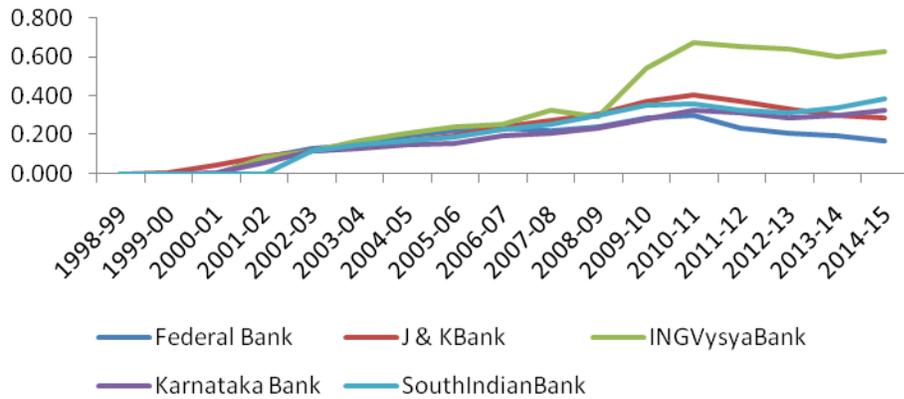
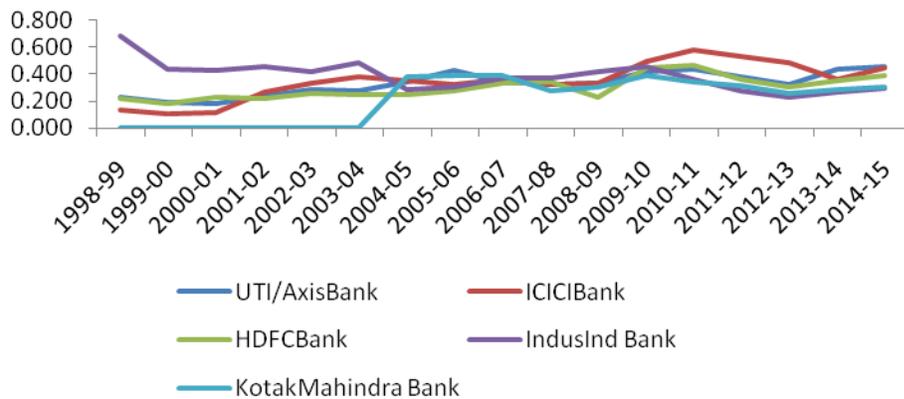


Figure-VI IT Index NPS Group



				%	%	(1999-2006)	(2007-2014)		
NB	45.83	54.93	73.77	19.86	34.30	56.14	73.48	17.35	5.73*
SBI	44.32	58.03	82.02	30.93	41.34	54.96	80.21	25.26	7.72*
OPS	39.02	60.08	76.11	53.97	26.68	51.45	71.29	19.84	19.1*
NPS	45.37	75.14	86.36	65.62	14.93	64.08	81.69	17.61	6.16*
FB	70.00	83.81	80.86	19.73	-3.52	73.21	81.17	7.96	2.04*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.16 reveals the comparative performance of individual banks under study. In period-I, 4 foreign banks, 2 each from SB and NPS group and 1 each from OPS and NB group are among the top 10 rank holders. State bank group shows above average performance as 4 out of 5 SB group banks are among top 10 in Period-II followed by 3 each from FB and NPS group. However, the significant t values again reveal the comparatively improved credit- deposit ratio for all banks during Period-II.

Table 1.16
Credit- Deposit Ratio (Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	58.05	73.28	82.56	26.24	12.66	57.55	77.09	19.54	-6.56*
SBI	56.38	62.88	82.45	11.53	31.12	54.43	64.60	10.18	-6.18*
SBH	64.58	69.98	80.71	8.36	15.33	56.09	77.08	20.99	-9.49*
SBP	66.57	70.27	84.83	5.56	20.72	61.43	81.32	19.89	-7.96*
SBT	67.43	69.96	75.45	3.75	7.85	62.10	88.56	26.46	-6.27*
CB	46.55	54.02	69.65	16.05	28.93	52.71	71.47	18.76	-6.75*
BOB	47.27	54.88	69.32	16.10	26.31	53.11	71.51	18.40	-8.68*
BOI	54.75	59.02	75.58	7.80	28.06	62.28	73.95	11.67	-4.78*
PNB	46.71	62.35	75.9	33.48	21.73	52.34	73.83	21.49	-15.84*
DenaB	54.22	60.24	68.08	11.10	13.01	52.74	68.26	15.52	-10.23*
PSB	43.17	53.81	73.66	24.65	36.89	45.06	68.19	23.13	-17.42*
UBI	40.19	56.71	80.68	41.10	42.27	54.09	72.05	17.97	-5.37*
AB	45.03	60.1	77.49	33.47	28.94	48.66	69.53	20.87	-19.94*
IOB	46.17	56.94	69.81	23.33	22.60	50.69	71.33	20.64	-6.70*
OBC	45.87	57.7	71.2	25.79	23.40	47.93	69.78	21.85	-7.73*
CBI	41.76	56.38	73.75	35.01	30.81	44.58	66.04	21.46	-29.44*
FB	62.34	65.64	72.41	5.29	10.31	60.59	72.96	12.36	-6.51*
JKB	45.79	59.55	67.8	30.05	13.85	48.77	64.17	15.39	-5.19*
INGVB	0	76.73	86.49	0.00	12.72	36.78	73.75	36.97	-2.74*
KB	53.35	58.84	68.86	10.29	17.03	51.94	62.83	10.89	-7.93*
SIB	53.31	60.11	72.03	12.76	19.83	55.47	68.37	12.90	-7.40*
Axis	71.36	55.63	87.17	-22.04	56.70	53.64	72.95	19.31	-3.94*

						2006)	2014)		
NB	2934.63	6192.42	14190.90	111.01	129.17	4085.71	11539.67	7453.96	-12.52
SBI	3964.38	7601.30	16318.03	91.74	114.67	5118.13	12553.85	7435.72	-13.80
OPS	2730.02	4787.40	10150.12	75.36	112.02	3692.75	8593.69	4900.94	-12.20
NPS	14025.65	28314.18	23405.55	101.87	-17.34	18417.42	21515.09	3097.67	-1.57
FB	46739.75	101870.77	192340.08	117.95	88.81	65523.41	151490.77	85967.36	-25.67

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.18 shows clear superiority of foreign and new private sector banks both in Period-I as well as Period-II. These banks captured the first 10 ranks in both the periods. Banks from the SB group show some improvement during period-II, however nationalized and more specifically old private sector banks exhibit relatively very poor performance as far as the business per branch is concerned. While analyzing such ratios, proper consideration must be given to the total number of branches of various banks under study. Here, the nationalized and state bank group obviously outnumbered other groups. This seems to be a genuine reason for the superior position of foreign and new private sector banks.

Table 1.18
Business Per Branch (Bank Wise)

(in Rs. Lacs)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	20.87	54.71	168.91	162.15	208.73	33.07	112.56	79.49	-9.24*
SBI	41.79	87.32	165.18	108.95	89.16	60.85	117.83	56.98	-11.65*
SBH	29.61	73.24	218.36	147.35	198.15	44.91	145.16	100.26	-9.23*
SBP	24.93	96.07	251.33	285.36	161.61	47.38	167.90	120.52	-11.96*
SBT	27.92	80.42	229.31	188.04	185.14	47.34	151.54	104.20	-9.76*
CB	33.14	92.1	273.68	177.91	197.16	57.33	181.08	123.75	-9.02*
BOB	31.72	68.79	267.94	116.87	289.51	48.31	172.45	124.14	-6.79*
BOI	33.42	72.17	328.12	115.95	354.64	46.23	203.10	156.87	-6.07*
PNB	20.51	57.9	208.93	182.30	260.85	35.03	134.36	99.33	-7.59*
DenaB	23.76	45.43	147.51	91.20	224.69	29.63	95.90	66.27	-7.14*
PSB	35.17	30.57	116.18	-13.08	280.04	29.42	73.00	43.57	-3.73*
UBI	24.34	73.68	234.41	202.71	218.15	41.22	151.73	110.51	-8.22*
AB	141.22	52.66	166.30	-62.71	215.80	116.46	107.16	-9.30	0.30
IOB	136.77	68.44	199.95	-49.96	192.16	93.44	133.61	40.16	-2.07
OBC	258.82	140.69	266.82	-45.64	89.65	233.59	175.80	-57.79	1.52
CBI	199.02	42.19	157.06	-78.80	272.27	120.61	100.72	-19.89	0.32
FB	33.95	76.03	196.29	123.95	158.18	48.18	131.40	83.22	-9.16*
JKB	31.74	91.37	227.27	187.87	148.73	63.69	151.77	88.08	-9.07*
INGVB	0	74.11	128.71	0.00	73.67	32.69	92.19	59.49	-7.94*

KB	19.18	67.3	182.67	250.89	171.43	38.40	120.69	82.28	-9.92*
SIB	16.59	41.53	139.55	150.33	236.02	29.14	91.70	62.57	-7.90*
Axis	180.34	236.49	509.45	31.14	115.42	206.27	348.31	142.04	-3.96*
ICICI	200.8	675.12	440.11	236.22	-34.81	311.44	388.95	77.51	-0.77
HDFC	109.12	222.9	358.99	104.27	61.05	176.74	267.23	90.49	-4.07*
IIB	375.96	216.98	485.58	-42.29	123.79	359.51	332.21	-27.30	0.34
KMB	0	384.63	565.31	0.00	46.98	119.91	472.68	352.77	-5.32*
SCB	477.25	779.86	2026.27	63.41	159.82	733.86	1332.82	598.96	-3.00*
RBS	864.17	1380.96	2116.08	59.80	53.23	1055.56	1607.79	552.23	-5.99*
DB	1085.8	851.92	4724.79	-21.54	454.60	1101.20	3030.37	1929.17	-4.43*
HSBC	505.84	1253.7	4512.80	147.85	259.96	836.23	2939.84	2103.61	-7.12*
Citib	2276.2	1613.41	4995.72	-29.12	209.64	1813.05	3407.37	1594.32	-3.75*
	5								

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

3 Business per Employee

Business per employee is a potency of the banks, a combination of deposits and credits. Table 1.19 depicts the performance of various bank groups where BPE was highest in NPS group followed by FB, OPS, NB and SB group during Period-I. However FB and NB group made significant improvement in this ratio by capturing place I and II during Period-II. The average productivity gap of NPS group has been found lowest among all the groups which is further supported by the insignificant t value of this group. All other groups except NPS made significant improvement in enhancing this measure of employee productivity during post e banking revolution era.

Table 1.19
Business Per Employee (Bank Group Wise)

(in Rs. Lacs)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	124.80	490.00	1690.90	292.63	245.08	307.40	1690.90	1383.50	-9.78*
SBI	121.20	436.40	1263.10	260.07	189.44	278.80	1263.10	984.30	12.25*
OPS	160.20	481.60	1163.80	200.62	141.65	320.90	1163.80	842.90	15.65*
NPS	889.00	807.80	1262.90	-9.13	56.34	848.40	1262.90	414.50	-2.03*
FB	581.40	974.80	3048.20	67.66	212.70	778.10	3048.20	2270.10	-5.75*

Source: Computed by the researcher
 Note: * indicates significant values at 5% level of significance

The same analysis holds for individual banks under study (Table 1.20). As the number of branches and employees are much lower in case of foreign and new private sector banks, hence the ratios such as business per branch and business per employee naturally favour these banks. This is the apparent reason why the foreign and new private sector banks are holding substantial number of top performing positions among the selected banks. Otherwise absolute level of business is much higher in case of public sector banks including the state bank group.

Table 1.20
 Business Per Employee (Bank Wise)
 (in Rs. Lacs)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	42.74	138.72	704.12	224.60	407.59	123.87	421.63	140.12	- 10.11*
SBI	78.64	99.44	737.09	26.45	641.27	227.94	441.37	100.44	- 12.75*
SBH	58.03	174.96	908.10	201.49	419.02	168.21	543.77	176.73	- 10.10*
SBP	61.23	210.33	1050.35	243.50	399.39	177.48	628.95	212.45	- 13.09*
SBT	61.18	181.84	947.99	197.22	421.32	177.34	567.66	183.68	- 10.68*
CB	74.09	215.96	1132.76	191.49	424.53	214.75	678.30	218.14	-9.87*
BOB	62.43	216.65	1078.79	247.04	397.94	180.95	645.98	218.84	-7.43*
BOI	59.74	273.75	1270.50	358.22	364.10	173.17	760.78	276.52	-6.64*
PNB	45.27	173.34	840.51	282.86	384.89	131.23	503.30	175.09	-8.31*
DenaB	38.30	115.65	599.91	202.00	418.72	111.00	359.23	116.82	-7.82*
PSB	38.03	76.04	456.64	99.97	500.52	110.22	273.44	76.81	-4.08*
UBI	53.27	192.85	949.16	262.02	392.17	154.41	568.36	194.80	-9.00*
AB	150.51	-16.24	670.34	-110.79	-4228.71	436.25	401.40	-16.40	0.32
IOB	120.76	70.09	835.82	-41.96	1092.46	350.03	500.49	70.80	-2.27*
OBC	301.88	-100.85	1099.76	-133.41	-1190.48	875.01	658.54	-101.87	1.67
CBI	155.87	-34.71	630.07	-122.27	-1915.28	451.80	377.29	-35.06	0.35

FB	62.26	145.23	821.99	133.26	465.98	180.47	492.21	146.70	-	10.02*
JKB	82.30	153.72	949.41	86.77	517.63	238.56	568.51	155.27	-9.92*	
INGVB	42.25	103.82	576.68	145.74	455.46	122.46	345.32	104.87	-8.69*	
KB	49.63	143.59	754.97	189.31	425.79	143.86	452.08	145.04	-	10.85*
SIB	37.66	109.19	573.66	189.95	425.39	109.15	343.51	110.29	-8.65*	
Axis	266.57	247.88	2178.90	-7.01	779.03	772.67	1304.73	250.38	-4.33*	
ICICI	402.49	135.26	2433.14	-66.39	1698.81	1166.64	1456.97	136.63	-0.85	
HDFC	228.41	157.91	1671.69	-30.86	958.60	662.06	1001.01	159.51	-4.45*	
IIB	464.60	-47.64	2078.16	-110.25	-4462.34	1346.67	1244.41	-48.12	0.38	
KMB	154.96	615.63	2956.92	297.27	380.31	449.17	1770.61	621.85	-5.82*	
SCB	948.40	1045.27	8337.69	10.21	697.66	2748.98	4992.63	1055.83	-3.28*	
RBS	1364.14	963.72	10057.74	-29.35	943.64	3954.02	6022.60	973.45	-6.55*	
DB	1423.12	3366.68	18956.94	136.57	463.07	4124.98	11351.46	3400.69	-4.85*	
HSBC	1080.69	3671.11	18390.62	239.70	400.96	3132.44	11012.35	3708.19	-7.79*	
Citib	2343.07	2782.33	21315.33	18.75	666.10	6791.51	12763.67	2810.43	-4.10*	

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

4 Profit per Employee

Profit per employee is one of the basic indicators to measure the performance of a bank group as it is both a profitability and efficiency indicator. Wage bill of the employees form an important part of expenses of the banks. Banks which have invested heavily in technology may have a well paid small but highly efficient work force than that of those who are over staffed. A higher ratio indicates more profit per employee which means greater efficiency of employee. Profit per employee of commercial bank groups in India is given in table 1.21. It is seen that during period-I as well as Period-II FB and NPS group were at position 1 and 2. SB group lost its 3rd place in Period-I and fell down to last place during Period-II. It is due to slow growth of profits as well as huge recruitment drive of this group during this period. The first rank of FB group more particularly in Period-II may be attributed to the smaller work force as compared to other bank groups.

