INFORMATION AND COMMUNICATION TECHNOLOGY DIFFUSION IN INDIAN BANKING:A STUDY WITH SPECIAL REFERENCE TO COMMERCIAL BANKS

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This thesis entitled, **"INFORMATION AND COMMUNICATION TECHNOLOGY DIFFUSION IN INDIAN BANKING: A STUDY WITH SPECIAL REFERENCE TO COMMERCIAL BANKS"**, is being submitted herewith for award of Degree of Doctor of Philosophy in Economics of University of Calicut, is the result of the original research work completed by **RAHUL K.** under my supervision and guidance and to the best of my knowledge and belief the work embodied in this thesis has not formed earlier the basis for the award of any degree, diploma, or fellowship of any other University or examining body.

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DECLARATION

I hereby declare that the thesis titled as **"INFORMATION AND COMMUNICATION TECHNOLOGY DIFFUSION IN INDIAN BANKING: A STUDY WITH SPECIAL REFERENCE TO COMMERCIAL BANKS"** is the result of original research work carried out by me under the guidance and supervision of **Dr. C. KRISHNAN** and this has not formed the basis for the award of any other degree by any University or Institution before. Further, I declare that I have not violated any of the provisions under Copyright Act.

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Rahul K.

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ABBREVIATIONS

ATM	Automated Teller Machine
CoF	Cost of Funds
ECS	Electronic Clearing Service
HDFC	Housing Development Finance Corporation
ICT	Information and Communication Technology
INFINET	Indian Financial Network
MICR	Magnetic Ink Character Recognition
NEFT	National Electronic Fund Transfer
NPA	Non Performing Assets
OCR	Optical Character Recognition
PNB	Punjab National Bank
POS	Point of Sale
PSBs	Public Sector Banks
RBI	Reserve Bank of India
ROA	Returns on Assets
ROE	Returns on Equity
RTGS	Real Time Gross Settlement
SB	State Bank
SBI	State Bank of India
SCBs	Scheduled Commercial Banks
SWIFT	Society for Worldwide Inter-Bank Financial Telecommunication
VAR	Vector Auto Regressive
VECM	Vector Error Correction Model

CHAPTER 1

CHAPTER I

INTRODUCTION

1.1. Introduction

The financial sector, which is the central nervous system of any economy, is important for the development of any nation. Within the financial sector, banks occupy a pivotal role. The role of banks in promoting economic development was meaningfully narrated by Joseph Schumpeter (1911) in his book: "The Theory of Economic Development". He maintained that financial intermediation is critical for economic development. He further argued that financial intermediation through the banking system plays an essential role in economic development by affecting the allocation of savings, thereby improving productivity, technical change and the rate of economic growth. The economists noted that efficient allocation of savings through identification and funding of entrepreneurs with the best chances of successfully implementing innovative products and production processes are tools to achieve this objective. The savings/investment process in a capitalist economy is structured around financial intermediation, thus making the financial intermediaries as cardinal to economic development. In fact, banking system of any country is the lifeblood of an economy (Ahluwalia, 2002).

In the same fashion, Rockfeller (1967) rightly pointed out "essential as the role of the international lending agencies is, however, it is the commercial banks, in my perhaps prejudiced opinion, which make the most basic and flexible contribution to the development process". It is the commercial banks which funnel and counsel private capital in its movements from the industrialized countries into the developing ones. Hence the banking system plays the important role of promoting economic growth and development through the process of financial intermediation both in the developed and developing countries.

Many economists have, thus, acknowledged that the financial system, with banks as its major component, provide linkages for the different sectors of the economy and encourage high level of specialisation, expertise, economies of scale and a conducive environment for the implementation of various economic policies of government intended to achieve non-inflationary growth, exchange rate stability, balance of payments equilibrium and high levels of employment. Commercial banks are considered not merely as dealers in money but also the leaders in economic development. They are not only the store houses of the country's wealth but also the reservoirs of resources necessary for economic development. Hence, the commercial banks in India are expected to perform multiple role in the form of accelerating the rate of capital formation, extension of finance and credit, monetisation of the economy, innovation, development of agriculture, promotion of industries, regional development, promotion of commercial virtues and in a big way fulfilling many a socio-economic objectives laid down by the State.

Among the various agents of economic growth, the Information and Communication Technology (ICT) sector has been a pioneer and a powerful mechanism in addressing the needs and interests of low-income groups in developing countries. Unbound from the strictures of the 'Post, Telephone and Telegraph' (PTT) days, ICTs has become the foundation of every sector, every economy, anywhere (Kramer et.al 2007). Banking sector is not an exception. It is well articulated that the ICTs reduce transaction costs and thereby improve productivity, offer immediate connectivity by which improve efficiency, transparency and accuracy, and widen the geographic scope of potential markets. These attributes underlie the important part the ICTs have played in the firm and macro level growth. At the macro level, various studies have shown significant positive impact on GDP from IT, telecommunications and mobile telecommunications investment in both developed and developing countries[1]. At the level of the firm, World Bank Survey of approximately 50 developing countries suggest that "firms using ICT see faster sales growth, higher productivity and faster employment growth"[2]. Hence, the aforesaid discussion points towards the idea that the financial intermediaries embracing technology can have higher impact on productivity, efficiency and transparency.

Modern banking in India has traversed a long way since Independence. Globalization of Indian economy has created an environment where the financial services system has to be cost effective, customer oriented and technology based. Banking sector has been undergoing drastic metamorphosis where the need for a stable, efficient, resilient and vibrant banking system has come to occupy the center stage. Advances in technology and financial theory and practice have jointly transformed many of the relationship- focused intermediaries of days gone by into data-intensive risk management operations of today. Consistent with this, we now find many commercial banks embedded as part of global financial institutions that engage in a wide variety of financial activities. The enhanced and increasing levels of deregulation, stiff competition and the technology revolution have placed numerous demands on the banks.

With the introduction of liberalization, privatization and globalization, the role of banking sector changed dramatically. Banks have gone beyond their primary function of accepting deposits and lending money. Functions such as agency functions and utility functions have overtaken the other functions taken up by the banks. The key drivers of sea change in banking operations in India are integration of financial markets across the globe, explosion of information and communication technology and management of knowledge. There is no doubt that the Indian banking industry today is in the midst of an IT revolution. A combination of regulatory and competitive reasons has led to increasing importance of total banking automation in the Indian Banking Industry.

When examined closely, it is clear that prior to the 1990s, the diffusion of Information and Communication Technology (ICT) in the Indian banking industry was mainly on operations, but from the mid 1990s, the use of technology is present in external environment, that is, in products or service offerings to customers. Information technology enables sophisticated product development, better market infrastructure, implementation of reliable techniques for control of risks and helps the financial intermediaries to reach geographically distant and diversified markets. In the area of payment systems, there have been significant advancements of technology on the customer transactions. India is one of the countries that have effectively tackled huge volumes of paper instruments in cost effective manner through the instruments of MICR cheque, CTS, and NEFT among others.

The landscape of Indian banking has been transformed by technology over the last decade. Implementation of core banking has automated basic processes, enabled the movement to a single customer view and allowed for optimization of work across branch and hub network. Core banking platform have also given banks a strong launch pad to offer digital channel capabilities –almost all banks today are feverishly building out their online and mobile channel offerings. ATM deployments and technology-enabled Business

Correspondent (BC) network have allowed banks to service large parts of the Indian hinterland. Responding to Basel norms and a more aggressive supervisory regime, banks have undertaken risk and compliance management system implementations. Information management and analytics are in focus as banks have built out large data warehouses in an attempt to leverage their data assets to better understand, sell and serve their customers. All this points to a flourishing industry, focused on technological innovation (IBA 2014). It is in this background that the present study examines the extent and impact of ICT diffusion in Indian Commercial Banking.

1.2. Scope of the study

The banking system in India consists of commercial banks and co-operative banks. The commercial banks, which also include foreign banks and private banks, are the predominant segment. Cooperative banks, which are organized on the 'unit' banking principle, are mainly rural based although there are urban cooperative banks also operating in urban areas. Both these banks have been in the forefront in evolving mechanisms to serve their clients in a better way. Among the various innovations taking place in the banking sector, ICT diffusion is one of the latest additions.

Technology has become a part of all walks of life and across all business sectors, and even more so in banking. There has been massive use of technology across many areas of banking business in India, both from the asset and the liability side of a bank's balance sheet. Electronic banking services, whether delivered online or through other mechanisms have spread quickly in recent years. The threat of new entrants has led many banks to render e-finance ranging from basic to fully integrated internet services (Shenoy, 2003). Banks compete with each other to leverage technology to improve their financial performance as well as customer service. Many banks in India have introduced IT for several reasons like, adoption of information technology in financial institutions and IT based new services offered by them/competitors, rising competition in banking industry, globalisation in banking, to meet the growing demand of customers for mobility, speed, efficiency and economy through various technology based services and a technological revolution in the Indian economy. It has resulted in the core banking solutions, ATM based primary functions of the banks, anywhere any time banking, and Real Time Gross Transfer Settlement Services, among others. A time has now come where the efficiency of the banks is measured in terms of the degree of their technology diffusion. Though all the banking institutions are embracing technology for delivery of services, there remains large differences among them. While the new generation banks and the SBI could embark upon the technology-mediated banking service in a big way, there are some public and private sector banks which are lagging behind in our country.

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

Similarly, the studies of Loveman (1994) and Bara et al. (1991) show that there is no correlation between IT investment and financial productivity. While, Jordan and Katz (1999) found that even the most successful banks offering Internet banking were able to serve only a relatively small share of their customer base with IT channels. Thus, it was difficult to determine whether Internet banking has a significant impact on bank performance.

At the other extreme, there are studies which have found significant contributions from IT toward financial growth (Lichtenberg 1995; Brynjolfsson and Hitt 1996). There are studies which have drawn on the statistical correlation between IT spending and profitability or stock value for their analyses and they have concluded that the impact of IT on productivity is positive ((Brynjolfsson 1993; Wilson 1993).

In India, there are not many studies that have focused on IT contribution in the banking sector. Nevertheless, a study by Mariappan (2006) found that the IT revolution has brought stunning changes in the business environment. No other sector has been influenced by advances in technology as much as banking and finance, as a result, the Indian banking has a totally new face today. Similarly, Kamakodi (2007) found that change of residence, salary account and non-availability of the technology based services were the three main reasons for shifting to another bank.

Intense competition has forced many banks to pay greater attention to retain customers and winning new ones. Customer focus has become the watchword. Concentration on customer experience and customer intimacy has become the key to better customer service. More and more banks are embracing customer relationship management (CRM) systems. Along with other CRM solutions, data mining can also provide vital information about the customer for better relationship management. Many studies have also highlighted the importance of customer satisfaction and the management of customer relations in the success of banking business (Singh 2004; Krishnaveni, Prabha and Divya 2006; Mishra and Jain 2007; Raveendra 2007; Sharma, Kaur and Sharma 2007; Sharma and Dhanda 2007; Singh and

Kabirai 2007; Thakur 2007; Uppal and Kaur 2007; Uppal 2008; Vanniarajan and Nathan 2008). The process of economic liberalization and financial sector reforms has underlined the importance of customer-focus by the banks (Shanker 2004). The technology has found boundless scope in serving the customers of the banks. Hence, one can conclude that the dependence on technology is such that the banking business cannot be thought of in isolation without technology; such has been the spread of technology footprints across the Indian commercial banking landscape.

In this background, it is useful to study the extent of ICT diffusion in Indian banking covering the public sector, private sector and foreign banks functioning in India. It is also interesting to understand the impact of ICT diffusion on productivity and profitability of the selected banks. Again, it is a fact that customer is the ultimate beneficiary of these developments. Hence, it is also a meaningful exercise to analyse the customer satisfaction with respect to the ICT products offered by the banks. The present study is framed in such a background to give adequate explanation to the correlation between ICT diffusion and productivity on the one hand and profitability on the other. The scope of the study is limited to the selected banks functioning in India. Before proceeding to the objectives of the study, let us acquaint with the empirical evidences in the area of our interest so as to better place the study in proper direction.

1.3. Review of Literature

It is customary to review the related studies in every research. This exercise will provide the researcher a sound understanding of the methodology and findings of earlier research and help in shaping the current study in proper directions. Keeping this idea in mind, we present some of the very important works connected with the topic in the following pages. The review is presented in two broad headings.

1.3.1. ICT and Banking

A number of empirical studies have been conducted covering the role of ICT in banking sector. These studies mainly examined the role of ICT in the development of the sector and changes caused by ICTs. For example, Chandrasekhar and Rajendra (2009) analyzed the impact of IT on the productivity and profitability of banks. The results of the study shows that the elasticity coefficients associated with IT investments and IT personnel expenses were positive and high, marginal product of IT investments and IT personnel were positive and high, and the ratio of marginal to IT investment and the ratio of marginal product to IT personnel expenses were higher than those on Non-IT investment and Non-IT personnel respectively. The results implies that there is strong evidence to conclude that IT investments and expenses on IT personnel contribute to productivity, IT yields pay more than what is spent on IT and IT yields are higher than those from Non-IT investments and personnel expenses.

Deepti Bhatnagar (1983) highlights the need to examine communication strategies at the macro and micro level for banks for increasing efficacy of their rural branches. According to her, communication strategy is an important variable determining the efficacy of rural branches and if banks have to play a greater part in the economic development of rural areas, they have to perceive their role as a change agent and diffuse the action of innovation "banking" among the rural masses. This study also discusses about the effective application of some concepts of diffusion theory to rural banking.

Chandrika (2009) focused on the role of technology in banking environment, especially PSBs. The study reveals that the technological evolution in banks/banking services had passed through four phases: (i) introduction of computers and computerization of transaction system; (ii) up gradation of computerized transaction system into Management Information System; (iii) networking of the bank's branches and head office; and (iv) seamless flow of information between the bank's branches, across banks and customers. The study concludes with the observation that the PSBs were left with no option but to use IT both intensively and extensively for their in-house as well as external operations so that they can create a level playing field in terms of services they can offer to their customers like any other private and foreign banks.

Avasthi and Meera Sharma (2001) briefly surveyed the electronic products used in banking sector and examined the potential risks arising from their development. It also explores the challenges that the banking industry and its regulators face. The study identified ATMs, Internet/Mobile Banking as the major electronic products used by the banking sector. It analysed the potential risks of using electronic products by classifying it into: (i) risks to customers which includes theft of cards, threat to privacy, manipulation of security systems, and large-scale breakdown of electronic systems; (ii) risks to bankers which includes fraud committed owing to security breaches and large scale breakdown of system; (iii) systematic risks related to passing of bad signals immediately which may result in insolvency of banks; and (iv) social risks which includes the use of technological advances for money laundering and tax evasion, and the threat of cyber-terrorism. The study also observes the role of regulators in providing a legal framework, establishing regulatory and supervising arrangements, acting as facilitators, and developing institutional/telecom/other infrastructure.

Pooja Malhotra and Balwinder Singh (2005) analysed the internet banking in SAARC countries. They had surveyed a sample of 140 commercial banks. The study was mainly based on the information collected from Bank Websites. The authors claim that although data is confined to commercial banks only, it is broadly applicable to the banking system at large. The study made the comment that the progress of internet banking in all the seven countries was slow, but steadily, the customers were moving towards internet banking. The study ends with the conclusion that major share of the market of internet banking was still untapped by the SAARC countries.

Sharma (2012) found that the partially IT oriented banks are less profitable than the fully IT oriented banks. Foreign banks are on the top in terms of the overall productivity and profitability parameters. Analyzing further, it is found that SBI and Associate Banks (Partially it oriented banks) are ranked second after the Foreign Banks (Fully IT oriented banks) in terms of the spread ratios, but they have higher Burden ratios, which makes them less profitable as compared to the Private Banks. Overall, for the banking industry, the correlation between financial productivity and the Technology index is low and negative and statistically insignificant. The co-efficient of determination indicates that the effect of other factors is more than the effect of Technology on financial productivity.

England et al. (1998) found that there are no major differences in the performance of internet banks as compared to traditional banks in terms of profitability, efficiency or credit quality. However the study noted the difference between transactional Internet banks from other banks primarily by size. Sullivan (2000) reported that the use of internet technology has no significant impact on the profitability of banks. On average, this study found that neither banks were helped nor harmed by offering the internet delivery channel. The study pointed out that the profitability of internet banks and non-internet banks are almost similar to each other. Carlson et al., (2001) studied 2,517 US National Banks during 1998 - 2000. The study suggested that internet banking is not having an independent impact on bank profitability.

In contrast Jalan (2002) pointed out that information and communication technology (ICT) has bought fundamental revolution in banking sector. Due to the enormous benefits of IT application, now banks seem to perceive internet banking as a substitute for the existing branching structure (Corrocher 2002).

Some studies like Janice et al., (2002) observed that banks view internet as a good supplementary distribution channel for their products and services. Poatoglu and Ekin (2001) found that modern banking with internet techniques leads to better results regarding customer's satisfaction and is a good tool for attaining their retention.

In some countries banks have also applied wireless application protocol telephony technique which allows the building of a single platform for competing network technologies such as GSM and IS-95 networks.

Further it is an effective tool for downsizing the cost of operations through cheaper transaction costs, lesser paper work, less requirement of man-power and physical branches (Cheng et al., 2006). Hasan (2002) found that internet banking is highly preferred by larger banks and banks having higher branching networks. The study also noted that online home banking could be used as a strong incentive to have customer's penetration. Chang (2003) also examined the behaviour of Korean customers towards the introduction of internet banking. The study further revealed that largest bank in commercial banking remains dominant in internet banking.

Malhotra and Balwinder Singh (2009) describe the current state of Internet banking in India and discuss its implications for the Indian banking industry. Particularly, it seeks to examine the impact of Internet banking on banks' performance and risk. Using information drawn from the survey of 85 scheduled commercial bank's websites, during the period of June 2007, the results show that nearly 57 percent of the Indian commercial banks are providing transactional Internet banking services. The univariate analysis indicates that Internet banks are larger banks and have better operating efficiency ratios and profitability as compared to non-Internet banks. However, the multiple regression results reveal that the profitability and offering of Internet banking does not have any significant association, on the other hand, Internet banking has a significant and negative association with risk profile of the banks.

In a study, Avasthi and Sharma (2001)analyzed how advances in technology are set to change the face of banking business. Technology has transformed the delivery channels by banks in retail banking. It has also impacted the markets of banks. The study also explored the challenges that banking industry and its regulator face. Janki (2002)analyzed how technology is affecting the employees' productivity. There is no doubt, in India particularly public sector banks will need to use technology to improve operating efficiency and customer services. The focus on technology will increase like never before to add value to customer services, develop new products, strengthen risk management etc. The study concludes that technology is the only tool to achieve their goals

A study by Neelu Rohmetra (2004) highlights the need for taking a transformative view for IT systems with due appreciation of HRD-IT Interface. The study seeks to investigate the transformative potential of IT using the case of Jammu and Kashmir Bank Ltd. in India. The findings of the study reveal that development climate in Jammu and Kashmir Bank is not satisfactory indicating a lot of scope for improvement. The study pointed out creativity discouraging attitude, secretive attitude of seniors, non-existence of the proactive culture, lack of autonomy, inadequate training and development systems, and absence of career planning as the main reasons behind weak development climate. At the same time, the result of the study exhibit that computerization has made the work easier and has enabled the speeding up of the delivery time. It had also helped in reduction of errors besides improving management of databases.

Chandrasinhji J. Desai (1983) in a study analysed the impact of manpower deployment on productivity and to devise a rational staffing pattern based on productivity which is flexible enough to permit variation in staffing commensurate with development potential. The author opted for business level as parameter for measuring productivity, by calculating the average business per employee and comparing it with some productivity standard, or norm, representing the expectations of “business per employee” from the relevant group of branches. The study also devised a rational staffing pattern, that is, a productivity based staffing pattern by undertaking a deeper analysis of the staff deployed at all the branches comparing basis ratio to RUP and analyzing the business mix into non-household and household sectors in terms of branch group and age group profiles.

Alpar and Kim (1990) analyzed the impact of ICT on economic performance of U. S. banks during 1979-1986. Using cost function approach it was found that ICT was able to reduce operating costs, increase capital expenditures of banks, save personnel costs, reduce demand deposits, and increase time deposits. Elena Beccalli (2003) examined the impact of ICT (in terms of hardware, software and IT services) on the performance of banks and found that there was an insignificant positive correlation. It was also found that there exists a productivity paradox. Sangjoon Jun (2006) examined the nexus between the information and communication technology investment of Korean banks using panel data and found that there is some improvement in the returns of large banks.

Baba Prasad and Patrick T. Harkery (1997) studied the effect of ICT investment on productivity and profitability of retail banks in the United States. This study concluded that additional investment in ICT capital have no real benefits and may be more of a strategic necessity to stay with the competition. Sumon Bhaumik and Jenifer Piesse (2004), based on their study made the observation that while foreign banks have high credit-deposit ratios, the domestic banks experienced much greater improvements in technical efficiency in the context of credit. Significant improvements in technical efficiency were registered mainly by the domestic banks.

Gunter Lang and Peter Welzel (1998), considering 40% of German banking, and using multi-product translog cost function for evaluating the impact of technology on cost inefficiency of banking. It was found that scale economies exist up to a size of about 5 billion DM of total assets and smaller banks turn out to be more sensitive to input prices. Vijayakumar Bharathi and Ms. Manisha Akolkar (2004) in their study explained that Information and Communication Technology has basically been used under two different avenues in Banking. Firstly in Communication and Connectivity and secondly in Business Process Reengineering, both basically focusing on increasing its customer reach. Information and communication technology helps a lot for sophisticated product development, better market infrastructure, implementation of reliable techniques for control of risks and helps the financial intermediaries to reach geographically distant and diversified markets.

Shirley J. Ho and Sushanta K. Mallick (2008) observed that ICT can improve bank's performance by way of reducing operational cost, and facilitating transactions among customers within the same network. The study attempted to explain the inconsistency by focusing on the heterogeneity in banking services. The results obtained were tested by using panel data of 68 US banks over 20 years, and it was found that the bank profits decline due to adoption and diffusion of ICT investment, reflecting negative network effects in this industry.

Simon H. Kwan (2004) studied the cost efficiency of commercial banks in Hong Kong using the stochastic frontier approach and it was found that the average X-efficiency of Hong Kong banks was about 16 to 30 percent of observed total costs. William C. Hunter, Stephen G. Timme (1991), examined the technological change, and its relationship to firm size, and its impact on the efficient scale of output and product mix for large U.S.

commercia1 banks. They suggested that technological change can lower the real costs by 1% per annum.

Costas Lapavitsas and Paulo L. Dos Santos (2008), based on their work argued that money-dealing transactions had become cheaper, but cost of investment had increased. Kaparakis, Miller and Noulas (1994) studied cost efficiency of 5,548 American banks with assets of over $50 million and found a negative correlation between efficiency and the bank's size. It was also found that there exists a positive and significant correlation between X-efficiency and the ratio of capital to total assets, and a negative correlation between cost efficiency and the bank's credit risk, which is measured by the ratio of lost debts to total credit.

Laurent Weill (2009) in his study attempted to find evidence about the consistency of efficiency frontier methods on European banking samples. The cost efficiency of banks was measured using samples from five European countries (France, Germany, Italy, Spain, and Switzerland) with three approaches: stochastic frontier approach, distribution-free approach, and data envelopment analysis. The study concluded that there were some similarities between parametric approaches. Many techniques have been suggested in the literature to measure banking efficiency, based either on econometric techniques (stochastic frontier approach (SFA), distribution-free approach (DFA), thick frontier approach (TFA)) or linear programming tools (data envelopment analysis (DEA), free disposal hull (FDH)). He concluded that parametric techniques give consistent results of efficiency means and rankings.

Dannenberg and Kellner (1998), in their study, evaluated the services of banks via internet and observed that transactions via internet reduce the risk of data loss to customers, provide a chance to cut down expenses, gives higher flexibility for bank employees, and helps re-shaping the banks' image into an innovative and technologically leading institution. Daniel (1999) analyzed the current provision of electronic services of major retail banking organizations in the UK and found that 25% banks in the UK were those already providing e-banking services, 50% banks were testing or developing such services while 25% were not providing any e-banking services. Sathye (1999)stated that internet and other virtual banking had significantly lower the cost structure than traditional delivery channels.