Table 1.21
Profit Per Employee (Bank Group Wise)
(in Rs. Lacs)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate	Growth Rate	Pre E-Banking	Pre E-Banking	Average Productivity	t-Value
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				(from 1999- 2006) %	(from 2007- 2014) %	Revolution Period Average (1999- 2006)	Revolution Period Average (2007- 2014)	Gap	
NB	0.450	2.900	8.900	544.444	206.897	1.681	6.350	4.669	- 16.498
SBI	1.000	2.600	7.400	160.000	184.615	1.738	5.325	3.588	- 12.268
OPS	0.800	2.300	8.100	187.500	252.174	1.463	6.050	4.588	-9.327
NPS	9.300	5.900	26.700	-36.559	352.542	7.300	12.675	5.375	-1.956
FB	5.600	16.100	60.200	187.500	273.913	10.113	36.625	26.513	-5.501

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.22 reveals that profit per employee is quite high in case of foreign banks and new private sector banks while it is found fairly low in public sector banks. The larger work force and non profit motives of public sector banks are responsible for these results. It is, however, found that public sector banks including the state bank group have been doing efforts to improve their profitability position in Period-II as revealed by upward shifting of the ranks of some of the key banks.

Table 1.22
Profit Per Employee (Bank Wise)

(in Rs. Lacs)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	0.90	0.79	3.99	-12.43	403.99	1.19	4.49	3.30	-6.19*
SBI	0.98	1.02	4.93	4.04	382.85	1.29	5.54	4.25	-7.45*
SBH	1.30	1.32	6.42	1.57	386.26	1.71	7.22	5.50	-6.81*
SBP	1.50	0.85	4.92	-42.93	475.39	1.97	5.53	3.56	-6.71*
SBT	0.92	1.30	5.89	41.19	353.26	1.21	6.62	5.41	-6.88*
CB	1.14	3.62	14.76	217.89	307.21	1.50	16.60	15.10	-3.93*
BOB	1.12	1.34	6.27	19.87	368.00	1.47	7.05	5.58	-5.83*
BOI	0.84	2.05	8.60	143.53	318.45	1.11	9.67	8.56	-5.53*
PNB	1.00	1.45	6.54	44.50	351.37	1.32	7.36	6.04	-6.19*
DenaB	0.36	1.16	4.71	224.52	306.46	0.47	5.30	4.83	-6.03*
PSB	0.21	1.59	6.13	674.27	285.52	0.27	6.89	6.62	-5.80*
UBI	1.16	1.19	5.76	3.05	383.93	1.52	6.48	4.96	-8.68*
AB	1.00	0.92	4.58	-7.43	396.78	1.31	5.15	3.84	- 19.92*
IOB	1.00	1.32	6.06	33.07	357.65	1.31	6.82	5.52	- 11.96*

OBC	2.20	1.00	6.26	-54.65	528.37	2.89	7.04	4.15	-4.97*
CBI	0.46	0.39	1.97	-14.74	407.61	0.60	2.22	1.62	-6.49*
FB	1.09	2.01	8.73	85.28	333.55	1.43	9.82	8.39	-6.84*
JKB	2.15	1.21	7.01	-43.65	478.73	2.83	7.89	5.05	-3.97*
INGVB	0.32	0.88	3.64	176.69	312.69	0.42	4.10	3.68	- 5.12**
KB	1.71	1.02	5.77	-40.49	466.98	2.25	6.49	4.24	- 10.19*
SIB	0.87	0.57	3.13	-34.07	447.84	1.14	3.52	2.38	-5.11*
Axis	5.32	1.22	10.76	-76.99	778.83	7.00	12.10	5.10	-2.77*
ICICI	6.22	2.47	16.41	-60.31	565.16	8.18	18.46	10.28	-4.33*
HDFC	5.89	-0.38	5.50	-106.40	-1560.43	7.75	6.19	-1.57	1.51
IIB	8.26	-1.22	5.16	-114.73	-523.75	10.87	5.80	-5.07	1.59
KMB	1.22	0.90	4.77	-25.59	427.62	1.60	5.37	3.77	-4.84*
SCB	9.96	5.84	33.28	-41.42	470.09	13.11	37.43	24.32	-3.89*
RBS	10.12	-2.99	0.77	-129.52	-125.88	13.32	0.87	-12.45	6.47*
DB	19.67	5.76	44.35	-70.72	670.00	25.88	49.89	24.00	-2.22*
HSBC	4.83	4.52	22.39	-6.31	395.27	6.35	25.19	18.84	-6.38*
Citib	14.52	4.69	34.36	-67.71	632.68	19.11	38.65	19.54	-4.94*

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

5. NIM to total assets

The net Interest margin can be expressed as a performance metric that examines the success of a firm's investment decisions as contrasted to its debt situations. A negative Net Interest Margin indicates that the firm is unable to make an optimal decision, as interest expenses are higher than the amount of returns produced by investments. Table 1.23 contains NIM to total assets ratio of various bank groups under study.

Table 1.23
NIM to Total Assets (Bank Group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	2.34	2.80	2.15	19.66	-23.21	2.95	2.91	-0.05	.295
SBI	2.79	2.79	2.81	0.00	0.72	2.98	2.98	0.00	-.010
OPS	3.02	2.54	2.34	-15.89	-7.87	2.97	2.61	-0.36	2.003
NPS	2.80	2.79	3.37	-0.36	20.79	2.58	3.30	0.72	-3.602

FB	4.27	4.36	3.54	2.11	-18.81	3.84	3.92	0.08	-466
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Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

It reveals that during Period-I FB group was on the top followed by NB, SB and OPS group as these three groups were fighting neck to neck with almost same NIM ratio. The situation was no more different during Period-II with the exception of NPS group performance as this group claimed 2nd rank in this period as compared to last rank in Period –I. On the other hand, NB and OPS group show below average performance in Period-II with a negative average productivity gap. Hence the highlight of Period-II as far as NIM is concerned is NPS group. This fact is further supported by the only significant t value of NPS group. The same story is repeated in disaggregate analysis of banks under study (Table 1.24). 3 of the 5 selected NPS banks claimed a place among top 10 banks in Period-II while in Period-I no new private sector bank is on the top 10 list. However, the significant paired t values specifically for public sector banks show the happening improvement in NIM during Period-II.

Table 1.24
NIM to Total Assets (Bank Wise)

Name of Bank	1999-2000	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)	Average Productivity Gap	t value
SBBJ	2.74	10.84	15.91	296.31	46.73	5.82	22	16.18	-6.19*
SBI	2.96	13.95	19.61	371.10	40.56	6.3	27.12	20.82	-7.45*
SBH	3.94	4.94	11.39	25.54	130.44	8.38	15.76	7.38	-6.81*
SBP	4.54	4.93	12.31	8.50	149.69	9.67	17.03	7.36	-6.71*
SBT	2.79	5.16	9.85	85.10	91.02	5.93	13.63	7.7	-6.88*
CB	3.45	5.63	11.38	63.14	102.20	7.34	15.74	8.4	-3.93*
BOB	3.37	3.23	8.68	-4.30	168.66	7.18	12	4.82	-5.838
BOI	2.54	5.57	9.92	118.97	78.16	5.41	13.72	8.31	-5.53*
PNB	3.04	6.83	12.05	124.52	76.43	6.47	16.66	10.19	-6.19*
DenaB	1.07	7.18	9.39	569.62	30.88	2.28	12.99	10.71	-6.03*
PSB	0.63	8.11	9.71	1196.91	19.77	1.33	13.43	12.1	-5.8*
UBI	3.50	3.59	9.25	2.70	157.70	7.44	12.8	5.36	-8.68*
AB	3.02	6.22	11.37	105.96	82.60	6.43	15.72	9.29	-19.92*

IOB	3.00	5.10	10.12	69.77	98.52	6.39	14	7.61	-	11.96*
OBC	6.64	2.81	13.25	-57.73	371.82	14.13	18.32	4.19	-4.97*	
CBI	1.38	5.33	7.87	285.48	47.82	2.94	10.89	7.95	-6.49*	
FB	3.29	5.56	11.06	69.03	98.92	7	15.3	8.3	-6.84*	
JKB	6.52	2.95	13.21	-54.78	348.07	13.87	18.27	4.4	-3.97*	
INGVB	0.96	6.91	8.94	616.94	29.37	2.05	12.36	10.31	-5.12*	
KB	5.19	6.69	15.20	29.00	127.16	11.04	21.03	9.99	-	10.19*
SIB	2.61	7.81	12.45	198.95	59.37	5.56	17.22	11.66	-5.11*	
Axis	9.76	4.14	19.48	-57.58	370.58	20.77	26.95	6.18	-2.77*	
ICICI	8.90	3.26	17.21	-63.35	427.59	18.94	23.81	4.87	-4.33*	
HDFC	6.94	4.36	15.39	-37.17	252.74	14.77	21.28	6.51	1.51	
IIB	8.50	0.00	13.08	-100.00	#DIV/0!	18.09	18.09	0	1.59	
KMB	3.69	12.37	19.02	235.41	53.72	7.85	26.31	18.47	-4.84*	
SCB	8.09	2.56	15.21	-68.38	494.35	17.22	21.04	3.82	-3.89*	
RBS	6.05	1.35	10.76	-77.74	698.86	12.87	14.88	2.01	6.47*	
DB	7.67	3.10	15.14	-59.53	388.04	16.31	20.94	4.63	-2.22*	
HSBC	5.16	4.29	12.57	-16.91	193.04	10.98	17.38	6.4	-6.38*	
Citib	9.90	3.89	19.43	-60.69	399.25	21.07	26.88	5.81	-4.94*	

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

6. Non interest income to Total Assets

Non-interest income is derived primarily from fees e.g. deposit and transaction fees, insufficient funds fees, annual fees, monthly account service charges, inactivity fees, check and deposit slip fees, etc. In recent years, banks have started to move increasingly into areas that yield non-interest income – into activities that earn fees rather than interest. It is because of the fact that the profitability of traditional banking activities has, for a wide variety of reasons, come under pressure in recent years, hence, fee-earning activities have greatly increased their contribution to bank profits. Table 1.25 reveals the non – interest income position of various bank groups in pre and post e banking period. FB group has been found at the top of the list during pre as well as post e banking period followed by NPS, SB, NB and OPS group. The average productivity gap of all the bank groups except NB group turned negative due to the low non interest income earned during Period-II. The t values of all the bank groups have been

found insignificant thereby indicating not so much improvement in non interest income during Period-II. It is an indication of the fact that the Indian bank groups are still focusing on the traditional sources of revenue generation.

Table 1.25
Non Interest Income to Total Assets

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	1	0.96	0.82	-4.00	-14.58	1.38	1.40	0.02	-.261
SBI	0.93	1.26	1.42	35.48	12.70	1.49	1.44	-0.05	.400
OPS	0.8	1.06	0.91	32.50	-14.15	1.28	1.22	-0.07	.284
NPS	1.5	1.87	1.72	24.67	-8.02	1.85	1.80	-0.05	.344
FB	3	2.97	1.98	-1.00	-33.33	2.90	2.43	-0.47	1.786

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Bank level disaggregate analysis also confirms the same scenario. Most of the banks record a low level of non interest income in the financial statements. However, on comparing Period-I and Period-II it is found that foreign banks, new private sector banks and public sector banks capture top ten ranks. Hence it may be concluded that banks under study are making some efforts to follow a business model in which non interest component of income is high.

7. Operating profits to total assets

A bank's operating profit is calculated after deducting operating expenses from the net interest income. Operating expenses for a bank would mainly be more of administrative expenses. The main expense heads would include salaries, marketing and advertising and rent, amongst others. A higher ratio indicates

higher operating efficiency and vice versa. Table 1.26 contains operating profits to total assets ratio of various bank groups in India.

Table 1.26
Operating Profits to Total Assets

(in Rs. Lacs)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	1.24	1.34	1.93	8.06	44.03	2.01	1.93	-0.08	.420
SBI	1.39	1.57	1.96	12.95	24.84	2.14	2.05	-0.10	.636
OPS	1.51	1.91	1.66	26.49	-13.09	1.99	1.88	-0.11	.649
NPS	1.72	2.08	2.86	20.93	37.50	2.19	2.68	0.50	-6.261
FB	3.26	4.06	3.36	24.54	-17.24	3.49	3.80	0.31	-1.127

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

It has been found that during pre as well as post e banking period NB group was on the top followed by NPS, SB, NB and OPS group. On an average the performance of NB, SB and OPS group has been found quite poor as these bank groups displayed unsatisfactory operating efficiency. FB and NPS group have been found quite consistent and earning sufficient operating profits during Period-II. However the NPS group performed even better than FB group as also revealed by significant t value. The bank level analysis reveals the same picture with 4 of the 5 foreign banks, 3 new private sector banks and 2 state banks hold top 10 ranks in Period-I, however in Period-II the number of state bank group banks increases to 4 which is a good sign for public sector banks. Again the large assets base together with other than profit motives may be attributed to low figures of this ratio. Further, significant t values indicate the improved efforts on the part of public sector banks in Period-II.

8. Return on Assets

This ratio indicates how profitable a company is relative to its total assets. The return on assets (ROA) ratio illustrates how well management is employing the company's total assets to make a profit. The higher the return, the more efficient management is in utilizing its asset base. The ROA ratio is calculated by comparing net income to average total assets, and is expressed as a percentage.