Talwar (1999)observed that computerization of banks, introduction of Real Time Gross Settlement System, setting up of Infinet, Electronic Payment Products(such as Electronic Clearing Service) had ensured better resource management, systematic efficiency and substantially reduced inter-branch reconciliation entries. At same time banks should be prepared to face many challenges like fear of hacking, tampering of data, and secrecy maintenance.

Wenninger (2000)evaluated the changes that had taken place with the introduction of electronic commerce and opined that development of e-banking products such as electronic billing, establishing internet portals, electronic checks, and ATM had provided additional services to customers. Kamesam (2001)analyzed the changes that took place in the Indian banking industry which emphasized on technological advancements and profitability in banks and found that emergence of services such as electronic data interchange (EDI), usage of smart cards, RTGS, and e-commerce resulted in increasing the level of profitability and productivity of banks.

Unninthan (2001) analyzed the impact of e-banking adaptation on Australian and Indian banking sectors with the help of qualitative and quantitative analysis and found that Australia had a strong platform for e-banking growth with 37.7 per cent of population willing to engage in e-banking mostly in urban areas, but India by comparison was played by weak infrastructure, low PC penetration and consumer reluctance in rural sector.

Yakhlef (2001) in his study indicated that although internet banking provided more safe, convenient and efficient services to the customers, yet as far as personal contact and direct information was concerned, brick and mortar was more preferable than internet. Aki (2002) opined that new technologies cannot replace the branch network but these can support old methods of delivering the services.

Alu et al. (2002) evaluated the impact of IT on the banking industry in Nigeria and the study revealed that IT had appreciable effect on banks' productivity, cashier's work, banking transactions, bank patronage, bank service delivery and customers' services. Gurau (2002) in his study found that in 2005, distribution channels used by banks included 10 per cent internet banking, 65 per cent multi-channel,10 per cent telephone banking and 15 per cent through bank branches, whereas in 1998, it was only 15 per cent direct banking and 85 per cent in branch banking.

Harris and Spence (2002), in their paper, concluded that e-banking had forced the banking sector to recognize, restructure and reconsider its institutional arrangements. Durkin and Howcroft (2003) had made the observation that the banker-customer relationship was improved through mobile, phone and internet banking.

Joseph and Stone (2003), in their paper, found that customer friendly technology such as ATM, internet banking and telephone banking has been used by the banks to reduce the cost of providing services, and to increase the customer loyalty and market share. Lustik (2003) findings were helpful to understand the main reasons and factors responsible for the rapid growth of electronic banking.

Mattila et al. (2003) evaluation of the electronic banking adoption in Finland showed that the proportion of people in Finland, who have adopted online banking, was higher than anywhere else in the world. Sureshchander and Rajendran (2003), in their paper, had observed that there seems to be a great variation in respect of services offered by three groups of banks.

Lustik (2004), in his study, attempted to assess the profitability of electronic banking services for the banks and the results of the study indicated that electronic channels provide cost saving for banks and their clients. Lympero and Chaniotakir (2004) highlighted the advantages which influence the employees feel easy to adopt e-banking, i.e., cost alienation, customer service and foreign competition.

Heng Michael et al. (2006) analyzed the impact of e-banking on brick and mortar banks through innovation model. The researchers suggested that banks need to develop uniquely innovative services and products on the one hand and innovative business model that changes the way banks operate on the other.

Siam (2006) investigated the reasons behind providing electronic banking services through internet, their impact on banking services in general, and banks profitability in particular. The study revealed that electronic banking services had a negative impact on the profitability of banks in the short run because of increased capital costs involved in technical and electronic infrastructure, cost of training to employees and also the cost involved in creation of environment where the banks can operate smoothly.

On the other hand, these services had a positive impact in the long run on the profitability of banks.

1.3.2. Literature related to tools and techniques used in the study

Since this study has used several tools and techniques to analyse the impact of ICT diffusion on bank productivity, profitability and service quality, it is necessary to discuss the studies covering such tools. Hence, the following few paragraphs review research works which have used these techniques on a large scale.

1.3.2.1.SERVQUAL and Service Quality

There are two main conceptualizations of service quality in the literature. One is based on the disconfirmation approach, and the second is based on performance approach. Many works (Gronroos, 1984; Parasuraman et. al. 1985 and 1988a) on service quality conceptualized it based on difference between consumer expectations and perceptions.

Gronroos (1984) in his study developed service quality model taking expected service and perceived service as independent variables. The firm's promotional activities, consumer's past experience, word of mouth communication and consumer needs were considered for perception. The discrepancy between expectations and perceptions constitutes the measure for the customers' service quality assessment. This study was the first attempt to conceptualize service quality from the customers' point of view and it had laid the foundation for future service quality research.

Outstanding contributions to service quality and its measurement was made by Parasuram, Berry and Zeithmal (1985, 1988a, 1988b, 1990, 1991 and 1994a). They developed the Gaps model of service quality which analyzed various gaps to be managed by a firm in order to provide quality service from the point of view of customers. Parasuram et al. (1988a) defined service quality as the overall evaluation of a service firm by comparing that firm's service delivered as perceived by its customers with their general expectations of how it should be delivered. They developed a multi-dimensional service quality assessment instrument called SERVQUAL containing 22 variables divided into five dimensions and the service quality was assessed as the difference between the customers' perception (P) and expectations (E) along these variables. SERVQUAL technique has been extensively used in a number of studies for evaluating service quality related to different sectors.

Many studies deviated from this approach of taking the difference between expectation and perception citing the reason that expectations are dynamic and are subjected to change. Instead they focused on taking only perception of the customers. The studies by Andaleeb and Basu (1994) and Mittal and Lassar (1996) argued that this approach results in good predictive power of service quality. Babakus and Boller (1992) and Cronin and Taylor (1992) in their respective works made a comparison of the computed difference scores with perceptions and found that perceptions were a superior predictor of service quality than the gap between expectations and perception. This prompted Cronin (1994) to design a perception-only scale.

Dabholkar et al. (2000) also argued that the perception measure have higher predictive and explanatory power in service quality evaluation from the part of customers. Also, it was found that perception could allow an understanding of service quality at factor level and proposed all the dimensions of quality as antecedents, rather than components of service quality. A study by Page and Spreng (2002) observed that perception-only measure was more reliable and stronger indicator of service quality than gap between expectations and perceptions. Lee, et al. (2000) in his study proved that perception based measures of service quality capture more of the variation in service quality than do differences measure. Therefore they advocated that the managers should place more emphasis on performance perceived by customers rather than the difference between perceived performance and prior expectation.

1.3.2.2.Vector Auto Regressive Models

Sims (1980) was the first to introduce VAR models as an alternative to the large scale macro econometric models in macroeconomic research.

Subsequently the methodology has gained widespread application in macroeconomic research. The growth of this methodology was mainly because of dissatisfaction among the economic community with regard to the traditional large scale macro econometric models working in the tradition of the Cowles commission, in which identification was achieved by excluding variables - most often lagged endogenous variables - without any theoretical or statistical justifications.

Caesar Lack (2006) used vector-autoregressive (VAR) models at the Swiss National Bank in order to forecast Swiss consumer price inflation. The study used bank loans and the monetary aggregate M as the most important variables for inflation forecasting. The study used optimized procedure which reduced the root mean squared error (RMSE) of the inflation forecast to one third of the RMSE of a naive “no change” forecast over the period from 1987 to 2005.

Thanabalasingam Vinayagathasan (2013) in his paper attempts to identify the monetary policy indicator that explains the Sri Lankan monetary policy transmission mechanism. The study used a seven variable structural VAR model by utilizing monthly time series data covering the period from January 1978 to December 2011. Empirical findings of the study suggest that the interest rate shocks play a significant role in explaining the movement of economic variables.

Majali and Assaf (2014) in their study made an investigation whether the Amman stock exchange (ASE) performance as measured by the stock price index, was affected by macroeconomic variables. They used quarterly data from 1992-2014. Johansen co-integration test and vector error correction model (VECM), Impulse response function (IRF) and variance decomposition (VD) were used for this purpose. The results of the study give the impression that an increase in the weighted average interest rate on time deposit in the banking system had a greater impact on the stock price index than other macro economic and financial variables.

Rotemberg and Woodford (1997) used VAR models to study U.S. monetary policy, both for data description and as input in quantitative theoretical analyses. A Anjali and K T Thomachan (2015) in their study examined long run relationship between capital market and banking sector using daily data of ten years ranging from 1st January 2005 to 31th December 2014. The study used statistical tools like unit Root Test, Granger Causality/Block Exogeneity Test, Cointegration analysis, Impulse Response function and Error Variance decomposition. The study found that the effect in the banking sector leads to the movement of banking sector but not vice versa.

Jarkko Jaaskela and David Jennings (2010) examined the ability of vector autoregressive (VAR) models in identifying the transmission of monetary policy. The study found that sign-restricted VAR models do reasonably well at estimating the responses of macroeconomic variables to monetary policy shocks. At the same central tendency measures of sign-restricted VAR models gives misleading results and hardly ever coincide with the true impulses.

The aforementioned studies indicate that the introduction of ICT is inevitable for the present banking system. A detailed review of the literature reveals that in the post liberalization period a paradigm shift is taking place in ownership, corporate governance, business, ICT and performance of various bank groups. Hence, there is a need to examine the impact of information technology on the profitability and productivity of banks on the one hand and on the other hand, it is equally important to assess the impact of ICT on the quality of service provided by the bank from the point of view of customers. Research on the relation between ICT in banks and productivity and profitability is found to be very few in the Indian context. Hence, the present study is conducted with an aim to find out the impact of information and communication technology on banks' profitability and productivity, and the quality of service as perceived by customers.

1.4. Objectives of the Study

The general objective of the study is to analyse the extent and impact of the ICT diffusion in the Indian Banking Industry with special reference to the Commercial Banks. The specific objectives are as follows:

1. To examine the status of ICT diffusion among the banks operating in India
2. To analyze the impact of ICT on the profitability, and productivity of banks functioning in India, and,
3. To understand the effect of ICT on the quality of banking services.

1.5. Hypothesis

The study sets the following hypothesis:

Diffusion of ICT has improved the profitability and productivity of banks

1.6. Methodology and Data Source

As already stated, the present study analyses the ICT diffusion among the commercial banks functioning in the country.As per the Reserve Bank of India Act 1934, commercial banks are classified into scheduled commercial banks (SCBs) and non-scheduled commercial banks. The scheduled commercial banks are those commercial banks which are included in the second schedule of the 'RBI Act, 1934'. The scheduled commercial banks in India are, further, classified into public sector banks, private sector banks, and foreign banks. The public sector banks are sub-divided into two categories viz., the State Bank Group and the Nationalized Banks. The private sector banks are also sub-divided into two categories, viz., old private sector banks and new private sector banks. This study examines the case of scheduled commercial banks classified under the public and private sector categories (see Appendix I). In this study, we use both primary and secondary data.

In order to study the status of ICT diffusion and the impact of ICTs on productivity and profitability among the commercial banks, we have selected one bank each from the State Bank Group, Nationalised Bank Group, old private sector bank and new private sector banks. The banks selected from these categories are: State Bank of India from the State Bank Group, Punjab National Bank from the Nationalized Bank Group, Federal Bank from the old private sector and HDFC from the New Generation private sector banks. These banks were selected on the basis of sound footings. These are the banks which were rated high by the ICT diffusion indices.

Secondary data on the functioning of these banks, ICT diffusion in the areas of operation and customer service collected from different sources constitute the major inputs for the current study. These were collected individually from the concerned banks, from the RBI data base, IBA data base, SLBC and Prowess data base. Since the State level data on ICT diffusion is unavailable, the analysis is carried out on an all-India basis. The empirical investigation is carried out using monthly data from January 2009 to April 2015.

Primary data is supplemented to meaningfully analyse the customer satisfaction with the ICT mediated banking service. For this purpose, 600 customers availing services from the selected banks functioning in Kerala were selected at random and administered using a structured interview schedule (Appendix II).

1.7. Tools of Analysis

The study has used many statistical and mathematical tools for analysis. In addition to these, a few qualitative tools were also applied wherever necessary. We have constructed an original and comprehensive un-weighted simple index for understanding the status of ICT diffusion among the commercial banks. This index is constructed by taking the transactions through different technology oriented means like NEFT, RTGS, ECS, Mobile, Credit card (ATM & POS), and Debit card (ATM & POS). .

The impact of ICT on profitability and productivity of banks were analysed using the variables like Return on Asset (ROA), Return on Equity (ROE), Total Deposits, Loans and Advances. The study examined both immediate and lagged effect of ICT. For this purpose, a multiple regression model (VAR) using time series data was used. The steps used in this analysis consist of: (i) the variables were tested for stationarity by unit root test using the Dickey Fuller test[3]; (ii) a cointegration analysis is used to assess whether there exists a long run or equilibrium relationship between time series variables with the help of Johansen procedure[4]; (iii) the strategy of Ribba[5] was used to impose restrictions on adjustment parameters. This was done to know which variables are endogenous to the model; (iv) to further explore the nature of interactions between variables, the impulse responses function and error variance decomposition were used. Impulse responses trace out the response of current and future values of each of the variables to a one unit increase (or to a one standard deviation increase) in the current values of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. Variance decomposition was used to know whether the forecast error variance of one variable is increasingly explained by shocks in the other as the forecast horizon increases.

For analyzing the impact of ICT on quality of service, data were collected from bank customers by using a structured interview schedule on different dimensions of banking service such as: Tangibility, Reliability, Responsiveness, Assurance, Empathy, Efficiency and Accuracy. A tool called SERVQUAL[6], developed by Parasuraman, Leonard Berry and Valerie A Zeitham in the 1980s was used for this purpose.

The SERVQUAL used in the present study consists of 27 statements which are related to seven service quality dimensions such as Tangibility, Reliability, Responsiveness, Assurance, Empathy, Efficiency, and Accuracy.

Each of the statements first appears in the form of a question to measure customers' general expectations (E) about the service area being measured and second time appears as a question to measure customers' perceptions (P) about the organization whose service quality is being assessed. In both cases, customer responses are being measured on a five point Likert scale that ranges from "strongly disagree" to "strongly agree". The Service Quality and Gaps Model[7] were used to analyze the results.

1.8. Presentation of the Study

The Thesis is presented in six chapters. The first chapter, as usual introduces the topic, scope of the study, review of literature, methodology, tools of analysis and limitations. In the second chapter, a review of technology and banking in the context of the country is presented. In the third chapter, an attempt is made to examine the status of ICT diffusion in Indian banking. The impact of ICT diffusion in productivity and profitability of banks are discussed in Chapter four. The effect of ICT diffusion on quality of services provided by the commercial banks are analysed in the fifth chapter. The last chapter provides the summary of findings, suggestions and conclusion.

1.9. Limitations of the Study

As seen in the social science research, this study is also beset with some limitations. First of all, this study has analysed only selected technologies used by the banks. Secondly, primary data collection was done in selected regions of Kerala and hence the findings of the study cannot be generalised. Thirdly, primary data collected for evaluating service quality was not made on bank-wise basis and therefore an inter-bank comparison is not possible in this area. Fourthly, while running regression, all the variables affecting the dependent variables were not included in the model. Finally, as certain bankers were not ready to share some vital information about their functioning, a finer analysis of this information was limited. Despite these shortcomings, we have made every effort to provide objective answers to the research questions raised in the study.

Notes and References

Notes

1. Among others, see Ahmad, Nadim, Paul Schreyer and Anita Wolfl (2004), 'ICT Investment on OECD Countries and its Economic Impacts', Paris, Organisation for Economic Co-operation and Development. Also ferer, Waverman, Leonard, meloria Meschi and Melvyin Fuss (2005), 'The Impact of Telecoms on Economic Growth in Developing Countries' in Vodafore, 2005 Africa: The Impact of Mobile Phones, Vodafore Moving the Debate Forward Policy Paper Series, No.3, London: Vodafofe.

2. See the study of Khalil, Mohsen and Charles Kenny (n.d), 'The Next Decade of ICT Development: Access, Applications and the forces of Convergence' Washington DC, The World Bank Group, P.7.

3. Dickey-Fuller test is used for testing unit root in time series data, developed by Dickey and Fuller. Here the regression equation was expressed in first difference form, estimated by OLS, and find the tau value (test statistic of DF test). This was then compared with DF critical values to make a decision regarding accepting or rejecting the unit root hypothesis.

4. The Johansen test, named after Søren Johansen, is a procedure for testing cointegration of several time series. This test permits more than one cointegrating relationship. There are two types of Johansen test, either with trace or with eigenvalue, and the inferences might be a little bit different. In the Johansen framework, the first step is the estimation of a p^{th} order VAR (Vector Auto regression) in k variables. This can be reparameterized into a VECM form. Johansen suggests two test statistics namely λ_{max} statistics and λ_{trace} statistics to determine the cointegrating rank (number of cointegrating relationships). Both test statistics establishes the rank of the π matrix based on its Eigen values (and hence the number of cointegrating relationships). A decision regarding the existence of a long run relationship is based on the value of the test statistic obtained from sample.

5. Strategy of Ribba is a procedure by which some restrictions were imposed on the Vector Error Correction Model (VECM), known as Structural Vector Error Correction Model (SVECM), instead of unrestricted models.

6. SERVQUAL is a multi-item scale developed to assess customer perceptions of service quality in service and retail businesses (Parasuraman, Berry, & Zeihaml, 1988). The SERVQUAL customer perception tool requires customers to answer questions about both their expectations and their perceptions regarding different service quality dimensions (Parasuraman, Berry, & Zeihaml, 1988).

7. Service Quality and Gaps Model identify key discrepancies or gaps relating to perceptions of service quality, and tasks associated with service delivery to customers.

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CHAPTER 2

Rahul k. “Information and communication technology diffusion in Indian banking : a study with special reference to commercial banks ” Thesis. Department of Economics, University of Calicut, 2015.

CHAPTER II

TECHNOLOGY AND BANKS:

A REVIEW OF MAJOR COMMITTEE RECOMMENDATIONS AND TECHNOLOGICAL INNOVATIONS IN INDIA

2.1. Introduction

The banking sector is one of the beneficiaries of information and communication technology revolution in the world. Banks all over the world had utilized ICT in a big way for making its services more effective and efficient. And now a situation has reached in which this sector cannot survive without the support of information and communication technology. Harold and Jeff (1995) observed that all financial service providers including banks should modify their traditional operating practice to remain viable in the coming decades.

It helped the banking sector to achieve speed, efficiency, cost reduction, customer service and competitive advantage (Akinuli, 1999; Ovia, 2005). Technology enabled banking services is helping the customers a lot by providing them with anywhere, anytime and anyway banking. In India, technology oriented banking services had started with the adoption of these techniques by new generation private sector banks and foreign banks. It remained confined to these banks for many years. But gradually public sector banks also started switching over to technology aided banking services.

Presently, almost all the commercial banks operating in India had adopted ICT to a great extent.

2.2. The Concept of Technology Diffusion

Diffusion of technology had three different stages: invention, innovation and diffusion. Invention is a process arising from a cumulative synthesis of what has preceded. It is an early part of the process to innovation. Innovation is a process through which an invention is incorporated in the production process. It covers all activities between invention and diffusion. Diffusion is a stage succeeding invention and innovation. It is the rate at which innovations spread amongst firms. It is a process by which the use of an innovation spreads and grows. Economic impact of an invention begins to be felt during this stage.

From the point of view of stages of diffusion, it can be observed that many of the early works were done concentrating on technology innovation (second stage) in Indian banking. The present study is an attempt to analyze technology in banking and its impact on productivity, profitability and service quality from the third stage of diffusion.

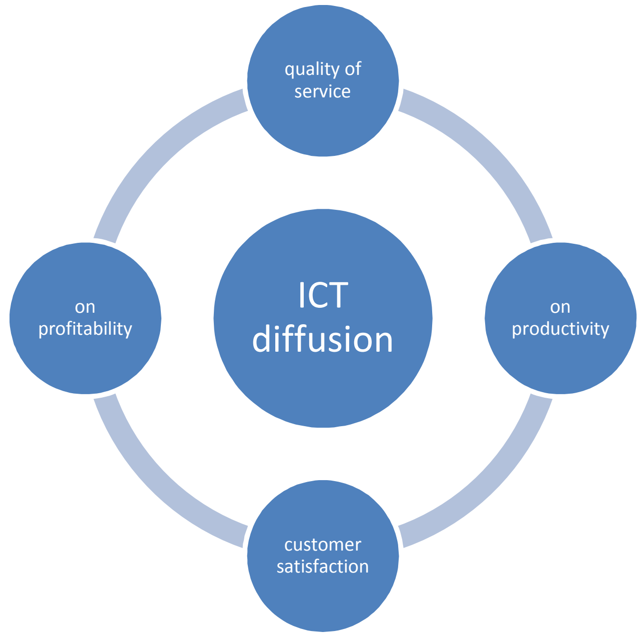

Figure 2.1: Methodological Framework of the Study

2.3. Evolution of Information and Communication Technology in Indian Banking

The technology-enabled banking services in India probably started off with HSBC bank introducing ATM for the first time in 1987 (Thamaraiselvan and Raja, 2007) . Internet banking was introduced in 1996 by the ICICI bank (Rajneesh De and Padmanabhan, 2002). The Rangarajan Committee recommendations (1989), the Saraf Committee recommendations (1993) and the Vasudevan Committee recommendations (1998) had given an impetus to ICT in banking. The new generation private sector banks and foreign banks have started their operations laying great emphasis on information and communication technology as a tool to overcome the limitation of less number of branches. A few of the old private sector banks have followed the same strategy as the new private banks (RBI 2005). The Reserve Bank of India is constantly pursuing the Banks to improve the quality of banking service through ICT.

The development of ICT in banking sector can be divided into different phases (Suruliavel, 2010). The Banks focused on automating the laborious accounting process and back office functionslike maintenance of deposits accounts, calculation of interest and maintenance of general ledgers during the first phase of development. This marked the beginning but demonstrated the advantages of introducing the technology in a bigger way.

In the second phase of development, the banks started automating the front-office as well as the back officefunctions to improve the level of customer service with reduction in processing time as well as to automatically synchronize the front-office and back-office functions for control purposes. All the branches can capture the entire data/transactions related to their operations in a stand-alone mode.

The third phase of development was marked by the opening of new generation Private Sector Banks. These banks started their operation with these technologies and could provide innovative financial products at a cheaper cost. The existing banks also started networking their branches and initiated the process of centralized operations. The "Core Banking Solution

(CBS)" was introduced during this phase. A transition had happened from "branch banking" to "bank banking". This helped the banks to solve the problems of decentralized network such as maintaining the stand-alone server, various applications, database and the related operational costs is avoided and they were able to take full advantage of centralization by improving the efficiency. This also improved the quality of customer service to a great extent through operational conveniences and reducing the transaction/remittances time. This enabled banks to retain and improve the customer base as well as able to lower the service cost after adoption of the centralized operations.

This gave way for the fourth phase of development, where the customers had given the option to carry out their own required transactions through Automated Teller Machines (ATM), mobile banking and internet banking**.**

With this the Banking Industry started witnessing the fifth phase of development with the intra-bank connectivity is effectively extended as "inter-bank" connectivity**.** The paperless on-line inter-bank remittances through "Real Time Gross Settlement (RTGS)", "National Electronic Fund Transfer (NEFT)", "Electronic Clearing Service (ECS)" and Mobile had become a reality during this phase. A further transition happened from "bank-customer" to "banking industry-customer". The "Cash tree" consortium of networking the ATMs of various banks is another step forward in this direction.

The induction of technology is now considered as an essential requirement for the overall progress in the banking sector. Nowadays bank customers were being provided with multiple modes of accessing banking transactions, including Tele-banking, Mobile banking, Internet banking, PC banking and Banking through ATMs. Appropriate technology usage can go a long way in making the process of financial intermediation smooth, developing an efficient payment system, improving customer service, handling larger volumes, and generating efficient MIS.

2.4. Various Committees on Technology in Banking

The recommendations of the committees headed by C. Rangarajan, in 1984 and 1989 laid the foundation for large-scale induction of ICT in the banking sector. In 1994, the Reserve Bank constituted a committee on 'Technology Upgradation in the Banking Sector' and this committee made a number of recommendations covering payment systems including setting up of an autonomous centre for development and research in banking technology. The IDRBT was created as part of it. This Institute has established the Indian Financial Network (INFINET) which performs research in banking technology and provides consultancy services apart from providing educational and training facilities for the banking sector.

Damle Committee (1982) made many recommendations regarding MICR/OCR technology for cheque processing. The Committee recommended for stage-wise introduction MICR/OCR technology for cheque processing. These recommendations had proved to be very effective in making national clearing of cheques a reality.