Table 1.27
Return on Assets

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	0.3	0.94	0.37	213.33	-60.64	0.81	0.82	0.01	-.050
SBI	0.33	0.86	0.66	160.61	-23.26	0.80	0.84	0.04	-.321
OPS	1.1	0.92	0.46	-16.36	-50.00	1.12	0.86	-0.26	3.804
NPS	0.34	1.02	1.68	200.00	64.71	0.90	1.46	0.56	10.784
FB	1.03	2.28	1.87	121.36	-17.98	1.62	1.78	0.16	-.795

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

table 1.27 shows the performance of various bank groups operating in India on the basis of return on assets. It has been found that FB group was on top during Period-I followed by OPS, NPS, NB and SB group. NPS displayed exemplary performance during Period-II by claiming 2nd place. The OPS group's return on assets declined on an average during Period-II thereby founding a negative average productivity gap. The average performance of NB and SB group was also more or less same in Period-I and II. This fact is also supported by significant t values in NPS and OPS group. In Period-I 4 of the 5 selected foreign banks, 3 new private sector banks and 2 state banks are the top 10 performers

while this ranking changed in Period-II when there are 2 foreign banks, 4 state banks and 4 new private sector banks among top 10. Public sector banks are found to be making effort to improve ROA during Period-II as revealed by the highly significant t values.

9. Return on Equity

ROE is a key profitability ratio that investors use to measure the amount of a company's income that is returned as shareholder equity. This metric reveals how effectively a corporation is at generating profit from the money that equity investors have put into the business. ROE is calculated by dividing net income by total shareholder equity.

Table 1.28
Return on Equity

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap	t-Value
NB	6	15.97	6.44	166.17	-59.67	14.30	14.44	0.14	-.050
SBI	13	16.31	10.56	25.46	-35.25	15.49	16.14	0.66	-.402
OPS	12.07	12.08	7.76	0.08	-35.76	13.88	14.39	0.51	-.362
NPS	17.23	13.71	15.74	-20.43	14.81	15.87	16.97	1.10	-2.162
FB	10.87	15.98	10.25	47.01	-35.86	13.72	13.77	0.05	-.031

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

Table 1.28 reveals the performance of various bank groups on the basis of ROE. During period-I as well as Period-II NPS group has taken the lead followed by SB, NB, OPS and FB group. The performance of NPS group and SB group was found robust during Period-II as revealed by large positive average productivity gap figures. FB group was found wanting on the front of ROE. The only significant value was also that of NPS group and is supportive of the above

results. The bank level analysis indicates that in Period-I top 10 ranks are captured by 3 foreign banks, 2 state banks, 3 new private sector banks and 2 nationalised banks. This composition changed to 1 foreign banks, 3 state banks, 4 old private sector banks and 2 nationalised banks. The significant t values also support these results.

Performance Index

The working of the banks both in public and private sector has become a more market driven with the growing emphasis on better efficiency. Many studies have attempted to evaluate the overall economic performance of banking sector by applying the profitability criteria but taking only profitability criteria is not justified as Indian banking industry is dominated by public sector banks which are not operated by profitability objective alone. Hence in addition to profitability criteria some efficiency and Productivity indicators have also been taken in the present study to develop a comprehensive index of performance. For construction of such an index, initially the researcher had selected 16 performance variables such as credit deposit ratio, business per branch, return on assets, return on equity, profit per branch, profit per employee, spread per branch, spread per employee, business per employee, burden per branch, NIM to total assets, Non interest income to total assets, capital adequacy ratio, overhead ratio, Non interest expenses to total income ratio, liquid assets to total deposits ratio. On the basis of sensitivity analysis, 9 indicators have been shortlisted to construct the performance index.

The selected parameters have been standardized to generate variables for constructing the performance index. The selected variables are credit deposit ratio, business per branch, profit per branch, profit per employee, NIM to total assets, Non interest income to total assets, operating profits to total assets,

return on assets and return on equity. Table 1.29 shows the bank group wise performance index for different years.

Table 1.29
Performance Index (Bank group Wise)

Bank Group	1999-2000	2006-07	2014-15	Growth Rate (from 1999-2006) %	Growth Rate (from 2007-2014) %	Pre E-Banking Revolution Period Average (1999-2006)	Pre E-Banking Revolution Period Average (2007-2014)	Average Productivity Gap
NB	0.341	0.483	0.784	41.783	62.319	0.519	0.766	0.247
SBI	0.410	0.583	0.915	42.301	56.947	0.555	0.801	0.246
OPS	0.462	0.565	0.705	22.168	24.802	0.572	0.725	0.153
NPS	0.565	0.692	0.909	22.554	31.431	0.631	0.795	0.164
FB	0.541	0.648	0.819	19.751	26.400	0.599	0.764	0.166

Source: Computed by the researcher

During pre e banking period, NPS group performed best with an average PI value of .631 followed by FB, OPS, SB and NB group with average PI values .599, .572, .555 and .519 respectively. This ranking changed during Period-II as NPS, SB, FB, NB and OPS with average PI values .795, .777, .764, .745 and .725 respectively. The important point to note is that during Period-I all the bank groups underperformed as compared to the PI values of the whole banking industry in India and this trend get a reversal when all the bank groups outperformed the composite performance index of Indian banking industry. The NB and SB group have been found the top performers during Period-II over Period -I. Figure 1.4 also show the flat curves for all banking groups thereby indicating quite consistent performance during post e banking period. The CAGR of NB, SB, OPS and NPS during Period-II was 11,13, 11 and 7 percent as against the Period-I CAGR of 6,4,5 and 5 percent. The CAGR of FB group during Period-I and II was 5 and 1 percent respectively, which may be attributed to some other factors than information technology adoption rate as this group was

the early starter in IT adoption. However for the rest of the groups possibly technology adoption has played a key role in improving the PI figures.

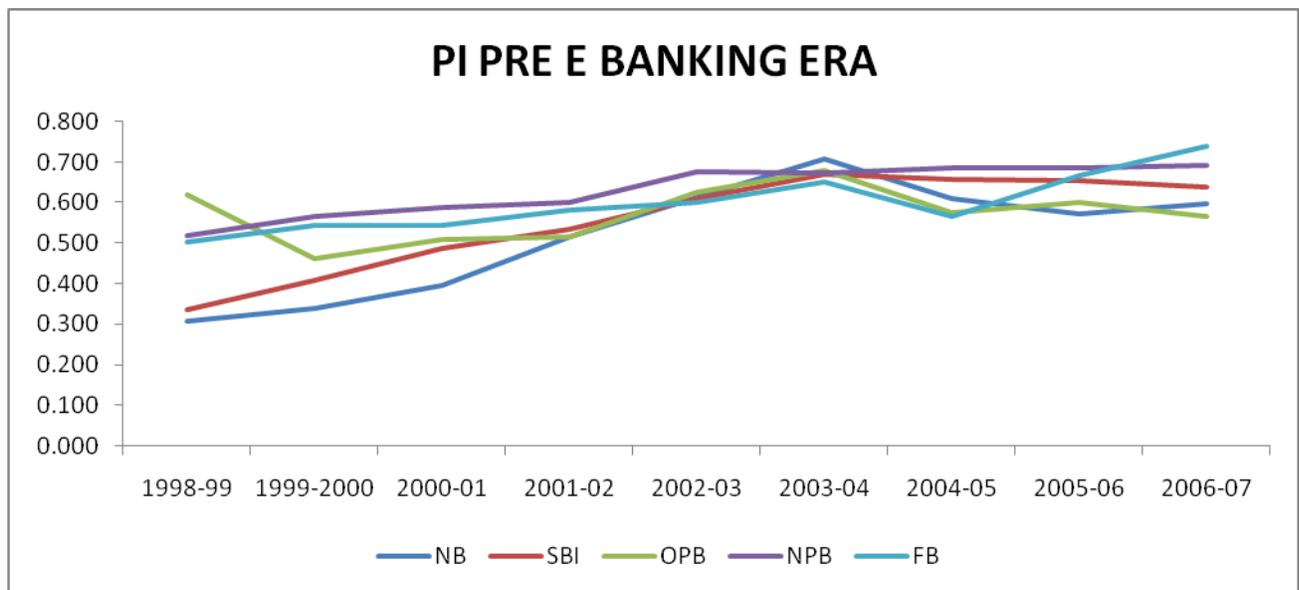
Table 1.30 shows that during period-I, 5 foreign banks and 4 new private sector banks capture nine positions out of top 10. The scenario did not change much during period-II. However the charts of performance index of various banks reveal consistent performance by all during Period-II.

Table 1.30
Performance Index (Bank Wise)

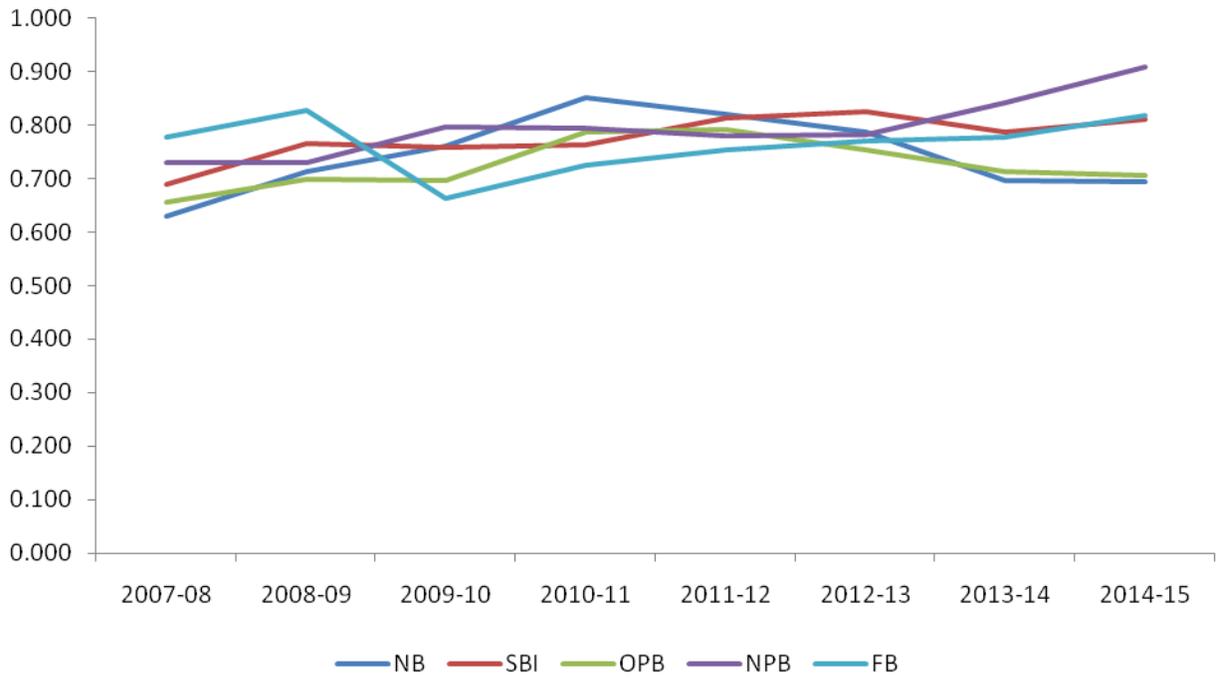
Name of Bank	2000-01	2006-07	2014-15	Growth rate (1999-2006)	Growth rate (2007-2014)	Average (1998-2006)	Average (2007-2014)
SBBJ	0.107	0.139	0.172	30.104	22.981	0.111	0.175
SBI	0.107	0.132	0.181	23.400	37.068	0.114	0.163
SBH	0.124	0.143	0.181	15.810	26.501	0.120	0.185
SBP	0.127	0.134	0.181	5.715	35.168	0.128	0.189
SBT	0.117	0.136	0.174	16.152	28.232	0.120	0.207
CB	0.090	0.150	0.261	65.942	74.295	0.107	0.237
BOB	0.099	0.135	0.172	36.742	27.205	0.109	0.182
BOI	0.101	0.133	0.194	31.330	45.702	0.115	0.195
PNB	0.089	0.135	0.184	50.743	36.196	0.103	0.185
DenaB	0.104	0.111	0.149	6.253	34.580	0.095	0.158
PSB	0.083	0.103	0.169	23.348	64.450	0.082	0.165
UBI	0.080	0.151	0.175	89.496	16.059	0.109	0.174
AB	0.107	0.140	0.151	31.495	7.698	0.110	0.150
IOB	0.097	0.116	0.162	19.508	39.550	0.109	0.176
OBC	0.154	0.160	0.181	4.134	13.414	0.156	0.184
CBI	0.105	0.102	0.143	-2.849	40.343	0.098	0.138
FB	0.103	0.157	0.189	52.949	20.325	0.118	0.198

JKB	0.105	0.143	0.170	36.455	19.170	0.118	0.172
INGVB	0.000	0.140	0.180	0.000	28.207	0.065	0.167
KB	0.108	0.144	0.158	34.010	9.740	0.109	0.158
SIB	0.093	0.127	0.150	37.015	17.564	0.104	0.155
Axis	0.246	0.219	0.247	-10.845	12.651	0.197	0.232
ICICI	0.185	0.233	0.296	25.946	27.172	0.256	0.296
HDFC	0.240	0.255	0.299	6.226	17.255	0.217	0.204
IIB	0.292	0.160	0.221	-45.077	37.802	0.294	0.198
KMB	0.000	0.275	0.238	0.000	-13.515	0.083	0.263
SCB	0.381	0.549	0.571	44.118	4.125	0.503	0.564
RBS	0.729	0.625	0.413	-14.237	-33.982	0.628	0.446
DB	0.700	0.557	0.966	-20.371	73.337	0.712	0.845
HSBC	0.211	0.580	0.663	175.274	14.227	0.370	0.618
Citib	0.759	0.947	0.798	24.724	-15.787	0.846	0.865