Iyer Committee (1987) had made many recommendations which include Setting up of X.25 based packet switching network called 'BANKNET' to be jointly owned by the Reserve Bank and the public sector banks, Inter-bank fund transfers on banks' own account and on customers' account, Inter-branch funds transfers on banks' own account and on customers' account, Currency chest transactions, Government transactions, Improvements in payment systems by facilitating automated clearing services and also India should join the SWIFT (Society for Worldwide Interbank Financial Telecommunication) Network for the transmission and reception of international financial messages among others.

Saraf Committee (1994) recommended for the establishment of an Electronic Funds Transfer (EFT) system, with the BANKNET communications network as its carrier, Enactment of suitable legislation on the lines of the Electronic Funds Transfer Act 1978, USA and Data Protection Act 1984, UK, MICR clearing be introduced at all centres with more than 100 bank branches, Introduction of a Delivery versus Payment (DvP) system for

SGL transactions, with settlement on gross basis both for securities transactions in PDO and funds transactions in current, Introduction of Electronic Clearing Service Credit for low value repetitive transactions such as interest, dividend, salary, pension payments and an Electronic Debit Clearing for payments to utility companies, Switch over to on-line inter-bank clearing on a gross basis, Large scale induction of computers and communication technology in service branches, and Optimal usage of SWIFT.

Committee on Technology Issues relating to Payments System, Cheque Clearing and Securities Settlement in the Banking Industry (1994) headed by K.S. Shere recommended to introduce EFT system by framing regulations under Section 58 of the RBI Act. The Committee also suggested a Model Customer Contract agreement to govern the banker-customer relationship with regard to EFT should be adopted by all banks participating in the system.

Report of the Committee on Technology Upgradation in the Banking Sector headed by Vasudevan(1998), Report of Working Group on Screen Based Trading In Government Securities (2004) headed by R.H. Patil, Report of the Expert Group on Internet Deployment of Central Database Management System (CDBMS) (2004) headed by A. Vaidyanathan, and Report of the Working Group on Preparing Guidelines for Access to Payment

Systems (2007) headed by R. Gandhi have also contributed much towards the progress of ICT in banking.

2.5. Technological Innovations in Indian Banking

Technology is nowadays considered to be the key to the future success of Indian Banks. ICT had influenced enormously the banking sector. Technology enabled the banks to offer better quality of services to customers besides ensuring accurate information at a faster rate on banking transaction. Thus ICT has become inevitable part of banking organization. Banks in India were making use of different technologies for banking services. This section deals with important technologies used in banking operations in India.

2.5.1. Internet Banking

Internet is a global interconnected network providing free exchange of information. Internet banking means setting up of a web-page by a bank to give information about its products and services, and also involves provision of facilities such as accessing accounts, fund transfer, and buying financial products or services online. ICICI Bank is the first bank to have introduced internet banking in India. It was followed by Citibank, Indus Indi Bank and HDFC Bank. Presently almost all the major commercial banks operating in India were provided internet banking facilities to its customers without charging any additional amount. Internet banking allows customers to manage their money from any type of browser device including mobile phones, internet enabled T.V., PC and even small hand electronic organizers. It also allows customer to have constant access to accounts at any time anywhere.

2.5.2. Mobile Banking

Mobile bankingis a term used for performing balance checks, account transactions, and payments among other services via a mobile device such as a mobile phone. Mobile banking is most often performed via SMS or the Mobile Internet. But this can also be done using some special programs called clients downloaded to the mobile devices.

2.5.3. Tele-banking

Tele-banking is a service provided by a bank which allows its customers to perform transactions over the telephone. Most tele-banking services use an automated phone answering system with phone keypad response or voice recognition capability. In order to ensure security, the customer must first authenticate through a numeric or verbal password or through security questions asked by a live representative. Except cash withdrawals and deposits, all other features of an automated teller were offered by this service. Tele banking makes use of a technology known as Interactive Voice Response Service (IVRS).

2.5.4. SWIFT (Society for Worldwide Inter-Bank Financial Telecommunication)

SWIFT provides telecommunication facilities for exchange of financial messages globally. The foreign exchange business done by the Banks presently would not have been possible without SWIFT.

2.5.5. INFINET (Indian Financial Network)

INFINET is a satellite based wide area network using VSAT (Very Small Aperture Terminal) technology set up by the RBI in June 1999. Among the major applications identified for porting on the INFINET are e-mail, Electronic Clearing Service - Credit and Debit, Electronic Funds Transfer and transmission of Inter-city Cheque Realization advices. Later, other payment system related applications and Management Information System (MIS) applications are also included under its purview.

2.5.6. NEFT (National Electronic Fund Transfer)

NEFT refers to the computer-based systems used to perform financial transactions electronically. NEFT is technique used for different transactions like cardholder-initiated transactions, direct deposit payroll payments for a business to its employees, direct debit payments from customer to business, electronic bill payment in online banking, transactions involving stored value of electronic money, wire transfer via an international banking network, and

Electronic Benefit Transfer. This facility is used mainly to transfer funds below two lakh rupees.

2.5.7. RTGS (Real Time Gross Settlement)

RTGS is a technology which is advancement over NEFT. Here transactions can be done at "real time", that is, fund transfer will happen at moment of operation. Minimum amount set for transaction through this technology is Rs. 2 lakh. Once processed through RTGS, payments are final and irrevocable. The banks can charge a few rupees as service charge/transaction fee.

2.5.8. Electronic Clearing Services (ECS)

ECS were operated by RBI since 1996-97. This service is used for making payment from a single account at a bank branch to any number of accounts maintained with the branches of the same or other banks. ECS facility is a popular technique mainly used by the public and private limited companies and Government departments, which makes bulk and recurring payments.

2.5.9. Optical Character Recognition (OCR)

OCR is the machine recognition of printed characters. OCR systems can be used to recognize many different OCR fonts, as well as typewriter and computer-printed characters. When a text document is scanned into the computer, it is turned into a bitmap, which is a picture of the text. OCR software is used to analyze the light and dark areas of the bitmap in order to identify each alphabetic letter and numeric digit. Once it recognizes a character, it was converted to ASCII text.

2.5.10 Magnetic Ink Character Recognition (MICR)

MICR is a technique used for machine recognition of numeric data printed with magnetically charged ink. It is used mainly for recognizing bank cheques and deposit slips. MICR readers are used to detect the characters which were then converted into digital data. Though optical methods (OCR) became as sophisticated as the early MICR technology, magnetic ink is still used. It is used as a deterrent to fraudulence, because a photocopied check cannot be printed with magnetic ink.

2.5.11.Debit Card

The debit card is a plastic card used at ATMs (Automated Teller Machines) or POS (Point of Sales) for making payments or for obtaining cash. The term 'debit' is generally used to refer to the deposit account-personal accounts. A debit card allows transferring money fairly quickly from customers' bank account to the store's account. After use of the debit card the transaction details will appear on the cardholder's account statement. Most of the Debit cards issued by the banks were also ATM cards. Hence they were also called as ATM – cum-Debit Cards. There are two major issuers of debit cards – VISA and Master Card. These cards were accepted at almost all the locations.

2.5.12.Credit Cards

Credit card allows the consumer to spend money on credit to the issuing bank. It is a step in the direction of an electronic fund transfer system. It is a plastic card with the right to its holder to use it from making the payment against purchases. The Central Bank of India was the first bank in India to introduce the credit card known as 'Central Card' in the middle of 1981. Credit card gained popularity among customers in India during 1990s. Credit Card is in effect a tool used to borrow funds for making payments to a specified ceiling of amount on the principle of 'Use First and Pay Later'.

2.5.13.Automated Teller Machines (ATMs)

ATMs are techniques through which banking services were made available 24 hours a day and 365 days a year. With ATM, customers need not visit banks for many transactions. ATM is operated by plastic card with some features. The Hong Kong and Shanghai Banking Corporation (HSBC) was the first bank to introduce ATM in India in the year 1987. Presently all the commercial bank operating in India provides ATM facilities to its customers. ATM can be used for a number of banking functions like fast cash withdrawal, balance enquiry, mini statement of account, and transfer transactions.

2.5.14. Cheque Truncation System

Cheque Truncation System is a system by which the physical cheque is scanned at the bank of first deposit, and thereafter the electronic image of the cheque, rather than the paper cheque itself, is sent to the Clearing House for sorting and then routing onwards to the Paying Bank. This will replace the physical cheques with the electronic images throughout the clearing process. Customers will be the biggest beneficiaries of this since it helps for fast clearances.

2.5.15. Electronic Fund Transfer at Point of Sale (POS)

Electronic Funds Transfer at POS is an Australian and New Zealand electronic fund transferring system for credit cards, and debit cards. European banks and card companies also sometimes refer this system as those used for processing card transactions through terminals on points of sale.

2.6. Conclusion

Technological innovation has brought in tremendous changes in the world and was considered as one of the most important factors for the development of mankind. The advent of Information and communication technology is a major breakthrough in the field of technology which is used for access, process, storage and dissemination of information electronically. Banking industry is a major beneficiary of ICT innovations and it is making use of a vast range of ICT techniques like ATMs, Internet banking, Tele-banking, Mobile banking, and plastic cards to mention a few. The growth of banking sector has been strongly supported by the development in the field of technology. Thus, the technological advancement has been instrumental in the transfiguration of the banking sector the world over with changing lifestyle of customers.

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CHAPTER 3

CHAPTER III

STATUS OF ICT DIFFUSION IN INDIAN BANKING

3.1. Introduction

Information and communication technology had significantly contributed to the development of financial institutions worldwide. Technology was now considered as the key to move towards providing integrated banking services to customers. Indian banks shy away from adopting information and communication technology (ICT) during the early phase of its implementation by banks all over the world. But with the global adoption of technology, Indian banks were compelled to make it an integral part of banking system.

It will be interesting to know the current status of ICT diffusion in Indian banking. Hence, this study developed and used a composite and original index, namely, ICT Diffusion Index which is a combination of transaction done through different ICT devices like NEFT, RTGS, ECS, Mobile, Credit Card (ATM and POS), and Debit Card (ATM and POS). First, average of transactions through these ICT devices was calculated and then the following formula was used for calculating the index:

$$ICT\ DIFFUSION\ INDEX = \frac{Current\ period\ average\ value}{Base\ period\ average\ value}\ x\ 100$$

This index was calculated for all the scheduled commercial banks operating in India taken together. It was also calculated separately for State Bank of India

(SBI), Punjab National Bank (PNB), Federal Bank and HDFC Bank, each representing SBI and its associates, nationalized banks, old private sector banks, and new private sector banks respectively.

3.2. ICT Diffusion in Indian Banking – The Case of All SCBs

This section deals with the status of ICT diffusion for all scheduled commercial banks taken together. This was done by constructing a composite index based on transactions through different technology oriented means like NEFT, RTGS, ECS, Mobile, Credit Cards (ATM and POS) and Debit Cards (ATM and POS). The variables considered for constructing the ICT Diffusion Index for all scheduled commercial banks taken together were given in Table 3.1, Table 3.2 and Table 3.3.

Table 3.1: Transactions through NEFT & RTGS – All SCBs

Year	Half Yearly	NEFT		RTGS	
		Outward	Inward	Inward	Outward
2009	I	3855284	3855252	1823663	1823663
	II	5537046	5537046	2707154	2707154
2010	I	7414965	7414965	3746043	3746043
	II	10988900	10988900	4179508	4179508
2011	I	14888443	37187185	4042741	4042741
	II	18362829	17912600	4475656	4475656
2012	I	24593037	24593042	5391868	5391868
	II	32009345	32009345	5519164	5519164
2013	I	42108762	42108763	6450117	6450117
	II	53200483	53200489	6564788	6564788
2014	I	70079387	70079387	7491203	7491203
	II	76207535	76207535	7588205	7588205
2015	I	101453660	101453660	8287049	8287049

Source: RBI Database

Note: Due to space limit half yearly averages were presented here. Monthly data for the same were given in Appendix II.

Table 3.1 presents the number of transactions done through National Electronic Fund Transfer (NEFT) and Real Time Gross Settlement (RTGS) for the period from January 2009 to April 2015.