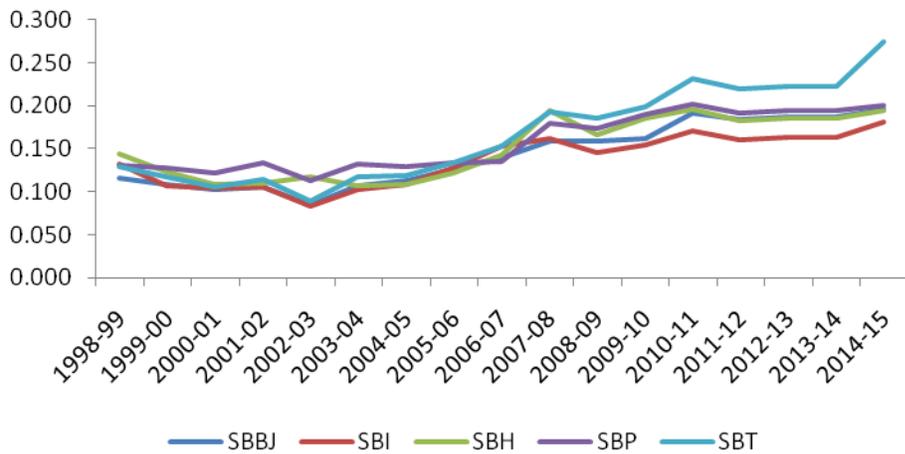
Source: Computed by the researcher



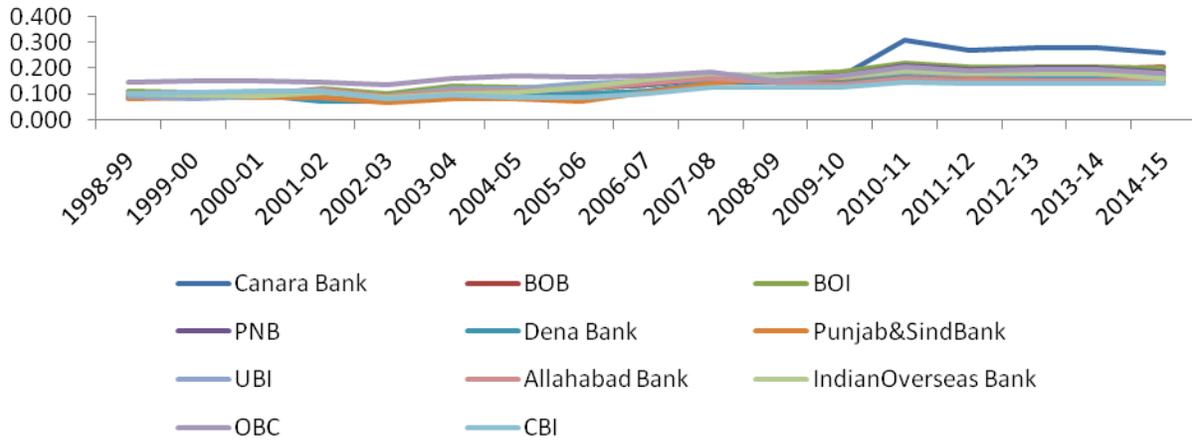
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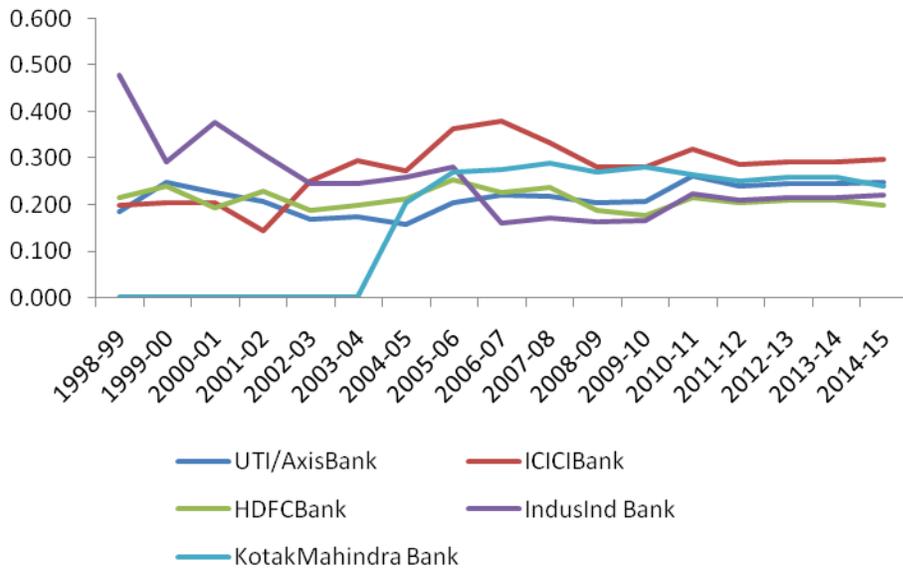
SB Performance Index

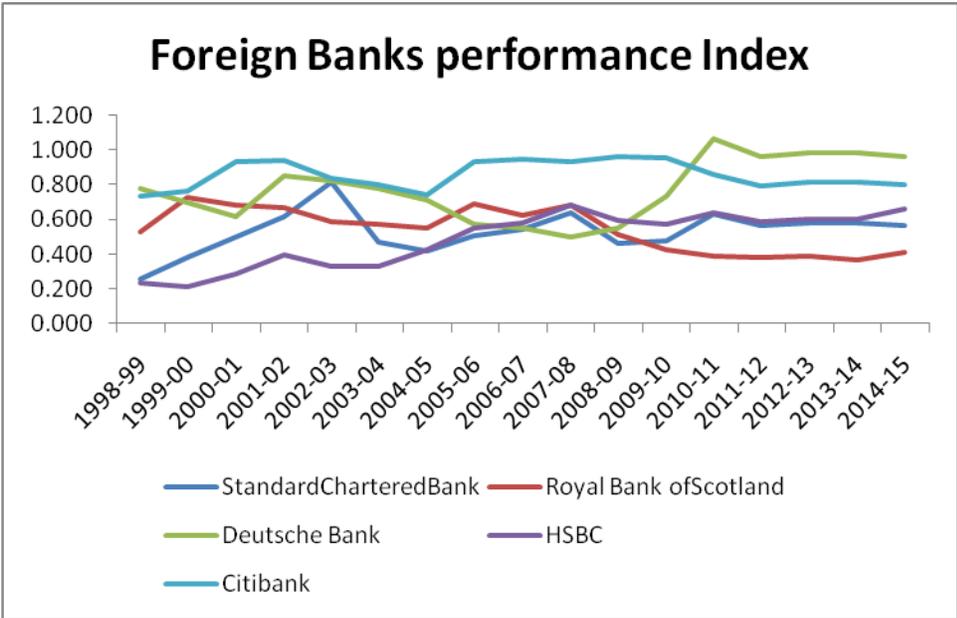
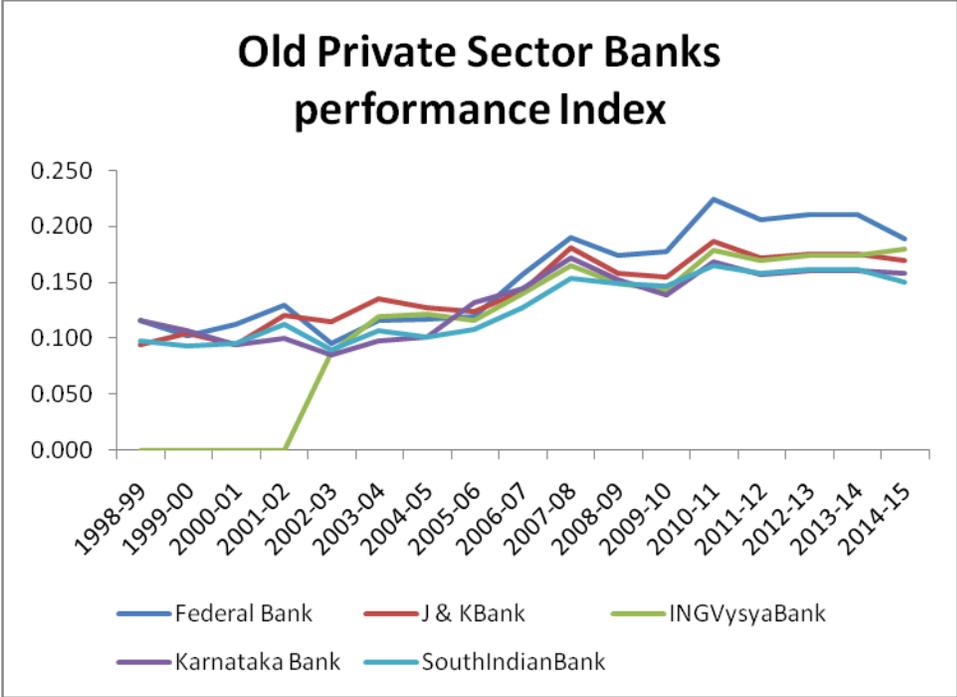


nationalised banks performance Index



New private Sector Banks Performance Index





1.8.3 Relationship between Technology and Performance

Simplest way to look at the relationship is to analyze the simple correlation coefficient. Correlation between technology and performance has been analyzed

using the cross-section data and time series data, first separately then by pooling the two and forming a panel data. Karl Pearson's correlation coefficient between the technology index and performance index, for cross section data, for different years is shown in table 1.31 and 1.32.

Table 1.31
Correlation between Technology Index and Performance Index in Indian Banking

Years	Karl Pearson Coefficient	T statistic		Bank Group	Period-I	Period-II
1998-99	0.29	1.437		nb	0.766	0.88
1999-2000	0.52*	3.332		sb	0.762	0.903
2000-01	0.58*	4.598		op	0.35	0.49
2001-02	0.43	2.98		np	0.79	0.84
2002-03	0.65*	4.678		fb	0.43	0.51
2003-04	0.36	1.91				
2004-05	0.29	1.437				
2005-06	0.66*	4.79				
2006-07	0.59*	4.604				
2007-08	0.77*	6.341				
2008-09	0.79*	7.131				
2009-10	0.84*	8.153				
2010-11	0.89*	8.901				
2011-12	0.91*	9.183				
2012-13	0.86*	8.564				
2013-14	0.89*	8.901				
2014-15	0.87*	8.873				

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

The statistical significance of correlation has been tested at 5 percent and 1 percent level of significance using t-test. It reveals that during the entire period under consideration, there has been a positive correlation between technology and performance. It is further learnt that the correlation coefficient gets stronger and significant during Period-II as compared to Period-I. A clear conclusion that emerges from this analysis is that performance is a positive function of

information technology in the Indian banking. That is to say, information technology is a driving force behind efficiency and performance in the Indian banking. Using the temporal data, table shows the correlation between technology index and performance index of all the 5 bank groups.

It is learnt from the table that there is a close relationship of technology index and performance index for all the bank groups. Again the noteworthy point is the tendency of stronger correlations in Period-II as compared to Period-I for all the bank groups. However much stronger correlations between IT and PI have been found in SB, NB and NPS group. The correlation coefficient was not found significant in case of OPS and FB group. The correlation is much stronger and significant for nationalized banks but statistical significance disappears for private and foreign banks. The logic is that public sector banks have a scale and size advantage. They stand at advantage so far as market share, size of bank and experience of the bank is concerned.

Their market share in the total business is large. Their branch network and customer base is large. These public sector banks are maintaining their performance (with exception of few banks) and information technology has undoubtedly contributed to large banks having greater flexibility to adapt to changes, whereas private banks and foreign banks remained technologically overcapitalized in relation to performance. They have invested heavily in costly technological infrastructures. These banks are making IT investments which are not essential, rather discretionary and irrelevant and they are not exploring cheaper IT solutions. This excessive investment in technology has negatively impacted banks' performance. Moreover, maturity level of technology use has also hurt the efficiency and performance of private sector banks.

Table 1.32
Bank-wise Correlation between Technology and Performance Index

Code	Nameofthebank	Correlation	t-statistics	Significance
1	SBBJ	0.85	5.36	**
2	SBI	0.892	6.55	**

3	SBH	0.747	3.73	**
4	SBP	0.926	8.14	**
5	SBT	0.801	4.44	**
6	CanaraBank	0.777	4.1	**
7	BOB	0.925	8.09	**
8	BOI	0.907	7.13	**
9	PNB	0.883	6.23	**
10	DenaBank	0.676	3.05	**
11	Punjab&SindBank	0.343	1.21	NS
12	UBI	0.76	3.87	**
13	AllahabadBank	0.834	5.02	**
14	IndianOverseasBank	0.898	6.76	**
15	OBC	0.516	2	NS
16	CBI	0.607	2.53	*
17	FederalBank	0.619	2.62	*
18	J&K Bank	0.91	7.28	**
19	INGVysyaBank	0.971	13.38	**
20	KarnatakaBank	0.72	3.44	*
21	SouthIndianBank	0.873	5.93	**
22	UTI/AxisBank	0.384	1.38	NS
23	ICICIBank	0.06	0.2	NS
24	HDFCBank	-0.012	0.04	NS
25	IndusIndBank	0.268	0.92	NS
26	KotakMahindraBank	0.958	11.14	**
27	StandardCharteredBank	0.821	4.76	**
28	RoyalBankofScotland	-0.008	0.02	NS
29	DeutscheBank	0.33	1.16	NS
30	HSBC	0.95	10.1	**
31	Citibank	0.081	0.27	NS

Source: Computed by the researcher

**Significant at 0.01 level; * Significant at 0.05 level; NS Not significant

To better investigate the above preliminary evidences and to gain a deeper insight into the relationship between technology index and performance index, a set of regressions has been analyzed. Technology index has been treated as independent (exogenous) variable and performance index has been treated as dependent (endogenous) variable. The mathematical representation of regression equation is written as follows:

$$Y = a + bX$$

Where Y is the performance Index; 'a' is the intercept; 'b' is the regression coefficient and X is the technology index. Regression coefficient represents the estimated change in the value of dependent variable, for each unit change in independent variable values. Following analysis deals with regression analysis at banking group and individual banks' level.