Table 3.2: Transaction through ECS & Mobile – All SCBs

Year	Half Yearly	ECS		Mobile
		CREDIT	DEBIT	
2009	I	5098405	12875652	51159
	II	10284772	12327839	108094
2010	I	7461785	12734886	279366
	II	11662095	13035938	560021
2011	I	8129536	13436352	1041232
	II	11909836	11929743	2169398
2012	I	8109910	14380345	3121637
	II	11922464	14751591	4325102
2013	I	9877224	15238447	6203786
	II	14681322	16138236	7629155
2014	I	10849283	17303058	10151826
	II	9297351	18728979	13837351
2015	I	7834797	19426687	18878569

Source: Ibid

Note: Due to space limit half yearly averages were presented here. Monthly data for the same were given in Appendix II.

Table 3.2 gives a picture of number of transactions through ECS and Mobile for the period January 2009 to April 2015.

Table 3.3: Transactions through Credit & Debit Cards – All SCBs

Year	Half Yearly	Credit Card		Debit Card	
		ATM	POS	ATM	POS
2009	I	129874	15222597	362746166	15001727
	II	139174	17078139	373954464	16073623
2010	I	149225	19224707	385522911	17974554
	II	160027	21662301	397451509	20704520
2011	I	171264	23961582	402437556	23425065
	II	179632	26725728	424971029	27896315
2012	I	195441	29047754	447887079	30935771
	II	215818	33668214	433397327	40215313
2013	I	218187	36727984	463422152	44965643
	II	243371	43626704	509531165	53157588
2014	I	288948	45719881	548230601	55793858
	II	360969	51760242	586770603	69074174
2015	I	411473	54982797	603174310	74649305

Source: Ibid

Note: Due to space limit half yearly averages were presented here. Monthly data for the same were given in Appendix II.

Number of transactions using credit cards and debit cards through Automated Teller Machines (ATMs) and Point of Sale (POS) was presented in Table 3.3.

Based on the number of transactions through technology oriented means presented in Table 3.1, Table 3.2 and Table 3.3 a composite index, namely, ICT Diffusion Index was constructed for the purpose of evaluating the status of ICT diffusion in scheduled commercial banks.

Diffusion of technology had three different stages: invention, innovation and diffusion. Invention is a process arising from a cumulative synthesis of what has preceded. It is an early part of the process to innovation. Innovation is a process through which an invention is incorporated in the production process. It covers all activities between invention and diffusion. Diffusion is a stage succeeding invention and innovation. It is the rate at which innovations spread amongst firms. It is a process by which the use of an innovation spreads and grows. Economic impact of an invention begins to be felt during this stage.

From the point of view of stages of diffusion, it can be observed that many of the early works were done concentrating on technology innovation (second stage) in Indian banking. The present study is an attempt to analyze technology in banking from the third stage of diffusion.

In Indian banking, different technologies had begun its spread at different periods. Also different banks had adopted these technologies at various periods. Therefore to ensure uniformity January 2009 was taken as the base period for the construction of ICT Diffusion Index. The index constructed for all scheduled commercial banks taken together for the period January 2009 to April 2015 was presented in Table 3.4.

Table 3.4: ICT Diffusion Index – All SCBs

Year	Month	ICT Diffusion Index
2009	January	100.00
2009	February	100.95
2009	March	101.49
2009	April	101.40
2009	May	102.03
2009	June	103.65
2009	July	105.84
2009	August	106.35
2009	September	106.71
2009	October	108.87
2009	November	107.93
2009	December	108.39
2010	January	109.11
2010	February	110.00
2010	March	112.66
2010	April	112.40
2010	May	112.97
2010	June	114.67
2010	July	116.74
2010	August	117.83
2010	September	117.88
2010	October	121.34
2010	November	119.95
2010	December	121.21
2011	January	121.41
2011	February	123.22
2011	March	125.26
2011	April	121.13
2011	May	123.82
2011	June	121.58
2011	July	128.54
2011	August	128.37
2011	September	128.24
2011	October	141.90
2011	November	129.70
2011	December	138.82
2012	January	136.88
2012	February	136.42
2012	March	150.09
2012	April	143.29
2012	May	147.20
2012	June	142.57
2012	July	145.50
2012	August	143.43
2012	September	141.75
2012	October	153.04
2012	November	147.97
2012	December	153.46
2013	January	156.06
2013	February	148.83
2013	March	169.50
2013	April	164.18
2013	May	168.53
2013	June	164.94
2013	July	176.89
2013	August	178.95
2013	September	178.58
2013	October	194.32
2013	November	182.22
2013	December	192.01
2014	January	197.44
2014	February	185.05
2014	March	215.66
2014	April	204.76
2014	May	208.94
2014	June	205.01
2014	July	215.28
2014	August	216.91
2014	September	226.44
2014	October	224.81
2014	November	211.48
2014	December	228.61
2015	January	230.12
2015	February	219.11
2015	March	249.49
2015	April	261.95

Source: Calculated by the researcher

It was clear from the table that ICT diffusion has more than doubled during this period. Starting from 100 in January 2009 it had increased to

261.95 in April 2015. Moreover it has shown a continuously increasing trend during this period. This implies that banking transactions are more or less moving towards a technology oriented mode. In the coming years it is expected to increase further and ultimately reach a stage where banking activities are done without going to banks.

3.3. ICT Diffusion in Indian Banking – The Case of SBI

This section deals with the status of ICT diffusion for State Bank of India representing State Bank Group. This was done by constructing a composite index based on transactions through different technology oriented means like NEFT, RTGS, Mobile, Credit Cards (ATM and POS) and Debit Cards (ATM and POS). The variables considered for constructing the ICT Diffusion Index for all scheduled commercial banks taken together were given in Table 3.5, and Table 3.6.

Table 3.5: Transactions through NEFT, RTGS & Mobile – SBI

Year	Half Yearly	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	I	256377	644587	311888	276654	722498
	II	394872	882655	442511	394217	231818
2010	I	646829	1222703	598033	544754	112529
	II	1379287	1810069	666222	590046	364629
2011	I	1856218	2588494	667206	567897	894084
	II	2487493	3207891	730338	620035	1727169
2012	I	3420602	4446218	873140	744650	2502447
	II	4152349	6017838	877563	711356	2962639
2013	I	6714415	7732523	1016692	826759	3882007
	II	9773645	9717157	1031655	814473	4307994
2014	I	14417679	13066302	1151735	900952	5083643
	II	13990779	14136661	1120151	867922	6380143
2015	I	23015187	15903496	1214721	930637	7820900

Source: RBI Database

Table 3.5 presents the number of transactions done through National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS) and Mobile for the period from January 2009 to April 2015.

Table 3.6: Transactions through Credit & Debit Cards – SBI

Year	Half Yearly	Credit Card		Debit Card	
		ATM	POS	ATM	POS
2009	I	3090	1371726	113993549	1505993
	II	7207	1621915	121326745	1894058
2010	I	11343	1942663	129197436	2499546
	II	15499	2333967	137605621	3322456
2011	I	19812	2756329	143963680	4301931
	II	22161	3172503	155099500	5223333
2012	I	30094	3559367	166604000	6071667
	II	30157	4412162	171764500	8073000
2013	I	32734	4856780	184106833	9713333
	II	40981	5548685	202447000	12033333
2014	I	48531	5768912	225911542	12431208
	II	72239	6269187	243511040	15369421
2015	I	67756	7375185	252054084	16576109

Source: Ibid

Number of transactions using credit cards and debit cards through Automated Teller Machines (ATMs) and Point of Sale (POS) was presented in Table 3.6.

Based on the number of transactions through technology oriented means presented in Table 3.5, and Table 3.6 a composite index, namely, ICT Diffusion Index was constructed for the purpose of evaluating the status of ICT diffusion in State Bank of India which is taken as a representative of State Bank of India and its Associates Group.

The index constructed for State Bank of India for the period January 2009 to April 2015 was presented in Table 3.7. To ensure uniformity January

2009 was taken as the base period for the construction of ICT Diffusion Index.

Table 3.7: ICT Diffusion Index – SBI

Year	Month	ICT Diffusion Index	Year	Month	ICT Diffusion Index
2009	January	100.00	2012	March	169.16
2009	February	100.97	2012	April	164.00
2009	March	102.19	2012	May	166.52
2009	April	103.16	2012	June	163.47
2009	May	104.27	2012	July	171.15
2009	June	105.40	2012	August	166.65
2009	July	106.60	2012	September	164.49
2009	August	107.65	2012	October	178.32
2009	September	108.87	2012	November	171.72
2009	October	110.35	2012	December	177.01
2009	November	111.57	2013	January	180.14
2009	December	112.89	2013	February	171.42
2010	January	114.16	2013	March	196.74
2010	February	115.57	2013	April	196.04
2010	March	117.43	2013	May	198.44
2010	April	118.60	2013	June	189.41
2010	May	120.06	2013	July	202.91
2010	June	121.68	2013	August	202.74
2010	July	123.43	2013	September	203.46
2010	August	125.05	2013	October	222.27
2010	September	126.50	2013	November	211.88
2010	October	128.66	2013	December	227.73
2010	November	130.14	2014	January	236.48
2010	December	132.22	2014	February	220.50
2011	January	133.47	2014	March	252.87
2011	February	135.32	2014	April	245.10
2011	March	137.91	2014	May	246.25
2011	April	136.33	2014	June	240.82
2011	May	137.39	2014	July	255.96
2011	June	134.86	2014	August	252.92
2011	July	144.35	2014	September	266.49
2011	August	144.55	2014	October	265.87
2011	September	141.42	2014	November	249.39
2011	October	158.80	2014	December	270.03
2011	November	145.05	2015	January	273.60
2011	December	157.02	2015	February	261.64
2012	January	157.16	2015	March	291.08
2012	February	153.45	2015	April	294.25

Source: Calculated by the researcher

It was clear from the table that ICT diffusion has almost trebled during this period. Starting from 100 in January 2009 it had increased to 294.25 in April 2015. Moreover it has shown a continuously increasing trend during this period. This implies that banking transactions are more or less moving towards a technology oriented mode.

3.4. ICT Diffusion in Indian Banking – The Case of PNB

This section deals with the status of ICT diffusion for Punjab National Bank representing Nationalized Bank Group. This was done by constructing a composite index based on transactions through different technology oriented means like NEFT, RTGS, Mobile, Credit Cards (ATM & POS) and Debit Cards (ATM & POS). The variables considered for constructing the ICT Diffusion Index for Punjab National Bank were given in Table 3.8, and Table 3.9.

Table 3.8 presents the number of transactions done through National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS) and Mobile for the period from January 2009 to April 2015.

Table 3.8: Transactions through NEFT, RTGS & Mobile – PNB

Year	Half Yearly	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	I	25153	713	72396	108904	0
	II	46401	1292	103561	159830	0
2010	I	77128	1798	142148	215194	0
	II	135809	2235	154858	225812	3
2011	I	231073	3200	157573	212697	52
	II	308587	3866	173846	228516	192
2012	I	420975	50016	218970	269368	458
	II	579990	35123	219576	270320	1025
2013	I	863169	120902	255736	316611	2605
	II	1191436	132223	255753	322634	15020
2014	I	1583318	171617	286720	353467	20196
	II	2108370	186434	283142	339902	38123
2015	I	3035883	252646	316638	382089	32028

Source: RBI Database

Table 3.9: Transactions through Credit & Debit Cards – PNB

Year	Half Yearly	Credit Card		Debit Card	
		ATM	POS	ATM	POS
2009	I	2003	68910	37629229	287063
	II	2069	74974	38289896	353416
2010	I	2138	81826	38493940	460162
	II	2208	89465	38241361	607302
2011	I	2261	93119	36834929	715173
	II	2345	108469	37472210	1019477
2012	I	2189	101019	38657159	1215874
	II	2156	137680	16404529	1351859
2013	I	2157	150162	17592679	1590013
	II	2231	169549	19265548	1721836
2014	I	2271	164482	19634190	1891863
	II	2663	174663	20194424	2447328
2015	I	2968	168893	20225856	2480956

Source: Ibid

Number of transactions using credit cards and debit cards through Automated Teller Machines (ATMs) and Point of Sale (POS) was presented in Table 3.9.

Table 3.10: ICT Diffusion Index – PNB

Year	Month	ICT Diffusion Index	Year	Month	ICT Diffusion Index
2009	January	100.00	2012	March	114.64
2009	February	100.51	2012	April	109.78
2009	March	101.09	2012	May	109.69
2009	April	101.48	2012	June	106.65
2009	May	101.92	2012	July	47.80
2009	June	102.33	2012	August	47.60
2009	July	102.68	2012	September	49.80
2009	August	102.97	2012	October	53.03
2009	September	103.27	2012	November	51.28
2009	October	103.67	2012	December	52.63
2009	November	103.88	2013	January	52.77
2009	December	104.15	2013	February	49.67
2010	January	104.26	2013	March	58.24
2010	February	104.43	2013	April	57.69
2010	March	104.78	2013	May	58.82
2010	April	104.66	2013	June	55.04
2010	May	104.77	2013	July	58.23
2010	June	104.77	2013	August	58.88
2010	July	104.77	2013	September	61.00
2010	August	104.72	2013	October	65.39
2010	September	104.58	2013	November	60.35
2010	October	104.64	2013	December	63.09
2010	November	104.43	2014	January	64.20
2010	December	104.29	2014	February	57.19
2011	January	104.06	2014	March	66.09
2011	February	103.78	2014	April	65.60
2011	March	103.86	2014	May	66.01
2011	April	99.28	2014	June	64.25
2011	May	100.06	2014	July	60.32
2011	June	97.19	2014	August	66.89
2011	July	101.82	2014	September	71.07
2011	August	101.42	2014	October	72.42
2011	September	103.54	2014	November	67.95
2011	October	108.77	2014	December	71.19
2011	November	101.74	2015	January	68.70
2011	December	107.89	2015	February	65.44
2012	January	105.70	2015	March	76.14
2012	February	104.45	2015	April	74.85

Source: Calculated by the researcher

Based on the number of transactions through technology oriented means presented in Table 3.8, and Table 3.9 a composite index, namely, ICT Diffusion Index was constructed for the purpose of evaluating the status of ICT diffusion in Punjab National Bank which is taken as a representative of Nationalized Bank Group.

The index constructed for Punjab National Bank for the period January 2009 to April 2015 was presented in Table 3.10. To ensure uniformity January 2009 was taken as the base period for the construction of ICT Diffusion Index.

Contrary to the results obtained for all scheduled banks taken together and State Bank of India, ICT diffusion has declined for Punjab National Bank during this period. Starting from 100 in January 2009 it had declined to 74.85 in April 2015. More than technology, this may probably be an aftermath of a general decline in banking transactions.

3.5. ICT Diffusion in Indian Banking – The Case of HDFC Bank

This section deals with the status of ICT diffusion for HDFC Bank representing New Private Sector Bank Group. This was done by constructing a composite index based on transactions through different technology oriented means like NEFT, RTGS, Mobile, Credit Cards (ATM & POS) and Debit Cards (ATM & POS). The variables considered for constructing the ICT Diffusion Index for HDFC Bank were given in Table 3.11, and Table 3.12.

Table 3.11 presents the number of transactions done through National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS) and Mobile for the period from January 2009 to April 2015.

Table 3.11: Transactions through NEFT, RTGS & Mobile – HDFC Bank

Year	Half Yearly	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	I	639838	522272	248903	194243	9376
	II	968029	738672	412248	291322	9852
2010	I	1212041	962795	599909	394105	11130
	II	1711136	1360526	668244	459440	13210
2011	I	2197286	1801620	609824	457690	15158
	II	2604558	2205424	690388	529735	19376
2012	I	3528204	2751670	818715	642586	35176
	II	4767534	3328677	854123	707422	56290
2013	I	5888091	4149791	983903	812821	148220
	II	6926651	4878681	1008737	825826	188720
2014	I	8003781	5472131	1138990	944040	314404
	II	9270211	6190546	1171461	990997	887388
2015	I	10678684	7249059	1278415	1096124	1626838

Source: RBI Database

Table 3.12: Transactions through Credit & Debit Cards – HDFC Bank

Year	Half Yearly	Credit Card		Debit Card	
		ATM	POS	ATM	POS
2009	I	30576	2812876	15366887	3430546
	II	34026	3313092	16193841	3780786
2010	I	38851	3969446	17478290	4176530
	II	45050	4781938	19220232	4617778
2011	I	51330	5564330	21156915	4897923
	II	59599	6649540	23371597	5646639
2012	I	68241	7463868	25517850	5705877
	II	76255	9036544	28776160	6982443
2013	I	78037	10711758	30026065	7656001
	II	75889	13728307	30696937	8364705
2014	I	88942	14611154	31430818	8503059
	II	108345	16635647	32514668	10388801
2015	I	126249	17427049	31383475	11266808

Source: Ibid

Number of transactions using credit cards and debit cards through Automated Teller Machines (ATMs) and Point of Sale (POS) was presented in Table 3.12.

Based on the number of transactions through technology oriented means presented in Table 3.11, and Table 3.12 a composite index, namely, ICT Diffusion Index was constructed.

Table 3.13: ICT Diffusion Index – HDFC Bank

Year	Month	ICT Diffusion Index	Year	Month	ICT Diffusion Index
2009	January	100.00	2012	March	214.52
2009	February	100.90	2012	April	206.24
2009	March	103.18	2012	May	217.14
2009	April	103.94	2012	June	218.76
2009	May	105.66	2012	July	231.27
2009	June	107.46	2012	August	232.82
2009	July	109.69	2012	September	231.80
2009	August	111.49	2012	October	251.35
2009	September	112.50	2012	November	249.62
2009	October	116.50	2012	December	261.08
2009	November	117.51	2013	January	256.61
2009	December	119.85	2013	February	241.60
2010	January	121.55	2013	March	283.84
2010	February	123.69	2013	April	268.53
2010	March	128.93	2013	May	286.62
2010	April	129.39	2013	June	277.50
2010	May	131.95	2013	July	289.60
2010	June	134.87	2013	August	293.23
2010	July	138.64	2013	September	286.36
2010	August	140.97	2013	October	313.81
2010	September	143.45	2013	November	291.35
2010	October	149.75	2013	December	307.01
2010	November	150.26	2014	January	306.06
2010	December	155.08	2014	February	284.14
2011	January	157.04	2014	March	331.67
2011	February	160.28	2014	April	309.99
2011	March	167.55	2014	May	329.02
2011	April	160.77	2014	June	322.32
2011	May	169.26	2014	July	338.00
2011	June	166.73	2014	August	342.52

Year	Month	ICT Diffusion Index	Year	Month	ICT Diffusion Index
2011	July	178.03	2014	September	342.68
2011	August	179.90	2014	October	361.17
2011	September	176.97	2014	November	339.72
2011	October	199.55	2014	December	363.46
2011	November	183.74	2015	January	359.68
2011	December	197.64	2015	February	334.64
2012	January	195.94	2015	March	382.42
2012	February	190.25	2015	April	385.73

Source: Calculated by the researcher

The index constructed for HDFC Bank for the period January 2009 to April 2015 was presented in Table 3.13. To ensure uniformity January 2009 was taken as the base period for the construction of ICT Diffusion Index.

It was clear from the table that ICT diffusion has more than trebled during this period. Starting from 100 in January 2009 it had increased to 385.73 in April 2015. Moreover it has shown a continuously increasing trend during this period. This implies that banking transactions are more or less moving towards a technology oriented mode.

3.6. ICT Diffusion in Indian Banking – The Case of Federal Bank

This section deals with the status of ICT diffusion for Federal Bank representing Old Private Sector Bank. This was done by constructing a composite index based on transactions through different technology oriented means like NEFT, RTGS, ECS, Mobile, Credit Cards (ATM & POS) and Debit Cards (ATM & POS). The variables considered for constructing the

ICT Diffusion Index for Federal Bank were given in Table 3.14, and Table 3.15.

Table 3.14 presents the number of transactions done through National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS) and Mobile for the period from January 2009 to April 2015.

Table 3.14: Transactions through NEFT, RTGS & Mobile – Federal Bank

Year	Half Yearly	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	I	7120	37483	11196	16815	20
	II	21112	54300	17418	25198	232
2010	I	50491	70354	26005	37194	179
	II	82099	95387	29446	41822	565
2011	I	129060	120250	29063	40064	1146
	II	178960	148635	32091	45283	2360
2012	I	216675	183430	36600	52174	3974
	II	322378	238904	38351	57976	16270
2013	I	497078	297303	46852	68498	13049
	II	622450	423808	51427	75009	27484
2014	I	730357	513990	60337	82968	41002
	II	791908	547651	62048	85558	56027
2015	I	868771	633532	67322	90287	64784

Source: RBI Database

Table 3.15: Transactions through Credit & Debit Cards – Federal Bank

Year	Half Yearly	Credit Card		Debit Card	
		ATM	POS	ATM	POS
2009	I	0	0	1954773	25076
	II	0	0	2034555	31822
2010	I	0	0	2118928	48929
	II	0	0	2207892	76395
2011	I	0	0	2360865	110175
	II	0	0	2303655	149033
2012	I	0	0	2392059	181803
	II	0	0	2683197	246134
2013	I	0	0	2979466	299386
	II	0	0	3408160	398720
2014	I	0	0	3647042	432471
	II	0	0	3832140	569456
2015	I	0	0	3926883	613600

Source: Ibid

Number of transactions using credit cards and debit cards through Automated Teller Machines (ATMs) and Point of Sale (POS) was presented in Table 3.15.

Table 3.16: ICT Diffusion Index – Federal Bank

Year	Month	ICT Diffusion Index
2009	January	100.00
2009	February	100.79
2009	March	102.35
2009	April	102.66
2009	May	103.76
2009	June	104.89
2009	July	106.07
2009	August	107.29

Year	Month	ICT Diffusion Index
2012	March	160.72
2012	April	149.52
2012	May	160.17
2012	June	159.27
2012	July	168.87
2012	August	176.07
2012	September	168.95
2012	October	184.35

Year	Month	ICT Diffusion Index
2009	September	107.70
2009	October	109.77
2009	November	110.83
2009	December	112.22
2010	January	113.27
2010	February	114.67
2010	March	117.92
2010	April	117.49
2010	May	119.71
2010	June	120.97
2010	July	122.76
2010	August	124.34
2010	September	124.75
2010	October	126.86
2010	November	128.76
2010	December	130.92
2011	January	132.05
2011	February	133.21
2011	March	137.73
2011	April	137.26
2011	May	150.95
2011	June	144.12
2011	July	150.01
2011	August	156.42
2011	September	127.92
2011	October	137.29
2011	November	135.24
2011	December	149.22
2012	January	147.75
2012	February	140.55

Source: Calculated by the researcher

Year	Month	ICT Diffusion Index
2012	November	182.43
2012	December	197.89
2013	January	200.92
2013	February	184.21
2013	March	218.14
2013	April	214.42
2013	May	225.59
2013	June	214.40
2013	July	229.16
2013	August	245.95
2013	September	240.57
2013	October	259.15
2013	November	250.45
2013	December	273.50
2014	January	269.72
2014	February	247.34
2014	March	295.32
2014	April	279.61
2014	May	281.87
2014	June	274.92
2014	July	295.04
2014	August	295.81
2014	September	300.33
2014	October	293.97
2014	November	281.32
2014	December	313.01
2015	January	299.40
2015	February	287.11
2015	March	341.38
2015	April	322.37

Based on the number of transactions through technology oriented means presented in Table 3.14, and Table 3.15 a composite index, namely, ICT Diffusion Index was constructed for the purpose of evaluating the status of ICT diffusion in Federal Bank which is taken as a representative of Old Private Sector Bank Group.

The index constructed for Federal Bank for the period January 2009 to April 2015 was presented in Table 3.16. To ensure uniformity January 2009 was taken as the base period for the construction of ICT Diffusion Index.

It was clear from the table that ICT diffusion has more than trebled during this period. Starting from 100 in January 2009 it had increased to 322.37 in April 2015. Moreover it has shown a continuously increasing trend during this period. This implies that banking transactions are more or less moving towards a technology oriented mode.

3.7. Conclusion

To conclude, the highest trend growth in ICT diffusion is observed in HDFC Bank which is a representative of new private sector bank group followed by Federal bank representing old private sector bank and SBI representing SB group. The case of all scheduled commercial banks taken together also depicts a similar trend of increasing throughout the period. But an exception can be found in case of Punjab National Bank, which was taken as a representative of nationalized bank group. The index for Punjab National

Bank shows that there is a declining trend in transactions using ICT means. Since this is the case of a single bank, it is not correct to generalize it to all nationalized banks. Therefore, a further study is required in this area to trace out the exact reasons for such a phenomenon.