Table 1.33

Regression Results for Performance and Information Technology Relationship in SBI and its Associates Group of Banks in India

Bank/Group	Constant(a)	Coefficient(b)	Standard Error	T value	R ²
SBBJ	0.089	0.184**	0.034	5.59	0.723
SBI	0.099	0.121**	0.018	6.55	0.796
SBH	0.108	0.095**	0.026	3.726	0.558
SBP	0.11	0.112**	0.014	8.138	0.858
SBT	0.083	0.183**	0.041	4.441	0.642
Bank group	0.101	0.126**	0.011	10.993	0.657

Source: Computed by the researcher

Note: ** indicates significant values at 1% level of significance

Table 1.34

Regression Results for Performance and Information Technology Relationship in Nationalized Banks Group in India

Bank/Group	Constant(a)	Coefficient(b)	Standard Error	T statistic	R ²
CanaraBank	0.047	0.402**	0.098	4.097	0.604
BankofBaroda	0.028	0.225**	0.028	8.092	0.856
BankofIndia	0.096	0.216**	0.03	7.126	0.822
PNB	0.073	0.227**	0.036	6.227	0.779
DenaBank	0.079	0.193**	0.063	3.046	0.458
Punjab& SindBank	0.078	0.110NS	0.091	1.209	0.117
UnionBankof India	0.074	0.260**	0.067	3.873	0.577
AllahabadBank	0.099	0.107**	0.021	5.016	0.696
IndianOverseasBank	0.085	0.200**	0.03	6.757	0.806
OBC	0.135	0.066NS	0.033	1.996	0.266
CentralBankofIndia	0.092	0.087*	0.034	2.534	0.369
NationalizedBanksGroup	0.089	0.151**	0.014	10.463	0.437
PublicSectorBanksGroup	0.093	0.142**	0.01	14.296	0.498

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

** indicates significant values at 1% level of significance

Table 1.35

Regression Results for Performance and Information Technology Relationship in Old Private Banks Group in India

Bank/Group	Constant(a)	Coefficient(b)	Standard Error	T statistic	R ²
Federal bank	0.079	0.263*	0.1	2.616	0.383
j & K Bank	0.094	0.189**	0.026	7.28	0.828
IngVysyaBank	0.008	0.431**	0.032	13.378	0.942
karnatka Bank	0.092	0.164**	0.048	3.438	0.518
SouthIndianBank	0.088	0.146**	0.025	5.928	0.762
OldPrivateBanksGroup	0.068	0.324**	0.038	8.622	0.541

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

** indicates significant values at 1% level of significance

Table 1.36
Regression Results for Performance and Information Technology Relationship in New Private Banks Group in India

Bank/Group	Constant(a)	Coefficient(b)	Standard Error	T statistic	R ²
UTI/AxisBank	0.139	0.191NS	0.138	1.381	0.148
ICICI	0.249	0.047NS	0.235	0.199	0.004
HDFC	0.214	-0.005NS	0.12	0.039	0
IndusIndBank	-0.076	0.668**	0.723	0.924	0.072
KotakMahindraBank	0.01	0.496**	0.044	11.14	0.919
NewPrivateBanksGroup	0.024	0.508**	0.039	12.97	0.728

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

** indicates significant values at 1% level of significance

Table 1.37
Regression Results for Performance and Information Technology Relationship in Foreign Banks Group in India

Bank/Group	Constant(a)	Coefficient(b)	Standard Error	T statistic	R ²
StandardCharteredBank	0.025	1.284**	0.27	4.761	0.673
TheRoyalBankofScotland	0.596	-0.012NS	0.482	0.025	0
DeutscheBank	0.439	0.474NS	0.409	1.159	0.109
HSBC	-0.16	1.369	0.136	10.1	0.903
Citibank	0.807	0.107NS	0.394	0.271	0.007
ForeignBanksGroup	0.038	1.188**	0.161	7.36	0.462

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

** indicates significant values at 1% level of significance

Table 1.38
Regression Results for Different Bank Groups in India

BankGroups	A	b1	b2	b3	R2
SB	0.183	-0.288	1.387**	0.382**	0.96
NB	-0.0463	-0.0017	0.993**	0.792**	0.95
OPS	-0.0492	0.148**	0.882**	-0.0324	0.94
NPS	0.197	0.549**	0.761**	0.289**	0.93
FB	0.029	-0.0732	0.99**	-0.0412	0.88

Source: Computed by the researcher

Note: * indicates significant values at 5% level of significance

** indicates significant values at 1% level of significance

Pooled Data Regression Results

Pooled data regression analysis has been done for all Indian bank groups for all the years under study (1999-2000 to 2014-15). The regression model is as follows:

Performance Index = f(Technology Index)

As per tables 1.33 to 1.37 Regression results are indicative of the fact that regression coefficient of performance as a function of technology is positive and statistically significant for almost all the banking groups. The coefficients show that technology is a significant determinant of performance in case of all the bank groups in India. Study confirms that contribution of technology to bank group's performance has a differential behavior. It varies with size, scale, ownership and phase of technology adoption.

Multivariate Regression Results

So far, performance has been taken as a sole function of technology, assuming the effect of other inputs to be constants. To refine the relationship, in this part of analysis, technology has been taken in conjunction with other inputs, capital and labour. Multivariate regression analysis has been used to ascertain the contribution of each of the independent variable to explain the dependent variable. The model specification is as follows:

Business performance = f(Capital, Labour, and Technology)

Pooled data has been used for this purpose. The explicit regression model is as follows: $[Y_i = a + b_1x_1 + b_2x_2 + b_3x_3+u]$; Where Y_i is performance; X_1 is the capital; X_2 is the labour; X_3 is the technology; and b 's are regression coefficients. The regression results are presented in Table 1.38. Table shows that in case of SB, coefficient of capital is negative, indicating the negative impact of capital on

performance but labour and technology contribution to performance is positive, as indicated by positive coefficient of labour and technology. Further the coefficients are statistically significant at 1 percent level of significance and the model explains to the extent of 94 percent. For NB group also the capital is contributing negatively, but coefficients of labour and technology are positive. Thus, in case of NB group, performance is positively determined by labour and technology and negatively by the capital, the regression coefficients for labour and technology are significant at 1 percent level of significance.

Coefficient of determination is 0.93 which shows that model is statistically a sound model. For OPS group all the three factors are significantly contributing to performance as all the three coefficients are positive and statistically significant too. In case of NPS group, capital and labour indicates positive contribution but technology contribution is negative and that too is statistically significant at 2 percent level of significance. For FB group, only labor is positively contributing to performance whereas the other two factors namely capital and technology have negative coefficient and coefficient of technology turns out to be non significant.

Overall, multivariate regression explains that out of three variables namely capital, labour and technology, capital is significantly contributing positively to business performance for OPS and NPS group but its impact is negative in case of SB, NB and FB group. It indicates that these bank groups have gone for a highly capital intensive mode of production. However the performance has not grown to that extent at which the capital has accelerated. Labour is contributing significantly for all the bank groups. It is because of better human resource management practices in all banks which include performance based pay, flexible job design, improving employee's skill and institutional structure affecting the labour management relations. So far as technology is concerned, it is contributing positively to SB, NPS and NB group but its effect is negative for OPS

and FB group thereby explaining the productivity paradox which is attributed to the insufficient response of these bank groups to use technology efficiently.

1.8.4 Technology-Productivity paradox: Non Parametric Analysis

In the previous section, efficiency was measured using the traditional accounting measures. However, such measures have limitations in that the choice of a single ratio does not provide precise information about various dimensions of the performance of a bank, which uses multiple inputs to produce multiple outputs. Moreover, these measures also do not differentiate between efficiency and productivity clearly. This problem is better addressed through economic measures that capture all aspects of banking operations in a single measure. Among the several techniques for economic measures, the data envelopment Analysis (DEA) approach used in this study has several advantages over others. One, it provides bank level efficiency score. Two, it does not require a prior specification about the underlying technologies.

Under the DEA approach, a best practice frontier which represents optimal utilisation level of resources is prepared and efficiency of banks is measured relative to that best frontier (benchmark). If a bank lies on the frontier, it is referred to as an efficient bank, otherwise it is termed as less efficient. More away the bank is from the frontier, lower is its efficiency level. Since, in practice, the true ideal technology is not observable, the DEA analysis attempts to define the feasible technology frontier. In order to estimate the best practice frontier, labour, fixed assets, deposits and borrowings have been treated as inputs, while credit, investments and asset equivalent of off-balance sheet operations have been used as outputs.

Efficiency Estimates

According to the DEA estimates, there has been a significant improvement in efficiency levels across the bank groups after the diffusion of technology and its adoption by various bank groups. The improvement in efficiency was significantly more pronounced between 2007 and 2014 than between 1999 and 2007. Clearly the period 2007-2014 has been categorised as Period-II in the present study which indicates the post e banking revolution period. During 1999-2000, the cost-efficiency based on DEA estimates of the banking sector was 0.42 (implying that given the observed input-output bundles and feasible technology, 58 per cent of cost could have been reduced to produce the same level of output), which rose to 0.77 by 2014-15. In terms of bank groups, the gains in cost efficiency were more significant in the case of OPS group between 1999 and 2014 compared to other bank groups largely due to their low base in 1990s. Despite the large gains by private bank groups, the SB group continued to be the market leader insofar as absolute efficiency levels were concerned.

Table 1.39
Efficiency Levels (Bank Group Wise)

Bank Group	Efficiency Type	DEA Efficiency Scores			Growth rates of Efficiency (%)		
		1999-2000	2007-08	2014-15	1999 - 2007	2007-2014	1999-2014
SB	cost	0.46	0.66	0.86	45.93	30.12	89.89
	technical	0.65	0.80	0.96	23.08	20.00	47.69
	allocative	0.70	0.83	0.90	18.57	8.43	28.57
NB	cost	0.45	0.66	0.83	46.16	24.77	82.36
	technical	0.63	0.78	0.94	23.81	20.51	49.21
	allocative	0.72	0.85	0.88	18.06	3.53	22.22
OPS	cost	0.24	0.49	0.64	101.64	29.55	161.21
	technical	0.47	0.56	0.76	19.15	35.71	61.70

	allocative	0.52	0.88	0.84	69.23	-4.55	61.54
NPS	cost	0.41	0.55	0.83	34.15	61.82	117.07
	technical	0.53	0.66	0.91	24.53	37.88	71.70
	allocative	0.77	0.83	0.91	7.72	17.36	26.43
FB	cost	0.37	0.60	0.69	60.15	15.49	84.96
	technical	0.49	0.71	0.81	44.90	14.13	65.38
	allocative	0.76	0.84	0.85	10.53	1.19	11.84
ALL	cost	0.42	0.57	0.77	34.06	35.21	81.26
	technical	0.59	0.67	0.86	13.56	28.36	45.76
	allocative	0.72	0.85	0.89	18.06	4.71	23.61

Source: Computed by the researcher using Coille DEA program

During 2014-15, the SB group was the most cost efficient with efficiency level of 0.86, followed by NPS and NB group both with an efficiency score of 0.83, FB group with the efficiency level of 0.69 and OPS group with the efficiency level of 0.64. In other words, the old private sector banks were the least cost efficient in absolute terms. Significantly, FB group was found to be less efficient than public sector banks. With regard to relatively low efficiency levels observed in the case of foreign bank group, it may be noted that it is quite a heterogeneous group with efficiency levels varying from as low as 0.28 to the maximum level of 1.0. Moreover, banks with very low efficiency among the group are also the banks with very small size and limited business operations. Of the total 5 foreign banks, as many as 3 banks had efficiency score 1.0 during 2014-15 while in 2007-08 only one foreign bank was with efficiency score of 1.0. On the other hand, all the 16 selected public sector banks were in the efficiency range of 0.8 and 1.0, of which, 5 were with efficiency level of 1.0. As many as 7 public sector banks migrated from the efficiency score of 0.60-0.79 in 2007-08 to 0.80-1.0 in 2014-15. Of the 5 new private sector banks, 3 were with efficiency level of 1.0. No old

private sector bank had efficiency level of 1.0. Out of total 13 banks in the industry, which recorded 1.0 per cent efficiency score in 2014-15, 3 were foreign bank group, 3 from new private sector bank, 5 from State Bank group and 2 from the nationalised bank group.

Table 1.40
Frequency Distribution of efficiency

		0-.19	.20-.39	.40-.59	.60-.79	.80-1.00
SB	1999-2000	0	0	0	4	1
	2006-07	0	0	0	4	1
	2014-15	0	0	0	0	5
NB	1999-2000	0	0	3	7	1
	2006-07	0	0	0	6	5
	2014-15	0	0	0	3	8
OPS	1999-2000	0	2	3	0	0
	2006-07	0	3	1	1	0
	2014-15	0	0	2	3	0
NPS	1999-2000	0	0	1	2	2
	2006-07	0	0	1	1	3
	2014-15	0	0	0	2	3
FB	1999-2000	0	2	1	1	1
	2006-07	0	3	1	0	1
	2014-15	0	1	1	0	3

Source: Computed by the researcher

Cost efficiency estimates drawn through DEA could be decomposed into technical and allocative efficiency. Technical efficiency refers to the ability of a bank to obtain maximum output from a given set of inputs, while allocative efficiency refers to ability of the bank to use inputs in optimal proportions, given their respective prices. Most of the gains in the overall efficiency have emanated

from improvement in technical efficiency (from 0.59 in 1999-2000 to 0.86 in 2014-15) than in allocative efficiency (from 0.72 in 1999-2000 to 0.89 in 2014-15). Relative gains in terms of technical and allocative efficiency provide further insight into the performance of different bank groups. Significantly, gains in the case of foreign and private banks were restricted to technical efficiency. Allocative efficiency of these banks has always been high since the late 1990s. In the case of public sector banks, gains have been distributed over both technical and allocative efficiency. Gains in allocative efficiency of public sector banks could be attributed to recovery of past NPAs and improvement in credit risk environment as a result of which incremental NPAs declined sharply in the post-reform period. Sizeable gains made by public sector banks in allocative efficiency may also be a pointer that rural and priority sector lending, which constitutes a significant proportion of total business of public sector banks, is a commercially sound and viable business proposition.

Table 1.41
Efficiency Scores of Banks

Name of Bank	1999-2000			2006-07			2014-15		
	Cost	Technical	Allocative	Cost	Technical	Allocative	Cost	Technical	Allocative
SBBJ	0.59	0.72	0.82	0.64	0.81	0.79	0.84	0.86	0.98
SBI	0.77	0.83	0.93	0.82	0.93	0.88	1.00	0.95	1.05
SBH	0.76	0.81	0.94	0.80	0.88	0.91	1.00	0.95	1.05
SBP	0.50	0.53	0.94	0.54	0.58	0.93	0.65	0.70	0.93
SBT	0.72	0.85	0.85	0.75	0.90	0.83	1.00	0.90	1.11
CB	0.56	0.57	0.98	0.59	0.62	0.96	0.72	0.80	0.90
BOB	0.58	0.60	0.98	0.62	0.64	0.96	0.71	0.79	0.90
BOI	0.46	0.48	0.98	0.49	0.52	0.96	0.64	0.69	0.93

PNB	0.83	0.85	0.98	0.86	0.92	0.93	1.00	0.95	1.05
DenaB	0.41	0.42	0.98	0.43	0.45	0.96	0.54	0.64	0.84
PSB	0.50	0.51	0.98	0.53	0.55	0.96	0.65	0.69	0.94
UBI	0.46	0.47	0.98	0.48	0.51	0.96	0.60	0.64	0.94
AB	0.40	0.41	0.98	0.42	0.44	0.96	0.53	0.59	0.90
IOB	0.82	0.88	0.93	0.85	0.93	0.91	1.00	0.94	1.06
OBC	0.77	0.85	0.91	0.82	0.93	0.88	0.92	0.94	0.98
CBI	0.40	0.41	0.98	0.43	0.45	0.96	0.56	0.60	0.93
FB	0.46	0.49	0.94	0.49	0.53	0.93	0.62	0.77	0.81
JKB	0.43	0.46	0.94	0.47	0.50	0.93	0.65	0.79	0.82
INGVB	0.79	0.84	0.94	0.82	0.91	0.90	0.90	0.96	0.94
KB	0.69	0.73	0.94	0.74	0.79	0.93	0.85	0.91	0.93
SIB	0.60	0.64	0.94	0.65	0.69	0.93	0.76	0.89	0.85
Axis	0.78	0.88	0.89	0.80	0.90	0.89	1.00	0.95	1.05
ICICI	0.77	0.88	0.88	0.82	0.92	0.89	1.00	0.93	1.08
HDFC	0.75	0.87	0.86	0.81	0.90	0.90	1.00	0.95	1.05
IIB	0.59	0.64	0.93	0.62	0.66	0.94	0.77	0.87	0.89
KMB	0.00	0.00	0.00	0.49	0.52	0.94	0.67	0.79	0.85
SCB	1.00	0.83	1.20	1.00	0.89	1.12	1.00	0.91	1.10
RBS	0.59	0.64	0.93	0.65	0.69	0.96	0.78	0.88	0.89
DB	0.52	0.56	0.93	0.57	0.60	0.96	1.00	0.61	1.64
HSBC	0.53	0.57	0.93	0.59	0.61	0.96	1.00	0.63	1.59
Citib	0.52	0.56	0.93	0.57	0.60	0.96	0.80	0.93	0.86

Source: Computed by the researcher

Table 1.41 shows efficiency estimates at the disaggregated level of individual banks. The cost efficiency increases more during 2006-2014 as compared to 1999-2006 for almost all the selected banks. The increase in cost efficiency is mainly due to the increase in allocative efficiency which means that banks are making use of technology and other inputs more efficiently in post e banking revolution period. In 2014-15 SBI, SBH, PNB, IOB, Axis, ICICI, HDFC, SCB, HSBC and DB are found on the efficient frontier. As every bank group has one or more of its representation on the frontier so it may be concluded that ownership issue is not that important as far as the efficiency due to technology adoption is concerned.

1.8.5 Measurement of Productivity

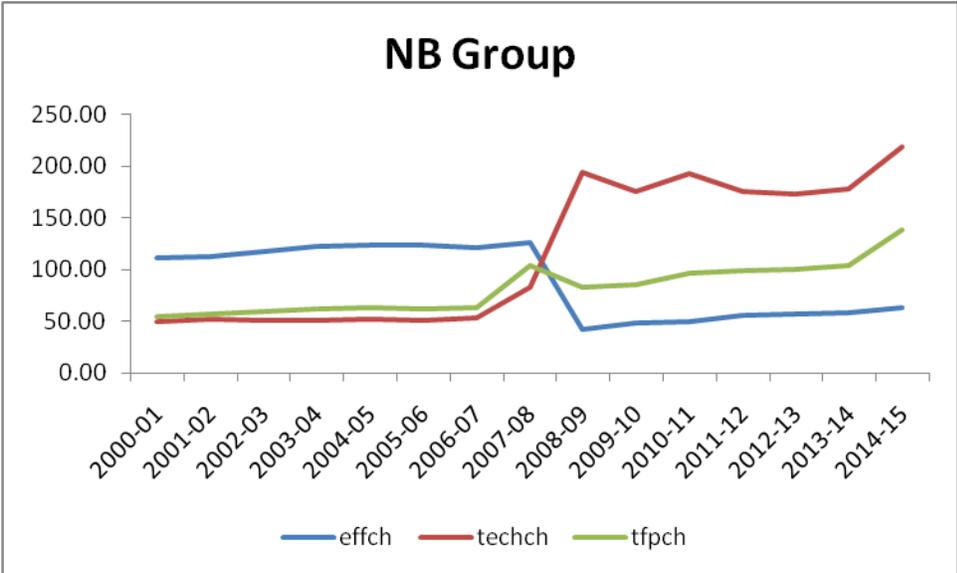
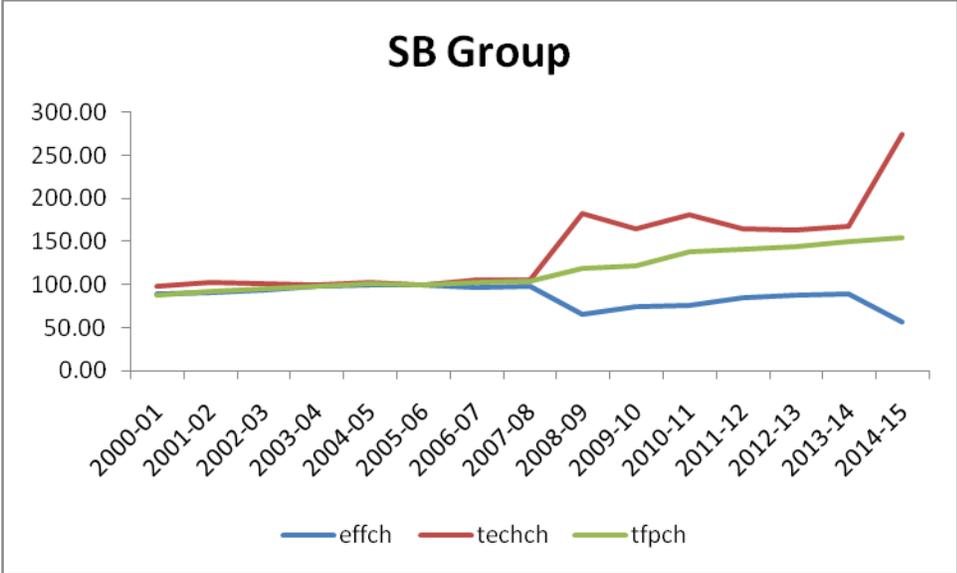
Productivity is a measure as to how efficiently the banking unit transforms its inputs into outputs, as alluded to earlier. When a firm uses a single input for producing a single output, it is easier to calculate productivity level by simply taking a ratio of its output to input. However, in case of a bank, which uses multiple inputs and outputs, such a ratio would only provide a partial measure of productivity that ignores variations in other inputs used. To overcome this limitation, productivity could be measured by computing an aggregate index of total factor productivity. One of the methods to compute productivity indices in such cases is the Malmquist Productivity Index. Productivity scores for various bank groups/banks suggest that there has been an across the board rise in productivity (table 1.42 and 1.43). Productivity change which was gradual till 2006-07, gathered momentum after 2006-07. Compared with 1999-2000 levels, the rise in productivity of Indian banks was of the order of 5.5 per cent over the period till 2006-07, whereas it rose by 43.5 per cent by 2014-15. In terms of groups, the largest improvement was noticed in the case of State Bank Group banks (53.82 per cent), followed by new private sector banks (43.66 per cent) and nationalised banks (38.09 per cent).

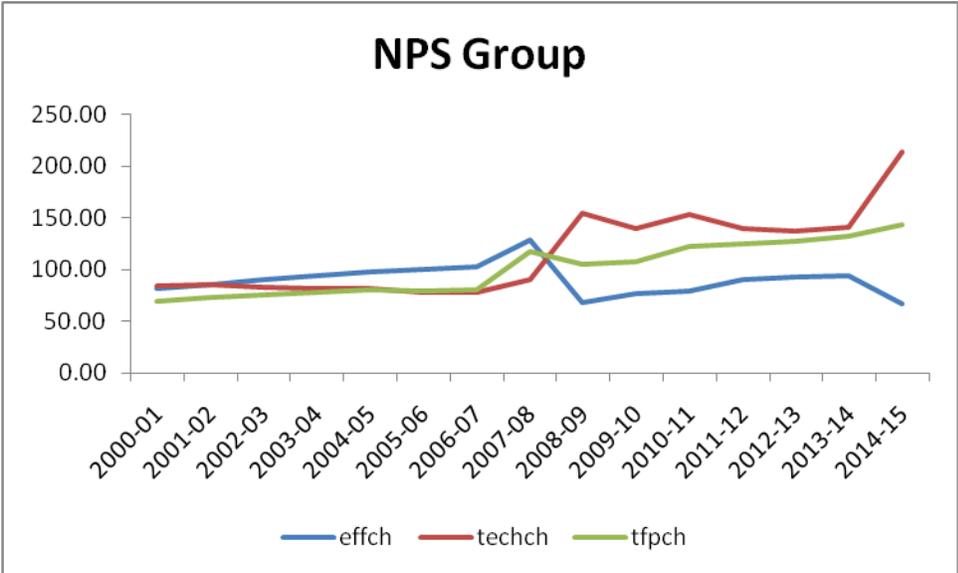
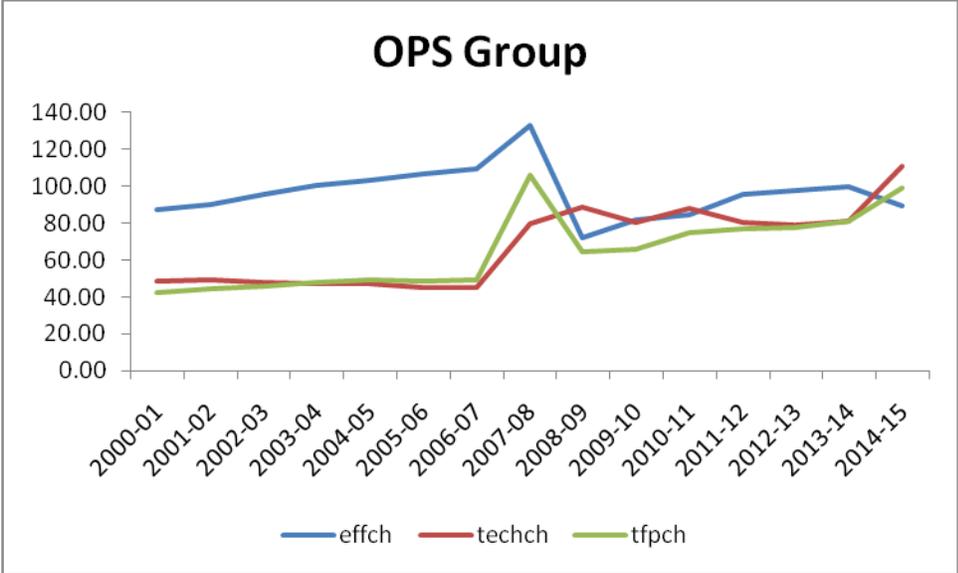
Table 1.42

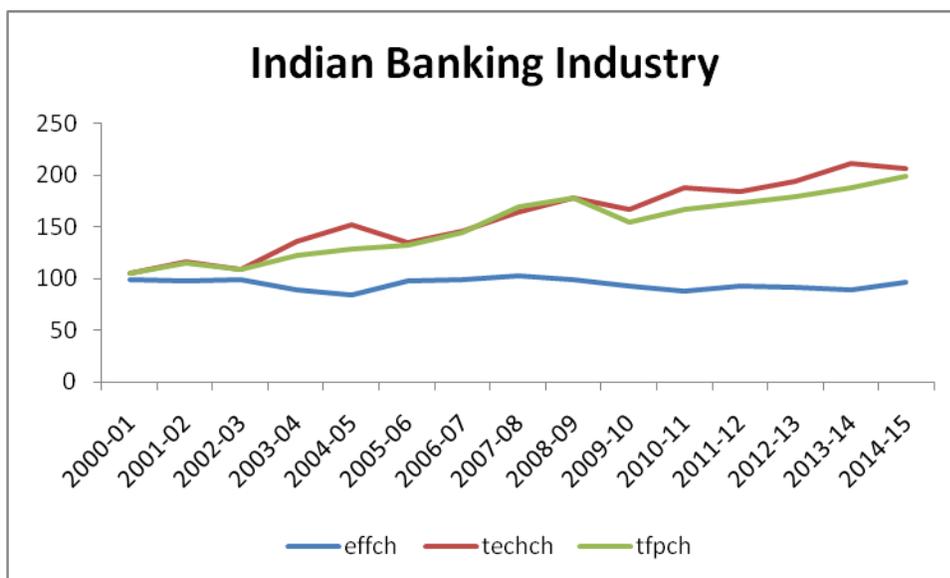
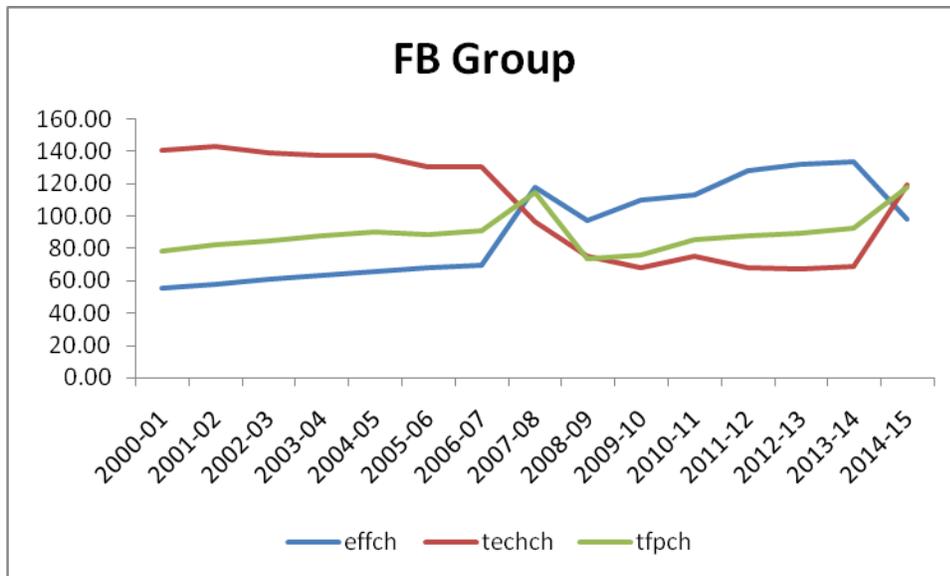
Malmquist productivity Index (Base 1999-2000)

	effch		Techch		pech		sech		tfpch	
	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15
Sb	98.54	56.1	105.34	274.19	1	1	98.54	56.1	103.8	153.82
Nb	125.62	63.23	82.39	218.39	1	1	125.62	63.23	103.5	138.09
Ops	132.83	89.36	79.55	110.88	1	1	132.83	72.99	105.67	99.08
Nps	128.9	67.32	90.86	213.40	1	1	128.9	67.32	117.12	143.66
Fb	118.38	98.74	96.68	119.46	1	1	118.38	87.04	114.45	117.95
All	118.25	76.77	89.18	186.95	1	1	118.25	76.77	105.46	143.52

Source: Computed by the researcher







These productivity estimates based on Malmquist productivity index could be decomposed into two mutually exclusive and exhaustive components: changes in technical efficiency, i.e., change in output for given inputs (catching up) and shifts in technology over time, i.e., technological improvements or technical progress (innovation). Relative trends in technical efficiency and technical progress reveal that between 1999-2000 and 2006-07, technical efficiency of the banking sector and all bank groups, other than State Bank group, improved.

However, the trend reversed if the period of analysis is extended to 2014-15. Between 2006-07 and 2014-15, all bank groups were slow to catch up (technical efficiency) with steep rise in technical progress of the industry. Efforts at computerisation, establishment of vast network of ATMs around the country, opening of tele and internet banking branches, starting of mobile banking and vast number of credit/debit cards etc., all contributed to this trend reversal.

Table 1.43

Malmquist Productivity Index (Bank wise)

	effch		techch		Pech		Sech		tfpch	
	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15	2006-07	2014-15
SBBJ	1.002	1.028	0.883	0.915	0.98	1.001	1.023	1.027	0.884	0.941
SBI	0.932	0.899	1.123	1.318	1	1	0.932	0.899	0.838	1.185
SBH	1	1	1.007	1.002	1	1	1	1	1.007	1.002
SBP	0.926	0.976	0.878	0.846	0.987	1.013	0.938	0.964	0.813	0.826
SBT	0.961	1	0.973	1.012	1	1	0.961	0.703	0.961	1.012
CB	0.912	1	0.887	0.91	1	1	0.912	1	0.912	0.910
BOB	0.903	0.942	0.854	0.869	1	0.926	0.903	1.018	0.851	0.818
BOI	0.94	1	1.022	0.949	1	1	0.94	1	0.940	0.949
PNB	0.923	1	0.889	0.961	1	1	0.923	1	0.923	0.961
DenaB	0.886	1	1.002	0.973	1	1	0.886	1	0.886	0.973
PSB	0.963	1	0.977	0.983	1	1	0.963	1	0.963	0.983
UBI	0.99	1.09	0.76	0.892	1	1.102	0.99	0.989	1.079	0.972
AB	0.933	1.089	0.78	0.85	1	1.038	0.933	1.05	1.016	0.926
IOB	0.854	0.886	0.98	1.017	1	0.973	0.854	0.911	0.757	0.901
OBC	0.98	1.023	1.004	0.843	1	1	0.98	0.98	1.003	1.003
CBI	0.89	0.998	1.004	1.023	1	1	0.89	0.998	0.888	1.021
FB	0.87	0.957	1.121	1.114	1	1	0.87	0.957	0.833	1.066
JKB	1.002	1.064	1.003	0.941	1	1.068	1.002	0.997	1.066	1.002
INGVB	1	1.058	0.99	0.888	1	1.165	1	0.909	1.058	0.940
KB	0.98	0.954	0.88	0.946	1	1	0.98	0.954	0.935	0.902
SIB	1.022	0.971	1.004	0.927	1	1	1.022	0.971	0.992	0.900
Axis	1.006	1	1.032	1.074	1	1	1.006	1	1.006	1.074
ICICI	0.977	0.963	1	1.01	1	1.004	0.977	0.959	0.941	0.973
HDFC	0.82	0.95	1.008	1.169	1	1.001	0.82	0.949	0.779	1.110
IIB	0.891	1	1.11	1.201	1	1	0.891	1	0.891	1.201
KMB	0.916	1	0.923	0.99	1	1	0.916	1	0.916	0.990
SCB	0.945	1	0.987	1.042	1	1	0.945	1	0.945	1.042
RBS	0.965	1.001	0.977	0.946	1	1.149	0.965	0.871	0.966	0.947
DB	0.99	1	0.887	0.912	1	1	0.99	1	0.990	0.912
HSBC	0.973	0.986	0.989	1.041	1	1.018	0.973	0.968	0.959	1.026

Citib	0.981	1	1.022	1.028	1	1	0.981	1	0.981	1.028
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Source: Computed by the researcher

4 banks from the SB group, 6 banks from NB group, 1 bank from OPS group, 5 banks from NPS group and 3 banks from FB group depict increase in total factor productivity in 2014-15 as compared to 2006-07. SBI records highest change in total productivity. Out of the 31 selected banks, 21 reveal increase in total productivity due to technological change which indicates the increased innovation in Indian banks.

To sum up, the economic measures of efficiency and productivity substantiate the results arrived at through the accounting measures. That is, efficiency has improved across all bank groups when measured from a grand frontier for all banks for the period 1999-2000 to 2014-15 and most of these efficiency gains have emanated after technology diffusion in banks.

Beginning with the efficiency levels in 1999-2000, efficiency gains were found to be the largest for old private sector banks. However, since their efficiency levels were very low at the beginning of the study period, they still continue to lag far behind the other bank groups. As of now, the state bank group are the most efficient, followed by the new private sector banks as a group, nationalized banks, foreign banks and old private sector bank groups.

1.9 CONCLUSION

The utilisation of information technology has magnificently increased in Indian banking industry. All commercial banks have shown an impressive growth in ATM installation. Notwithstanding such remarkable achievement, it is noted that India still lags far behind other countries. The reason behind the slow growth in

ATM expansion is the high installation costs. Further at a disaggregate level, technology revolution in Indian banking industry has been introduced by private and foreign banks and to compete public sector banks followed it. The public sector banks have been followers in terms of number of ATMs in the beginning but by their size and spread advantage; they have a wider coverage at the present. In terms of number of computerized branches, the public sector, both SBI and its associates and nationalized banks together, form the major share in Indian banking. The public sector, by its size and scale advantage has been able to do the computerization of branches on a very large scale. The public sector banks have a unique advantage over their competitors in terms of their branch network and large customer base. When this gigantic computerization is viewed in terms of number of customers served, as compared to public sector banks, the new private and foreign banks are very small players in this context.

Number of credit cards has been experiencing an upward trend for the entire period. Sector wise analysis shows that private sector banks are the market leader. Bank-wise growth of credit cards is evenly distributed among the banks but the SBI in particular and public sector banks in general have a major chunk of customer by virtue of their wider customer base. It is inferred that growth of foreign banks in terms of credit card is shrinking due to competition with Indian banks which are coming with better modernised and localized strategic solutions. The new generation private banks and foreign banks are the leaders in introducing internet banking in India. However, the number of public sector banks offering internet banking has been increasing exponentially. Keeping in view the customer segment served by public sector banks, the availability of hardware and security software for internet banking at the customer end is still in queue, but the culture of internet banking is picking up in urban Indian segment.

New private banks and foreign banks have been able to create a niche in the mobile banking in the early stages of technology adoption, as their share of

mobile banking branches in the total branches has been much higher as compared to public sector banks. Here, the size, scale, customer heterogeneity and mind set attuned towards resisting new technology are holding back the public sector banks. It is proving to be an impediment and resulting in delayed response in adoption of new technologies. This needs elaborate customer awareness and change in the mind set of banking staff.

The broad conclusion that emerges from analysis of technology parameters is that Indian model of banking is characterized by opening up of traditional public sector and old private sector banks to a stiff competition from new private and foreign banks armoured with state of the art technology. This competitive environment served as a catalyst for public sector and old private sector banks to go for up-gradation of technology base and their size, scale and spread gave them the advantage in this regard. Technology adoption in public and old Indian private sectors banks is slightly slow but its scale and size is massive and robust. The system is in its transitory mode in adoption of technology; back-end technologies have already been adopted, the front-end orientation of the system is in progress.

Overall technology index is indicative of the fact that fast technology adoption growth is associated with public sector banks or nationalized banks. Slow growth is associated with new private banks and foreign banks. This is attributed to the fact that nationalized banks have gone for gradual adoption of technology but slow growing new private and foreign banks have gone for one-time abrupt adoption of technology and continued with the same level. It is concluded that new private sector banks and foreign banks primarily drove the growth in technology index in the initial few years, but in the later years under study the growth of technology is predominantly triggered by the rapidly growing public sector banks or old private banks.

Volume of business per branch shows that foreign bank and new private banks are many time more efficient than the nationalised banks but this is highly misleading. No doubt some differences cannot be ignored due to the non-electronic work culture but it also assumes that branches across the industry are of the same size, following same technologies and are evenly distributed throughout the geographical length and breadth of country and are catering needs of all strata of the population. It is not so. Foreign banks and private sector banks with bigger branches located in metropolitan cities are catering very small elite strata. On the other hand, public sector banks and private banks with large number of small sized branches, with traditional technology and with a network of branches, are serving the needs of common masses that include the rural strata also. So, the comparison of branch efficiency among the banks of different organisational set up with different objectives is not valid.

Operating profit has grown faster than the net profit and profit per branch has grown faster than the profit per employee. First, it implies that non operating incomes of banks have grown at a slower pace than the operating incomes and non-operating expenditure has grown faster. Secondly, banks have been able to economize by managing their non-establishment branch expenses. Thirdly, cost saving by intellectual capital management will take a little longer time. Various performance parameters have been analysed. In terms of profit per branch foreign banks are twenty times more efficient as compared to public sector banks. It is inferred that branch profitability of foreign banks is the highest and is increasing due to their check on burden. New private sector banks are following the foreign banks and are initiating to fill this gap but the performance on the profit front of nationalized banks as compared to other banks has a dismal position, as these banks are lagging far behind the new private banks and foreign banks. Currently, the profit per employee of foreign banks is almost three times the industry average. Nationalised banks and private banks are performing

with a slight difference, almost at par with the industry benchmark but it is far below the national benchmark for SBI and its associate bank group.

NIM per branch is continuously showing an increasing trend for overall industry during the study period. Foreign banks continue to be much ahead of Indian banks which may be due to the vary objective and the nature of organization of different banking groups. This can be attributed to declining interest income, which is the result of high proportion of the total deposits being impounded in CRR and SLR; and earning relatively low rate of Interest. Further, a high proportion of bank deposits had to be allocated to priority sectors under social banking. No doubt, the interest rate paid by private sector banks are little more than the public sector banks but this is a case of tactful management through which the private sector banks were able to fetch huge funds on the basis of attractive interest rates.

Overall performance index is indicative of the fact that there has been significant change in the relative performance of different banks. Initially private banks and foreign banks were dominating the scene. The entry of the private banks and foreign banks resulted in great competitive pressure for nationalized banks and they responded to these challenges of economic environment by initiating tectonic measures such as up scaling their management capabilities, repositioning their competitive strategies, resorting to state of art IT architecture, increasing customer focus and profit orientation. Nationalized banks are competing relatively effectively with private banks and foreign banks and now they enjoy a prominent position among various private banks and foreign banks and they have emerged as an important driver of economic growth and overall development.

The technology-performance relation has been explored by using a variety of techniques. Correlation coefficient of technology and performance is positive,

stronger and significant for public sector banks and statistical significance disappears for some new private and foreign banks. With regards to this relation, the public sector banks stand at advantage, so far as market share, size of bank and experience of the bank is concerned. The public sector banks are maintaining their performance and information technology has undoubtedly contributed to large banks having greater flexibility to adapt to changes, whereas private banks and foreign banks remained technologically overcapitalised in relation to performance. They have invested heavily in costly technological infrastructures. Hence, the new private banks and foreign banks must evaluate their technology investment in relation to performance.

Regression coefficient of performance as a function of technology is positive for all most all the banks and wherever negative, it is statistically insignificant. The coefficient of determination shows that technology is a significant determinant of performance in case of SBI and its associates, old private group but a poor determinant in case of new private banks and foreign banks. Study confirms that contribution of technology to bank's performance has a differential behaviour. It varies with size, scale, ownership and phase of technology adoption. It contributes positively only to those banks where some preconditions conducive to performance are existing, e.g., trained manpower, size and scale of business. It shows that bank's performance is related not just to its technological stance but to other areas of competencies. Banks which gave greater stress both to use of advanced IT and human resource strategies, experience superior performance gains; whereas in some other banks, higher IT investments are not associated with higher level of performance. This implies that every investment decision relating to technology must be evaluated in the light of its interaction with other inputs and its contribution to performance.

To refine the relationship, technology has also been taken in conjunction with other inputs, capital and labour. The results shows that out of three factors

namely capital, labour and technology, capital is significantly contributing positively to business performance for old private banks and new private banks but its impact is negative in case of SBI and its associates, nationalized and foreign banks. It indicates that these banks have gone for a highly capital intensive mode of production. However the performance has not grown to that extent at which the capital has accelerated. Labour is contributing significantly for all the banks. It is because of better human resource management practices in all banks which include performance based pay, flexible job design, improving employee's skill and institutional structure affecting the labour management relations. So far as technology is concerned, it is contributing positively to performance in public sector banks and old private banks but its effect is negative in new private banks and foreign banks and thereby explaining the productivity paradox which is attributed to an insufficient response of bank to use technology effectively.

Increased application of technology also appeared to have played an important role in improving efficiency and productivity of the banking sector. Progress after 1999-2000 was directly traceable to several technological changes that have taken place on a continuous basis. These include improvements in payment and settlement systems, customer service, internal controls and audit. Beginning with the MICR cheque clearing system, the Indian retail payment system got a major boost during the reform period with the introduction of technologically advanced and secure systems such as electronic fund transfer, electronic clearing system, the special EFT and card based systems that greatly enhanced efficiency levels in banking operations. The introduction of RTGS helped improve the cash management by banks. Another technology induced cost effective initiative was the introduction of virtual banking services through the establishment of ATMs, shared ATM networks, smart cards, stored-value cards, phone banking and ultimately internet and intranet banking. These services economised on the staff

and branch infrastructure expenses and also boosted the volume of transactions per unit of input used. The Reserve Bank also operationalised the Very Small Aperture Terminal (VSAT) network to provide reliable communication backbone to the financial sector. To facilitate connectivity within the banking sector, the Reserve Bank, public sector banks and IDBRT collectively set up the Indian Financial Network (INFINET) based on satellite communication. Currently, INFINET is being migrated to a multiprotocol layer switching technology that offers economies of scale, apart from ease of operation. Such technological changes led to outward shift in the production frontier of banks.

As regards bank groups, the State Bank group and nationalised banks adopted technology long after foreign and new private sector banks. Hence, while foreign banks were mostly defining the grand technological frontier of the Indian banking system, public sector and nationalised banks closely pursued the frontier to stay competitive. Many public sector banks also computerised their branches and introduced core banking solutions. Although in the initial years, it pushed up the cost, it however, appeared to have resulted in cutting operating cost and improving efficiency in the subsequent years. New private sector banks such as ICICI Bank and HDFC Bank were relatively better off due to their access to the frontiers of technology assisted by foreign direct investment.

Hence the overall conclusion that emerges from the analysis is that in banking industry, performance is a positive function of information technology, if some other complement conditions like intellectual capital, size and scale of operations compatible with it are available; otherwise it can rather affect the performance adversely. This is what explains the productivity paradox in service sector, in general, and in banking sector, in particular. The study found strong evidences of the fact that technology can play a major role not only in reducing operating cost but also improving productivity. Banks, therefore, need to look at technology both

from the point of view of increasing labour productivity and cutting operating cost in the long run.

Policy Implications

The relation of technology and performance of Indian banking has been analyzed using the methodology outlined above. Following policy implications or suggestions emerge from the analysis:

a) It is not merely spending more on information technology that translates it into higher profitability but more important is that how banks manage information technology and integrate it with business functions to achieve higher profitability. Strong management and good governance of information technology is a need of the time.

b) It is not just the process of buying the computers and software that gives performance, rather the competitive advantage from introduction of information technology stems from the organizational dynamic capabilities which are defined in terms of timely responsiveness, rapid and flexible product innovation and management capabilities to effectively coordinate internal and external competencies.

c) With investment on information technology, new skills have to be acquired by the employees. It involves not just the learning the use of new technology by the operative level personnel. Even the managerial staff also needs training in management of technology because modernization of work technology without ensuring reasonable command and control system can lead to loss of managerial effectiveness.

d) As computer and software are increasingly becoming economical inputs for banks, an overriding feature of the information technology using banks is that they are close to a real time interaction between suppliers, producers, distributors

and customers. Interactive processes alone can place new demands and open opportunities for those who can respond to the need for increased flexibility. Especially, in the context of public sector banks, the organization structure is poorly suited to the effective implementation of information technology and it need to be restructured.

e) Computerization needs to go beyond the mere arithmetical calculations and need to be leveraged optimally to achieve and maintain a high service and efficiency standard. Therefore, driving the productivity improvements in banking involves acquiring the right technology, deploying it optimally and remaining cost effective. Each organization needs to compute the optimum dose of information technology that will be compatible with its performance.

f) Banks must revamp their human resource management processes. There should be improvement in the existing practices of recruitment, training and deployment. The focus must shift from generalist orientation of the staff to specialist orientation, i.e., the ability to imbibe and absorb technology. Banks should evolve appropriate policies to make the best use of their primary asset, i.e., human resources.

g) Performance of information technology investment depends on environment, quality service to end users and other partners, which would necessitate a well qualified and robust group of skilled people to meet external and internal commitments. Hence, banking system needs to spend a lot on training.

h) To translate the information technology investment into higher performance, banks need to go beyond the traditional human resources jargon. Present day organization needs intellectual capital that is a function of human capital, structural capital and relationship capital. There needs to be a positive interaction between information technology, skills and work organization. Adopting efficient and productive methodologies that will foster innovations is need of the time.

To sum up, the above conclusions and policy implications are indicative of the fact that there exists a relation between information technology and performance but contribution of technology to performance has a differential behavior. In banking sector, to translate information technology in to higher performance, a package of other factors and conditions is required.

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ANNEXURE-I IT INDEX (BANK WISE)

	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15
SBBJ	0	0	0.076	0.076	0.119	0.129	0.161	0.151	0.227	0.255	0.31	0.43	0.448	0.432	0.404	0.452	0.497
SBI	0.01	0.013	0.026	0.026	0.058	0.087	0.13	0.191	0.128	0.376	0.353	0.436	0.695	0.666	0.646	0.693	0.783
SBH	0	0	0.021	0.021	0.054	0.082	0.149	0.143	0.121	0.282	0.32	0.553	0.604	0.541	0.523	0.594	0.629
SBP	0.035	0.079	0.082	0.082	0.116	0.136	0.237	0.325	0.119	0.521	0.524	0.728	0.674	0.646	0.623	0.649	0.681
SBT	0.02	0.05	0.101	0.101	0.167	0.225	0.3	0.301	0.178	0.483	0.497	0.594	0.626	0.57	0.511	0.577	0.592
CBI	0.051	0.058	0.055	0.055	0.106	0.151	0.215	0.232	0.106	0.232	0.273	0.295	0.306	0.278	0.27	0.349	0.392
BOB	0.103	0.089	0.123	0.123	0.154	0.196	0.221	0.268	0.199	0.333	0.386	0.572	0.676	0.585	0.543	0.562	0.599
BOI	0.013	0.025	0.049	0.049	0.067	0.088	0.128	0.14	0.124	0.125	0.164	0.26	0.353	0.31	0.295	0.31	0.375
PNB	0.003	0.015	0.06	0.06	0.119	0.143	0.196	0.242	0.178	0.281	0.299	0.296	0.306	0.279	0.271	0.299	0.326
DENAB	0	0	0.078	0.078	0.117	0.156	0.191	0.226	0.193	0.194	0.232	0.276	0.277	0.266	0.245	0.283	0.319
PSB	0	0	0.079	0.079	0.115	0.127	0.188	0.18	0.115	0.11	0.14	0.168	0.169	0.184	0.19	0.203	0.268
UBI	0.017	0.032	0.051	0.051	0.092	0.101	0.126	0.159	0.149	0.151	0.168	0.307	0.438	0.414	0.384	0.439	0.492
AB	0	0	0.026	0.026	0.043	0.056	0.108	0.156	0.204	0.245	0.261	0.4	0.518	0.502	0.474	0.497	0.512
IOB	0	0	0.029	0.029	0.068	0.1	0.144	0.214	0.211	0.26	0.302	0.47	0.531	0.444	0.407	0.473	0.499
OBC	0.017	0.022	0.08	0.08	0.086	0.098	0.096	0.187	0.235	0.408	0.492	0.54	0.576	0.537	0.495	0.529	0.549
CBI	0	0	0.004	0.004	0.014	0.051	0.081	0.115	0.089	0.196	0.239	0.27	0.278	0.26	0.245	0.29	0.329
FB	0	0	0.087	0.087	0.133	0.149	0.194	0.221	0.174	0.223	0.243	0.288	0.3	0.237	0.208	0.198	0.267
JKB	0	0.004	0.089	0.089	0.119	0.14	0.172	0.199	0.243	0.274	0.307	0.376	0.405	0.371	0.335	0.301	0.289
ING	0	0	0.082	0.082	0.116	0.172	0.209	0.241	0.253	0.327	0.292	0.543	0.67	0.648	0.64	0.601	0.623
KB	0	0	0.061	0.061	0.115	0.127	0.152	0.154	0.197	0.212	0.237	0.279	0.326	0.311	0.289	0.301	0.323
SIB	0	0	0	0	0.116	0.151	0.167	0.188	0.23	0.252	0.299	0.35	0.358	0.328	0.312	0.342	0.385
AXIS	0.226	0.192	0.243	0.243	0.288	0.28	0.343	0.43	0.345	0.321	0.332	0.418	0.439	0.379	0.322	0.435	0.455
ICICI	0.128	0.102	0.265	0.265	0.334	0.375	0.35	0.324	0.355	0.316	0.333	0.488	0.578	0.534	0.481	0.358	0.444
HDFC	0.221	0.181	0.223	0.223	0.256	0.242	0.244	0.272	0.332	0.337	0.231	0.448	0.462	0.363	0.307	0.345	0.387
IIB	0.684	0.442	0.275	0.457	0.414	0.487	0.289	0.303	0.369	0.368	0.416	0.457	0.364	0.279	0.229	0.265	0.342
KMB	0	0	0	0	0	0	0.38	0.392	0.393	0.282	0.309	0.392	0.348	0.316	0.261	0.284	0.302
SCB	0.225	0.191	0.189	0.189	0.211	0.351	0.325	0.426	0.49	0.465	0.48	0.569	0.6	0.601	0.576	0.216	0.214
RBS	0	0	0.734	0.734	0.446	0.523	0.628	0.652	0.716	0.736	0.76	0.83	0.876	0.878	0.89	1	1
DB	0.605	0.84	0.743	0.743	0.751	0.788	0.838	0.589	0.81	0.754	0.704	0.749	0.676	0.678	0.61	0.206	0.206
HSBC	0.49	0.467	0.398	0.398	0.484	0.51	0.555	0.531	0.65	0.686	0.716	0.747	0.778	0.78	0.791	0.291	0.291
CITIB	0.716	0.549	0.666	0.666	0.769	0.721	0.663	0.682	0.78	0.857	0.929	0.919	0.965	0.967	0.979	0.33	0.311

ANNEXURE-II PERFORMANCE INDEX (BANK WISE)

	98-99	99-00	00-01	01-02	02-03	03-04	04-05	05-06	06-07	07-08	08-09	09-10	10-11	11-12	12-13	13-14	14-15
SBBJ	0.115	0.107	0.102	0.105	0.084	0.106	0.113	0.126	0.139	0.158	0.159	0.162	0.192	0.183	0.186	0.187	0.172
SBI	0.132	0.107	0.104	0.105	0.083	0.103	0.109	0.128	0.152	0.162	0.146	0.155	0.171	0.160	0.164	0.164	0.181
SBH	0.144	0.124	0.109	0.110	0.117	0.107	0.108	0.121	0.143	0.195	0.167	0.186	0.196	0.183	0.187	0.187	0.181
SBP	0.130	0.127	0.122	0.133	0.113	0.132	0.129	0.134	0.134	0.180	0.174	0.191	0.202	0.192	0.195	0.195	0.181
SBT	0.130	0.117	0.107	0.114	0.090	0.117	0.119	0.134	0.154	0.193	0.187	0.200	0.232	0.220	0.223	0.223	0.174
CBI	0.087	0.090	0.090	0.102	0.089	0.117	0.116	0.125	0.150	0.169	0.152	0.166	0.310	0.272	0.283	0.283	0.261
BOB	0.103	0.099	0.098	0.114	0.092	0.105	0.112	0.123	0.135	0.160	0.160	0.178	0.204	0.191	0.195	0.195	0.172
BOI	0.107	0.101	0.094	0.122	0.101	0.130	0.123	0.121	0.133	0.164	0.174	0.184	0.222	0.204	0.208	0.208	0.194
PNB	0.087	0.089	0.088	0.105	0.085	0.108	0.108	0.124	0.135	0.162	0.158	0.170	0.210	0.196	0.200	0.200	0.184
DENAB	0.100	0.104	0.096	0.072	0.073	0.101	0.101	0.102	0.111	0.146	0.146	0.147	0.175	0.165	0.167	0.168	0.149
PSB	0.082	0.083	0.084	0.086	0.066	0.082	0.082	0.072	0.103	0.139	0.156	0.157	0.183	0.170	0.174	0.174	0.169
UBI	0.090	0.080	0.088	0.106	0.091	0.119	0.118	0.137	0.151	0.176	0.167	0.166	0.184	0.173	0.176	0.176	0.175
AB	0.097	0.107	0.104	0.113	0.089	0.111	0.110	0.122	0.140	0.160	0.143	0.134	0.158	0.150	0.152	0.152	0.151
IOB	0.103	0.097	0.094	0.109	0.087	0.102	0.105	0.129	0.154	0.182	0.164	0.168	0.190	0.178	0.181	0.181	0.162
OBC	0.145	0.154	0.152	0.145	0.137	0.160	0.169	0.167	0.173	0.184	0.153	0.169	0.205	0.190	0.195	0.195	0.181
CBI	0.101	0.105	0.110	0.111	0.082	0.095	0.085	0.090	0.102	0.128	0.127	0.127	0.148	0.143	0.145	0.145	0.143
FB	0.116	0.103	0.112	0.130	0.096	0.116	0.117	0.119	0.157	0.190	0.174	0.177	0.225	0.206	0.211	0.211	0.189
JKB	0.095	0.105	0.095	0.121	0.116	0.135	0.128	0.125	0.143	0.181	0.159	0.155	0.187	0.172	0.176	0.176	0.170
ING	0.000	0.000	0.000	0.000	0.088	0.120	0.122	0.116	0.140	0.165	0.149	0.143	0.179	0.170	0.174	0.174	0.180
KB	0.116	0.108	0.095	0.100	0.086	0.098	0.102	0.132	0.144	0.172	0.152	0.138	0.169	0.157	0.160	0.160	0.158
SIB	0.098	0.093	0.096	0.113	0.090	0.107	0.101	0.108	0.127	0.153	0.149	0.146	0.165	0.158	0.161	0.161	0.150
AXIS	0.182	0.246	0.224	0.206	0.166	0.173	0.156	0.202	0.219	0.217	0.204	0.204	0.261	0.238	0.244	0.244	0.247
ICICI	0.199	0.204	0.204	0.144	0.250	0.295	0.271	0.362	0.378	0.331	0.280	0.280	0.317	0.284	0.291	0.291	0.296
HDFC	0.215	0.240	0.192	0.230	0.187	0.199	0.213	0.254	0.225	0.238	0.186	0.175	0.215	0.203	0.207	0.208	0.199
IIB	0.478	0.292	0.377	0.307	0.245	0.244	0.258	0.281	0.160	0.172	0.162	0.165	0.223	0.210	0.215	0.215	0.221
KMB	0.000	0.000	0.000	0.000	0.000	0.000	0.204	0.270	0.275	0.288	0.268	0.280	0.264	0.251	0.257	0.257	0.238
SCB	0.259	0.381	0.500	0.616	0.818	0.471	0.424	0.508	0.549	0.638	0.464	0.479	0.634	0.567	0.580	0.580	0.571
RBS	0.532	0.729	0.688	0.668	0.586	0.573	0.555	0.692	0.625	0.683	0.513	0.430	0.391	0.380	0.394	0.368	0.413
DB	0.782	0.700	0.618	0.856	0.826	0.783	0.715	0.574	0.557	0.502	0.553	0.735	1.068	0.964	0.987	0.986	0.966
HSBC	0.234	0.211	0.285	0.393	0.328	0.332	0.423	0.547	0.580	0.683	0.595	0.575	0.637	0.589	0.601	0.601	0.663
CITIB	0.732	0.759	0.929	0.936	0.839	0.798	0.740	0.935	0.947	0.929	0.961	0.956	0.860	0.789	0.812	0.812	0.798