CHAPTER 4

CHAPTER IV

IMPACT OF ICT DIFFUSION ON PRODUCTIVITY AND PROFITABILITY OF BANKS

The present chapter deals with the impact of ICT diffusion on the productivity and profitability of commercial banks. The analysis has been done by taking all scheduled commercial banks (SCBs) as a whole first and then taking the specific cases of State Bank of India, Punjab National Bank, Federal Bank and HDFC Bank, each representing SB Group, Nationalized Bank Group, Old Private Sector Bank Group, and New Private Sector Bank Group respectively. The analysis is carried out in two sections. In the first section, the impact of ICT on productivity and in the second section the impact of ICT on profitability is analyzed.

SECTION I

4.1: Productivity

Productivity in the banking sector is defined as the sum total of deposits, advances and loans. The commercial banks had an important role in the mobilization of deposits and disbursement of credit to various sectors of the economy. The study uses monthly data for the period from January 2009 to April 2015.

4.1.1: Impact of ICT diffusion on Productivity – All SCBs

This section examines the impact of ICT on the productivity of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between productivity and ICT diffusion in banking sector. The productivity of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LProd and Ltech respectively.

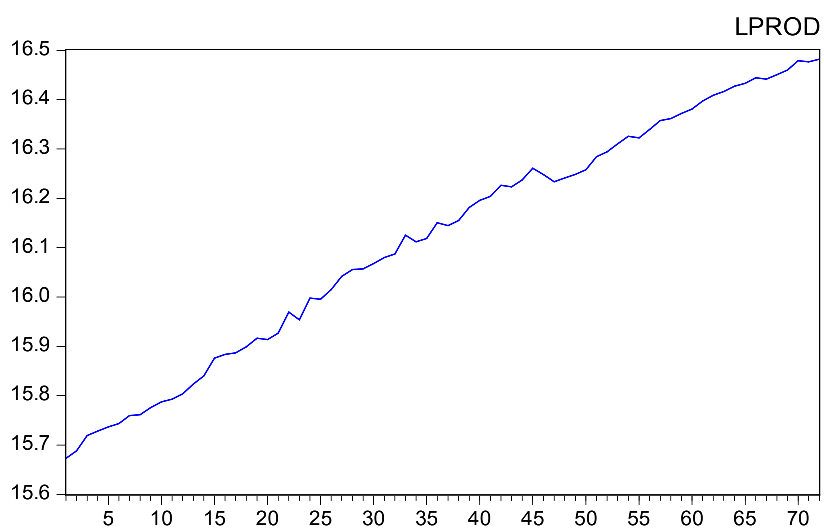

Figure 4.1: Productivity Pattern (in Log) – All SCBs

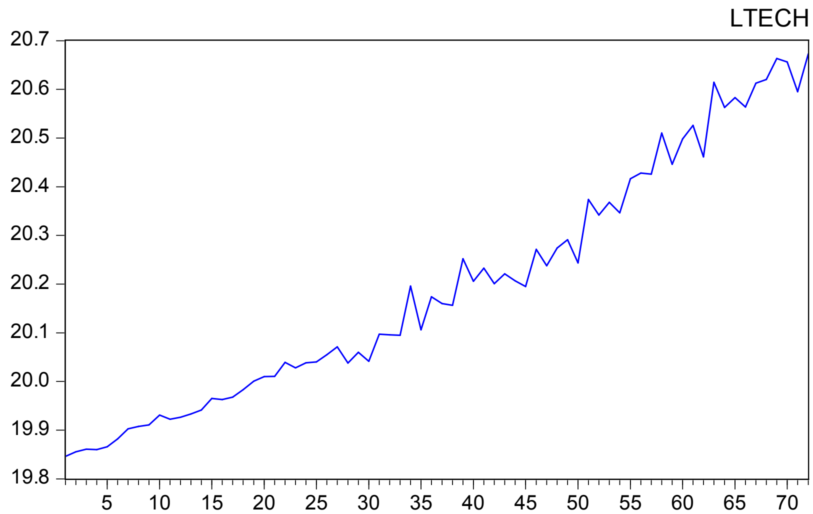

Figure 4.2: Technology Pattern (in Log) – All SCBs

In this regard, the error correction model was estimated as:

$$\begin{aligned}\Delta LProd_t = \; & \beta_{10} + \beta_{11}\Delta LProd_{t-1} + \beta_{12}\Delta LProd_{t-2} + \beta_{13}\Delta LProd_{t-3} \\ & + \beta_{14}\Delta LProd_{t-4} + \beta_{15}\Delta LProd_{t-5} + \beta_{16}\Delta LTech_{t-1} \\ & + \beta_{17}\Delta LTech_{t-2} + \beta_{18}\Delta LTech_{t-3} + \beta_{19}\Delta LTech_{t-4} \\ & + \beta_{110}\Delta LTech_{t-5} + \alpha_{11}(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$\begin{aligned}\Delta LTech_t = \; & \beta_{20} + \beta_{21}\Delta LProd_{t-1} + \beta_{22}\Delta LProd_{t-2} + \beta_{23}\Delta LProd_{t-3} \\ & + \beta_{24}\Delta LProd_{t-4} + \beta_{25}\Delta LProd_{t-5} + \beta_{26}\Delta LTech_{t-1} \\ & + \beta_{27}\Delta LTech_{t-2} + \beta_{28}\Delta LTech_{t-3} + \beta_{29}\Delta LTech_{t-4} \\ & + \beta_{210}\Delta LTech_{t-5} + \alpha_{21}(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}\end{aligned}$$

The equation with $\alpha_{21} = 0$ implies that Lprod adjusts to long run equilibrium whereas Ltech does not. In other words, there is only one way causality from Ltech to Lprod at zero frequency. That is, shocks in technology can influence the long run forecast of productivity and not vice versa. If so,

$$\lim_{h\to\infty} \frac{\partial E(LProd_{t+h})}{\partial E(LTech_t)} \neq 0$$

$$\lim_{h\to\infty} \frac{\partial E(LTech_{t+h})}{\partial E(LProd_t)} = 0$$

This implies that the conditional forecast of productivity h period ahead depends only on technology.

There are five steps involved in testing the long run association between productivity and technology:

(i) Examining time series properties of productivity and ICT diffusion. That is, both productivity and ICT are tested for stationarity. The Augmented Dickey-Fuller (ADF) unit root test was used for this purpose.

(ii) Test whether there is any cointegration between productivity and ICT diffusion. Johansen system cointegration test was applied here.

(iii) Test to know whether the restriction imposed on the error correction mechanism is valid or not.

(iv) Examining the dynamic behavior of one variable after a standard deviation shock in other variable by using the impulse response function.

(v) Evaluating the proportion of forecast error variance of productivity and ICT diffusion to know whether the forecast error variance of productivity is increasingly explained by shocks in ICT diffusion as the forecast horizon increases.

The result of the analysis made on procedure (i) was given in Table 4.1. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.1: Test Result of Unit Root Test for All SCBs

Variable	Test Statistic	p value
Lprod	-1.2945	0.8812
Ltech	-0.4915	0.9814
Δ Lprod	-11.67886**	0.0000
Δ Ltech	-4.241190**	0.0071

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of the analysis made on procedure (ii) was given in Table 4.2. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.2: Unrestricted Cointegration Rank Test (Trace) – All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.287283	28.47479	0.0029
At most 1	0.088592	6.122477	0.1815

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.3: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.287283	22.35231	0.0042
At most 1	0.088592	6.122477	0.1815

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LProd_t = {} & 0.366678\ \Delta LProd_{t-1} + 0.064728\ \Delta LProd_{t-2} \\ & + 0.132861\ \Delta LProd_{t-3} + 0.110352\ \Delta LProd_{t-4} \\ & + 0.174051\ \Delta LProd_{t-5} + 0.002896\ \Delta LTech_{t-1} \\ & + 0.026053\ \Delta LTech_{t-2} + 0.027796\ \Delta LTech_{t-3} \\ & + 0.094347\ \Delta LTech_{t-4} + 0.051036\ \Delta LTech_{t-5} \\ & + 0.002089\ (LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$\Delta LTech_t = 0.366678\ \Delta LProd_{t-1} + 0.064728\ \Delta LProd_{t-2}$$
$$+ 0.064728\ \Delta LProd_{t-3} + 0.064728\ \Delta LProd_{t-4}$$
$$+ 0.064728\ \Delta LProd_{t-5} + 0.006478\ \Delta LTech_{t-1}$$
$$+ 0.017687\ \Delta LTech_{t-2} + 0.017687\ \Delta LTech_{t-3}$$
$$+ 0.017687\ \Delta LTech_{t-4} + 0.017687\ \Delta LTech_{t-5}$$
$$+ 0.004267\ (LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that Lprod adjusts to long run equilibrium whereas Ltech does not.

Table 4.4:LR test for binding restrictions α_{21}= 0 (rank = 1) – All SCBs

Chi-square(1)	6.335295
Probability	0.011836

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between productivity and technology. Therefore only the first equation where productivity is taken as the dependent variable is relevant here, that is, it is true that productivity depends on technology, but on the basis of data collected the opposite is not true.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We

estimate these quantities from the VAR model in Lprod and Ltech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

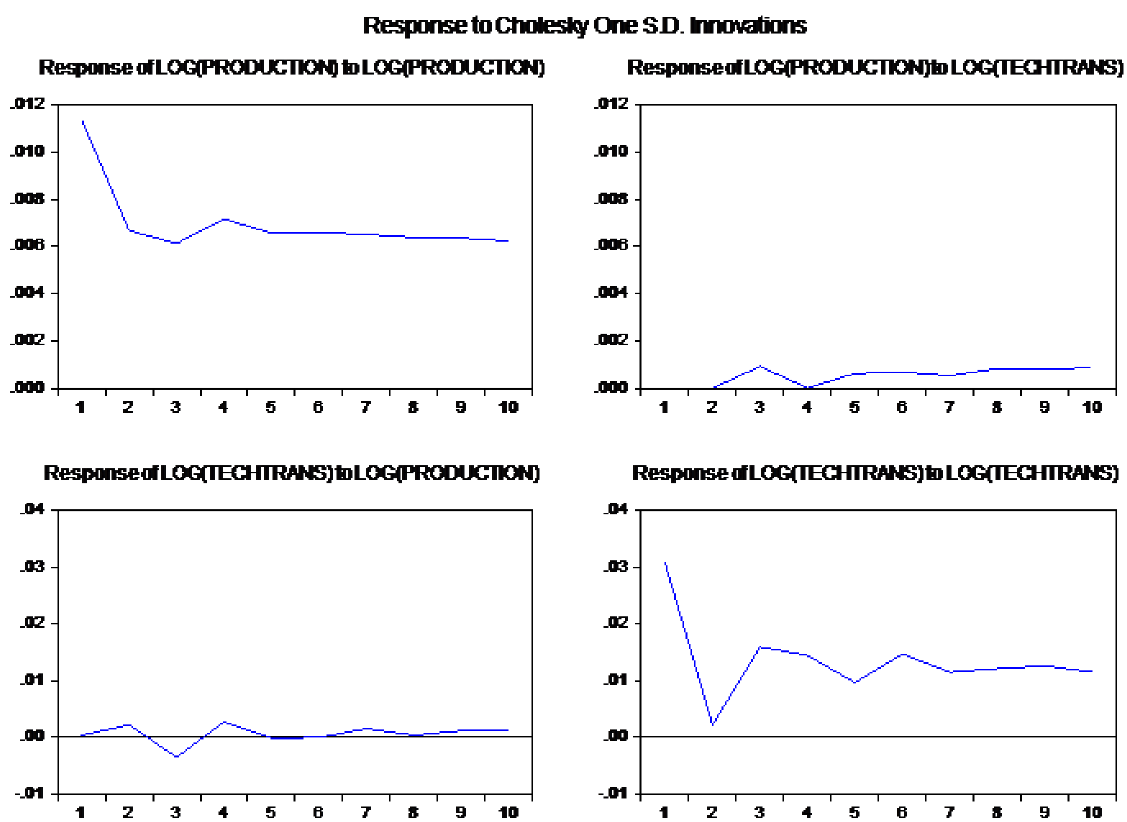

Figure 4.3: Impulse Response (Cholesky dof adjusted) – All SCBs

Figure 4.3 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that productivity has little impact on technology whereas technology has considerable impact on productivity.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.4.

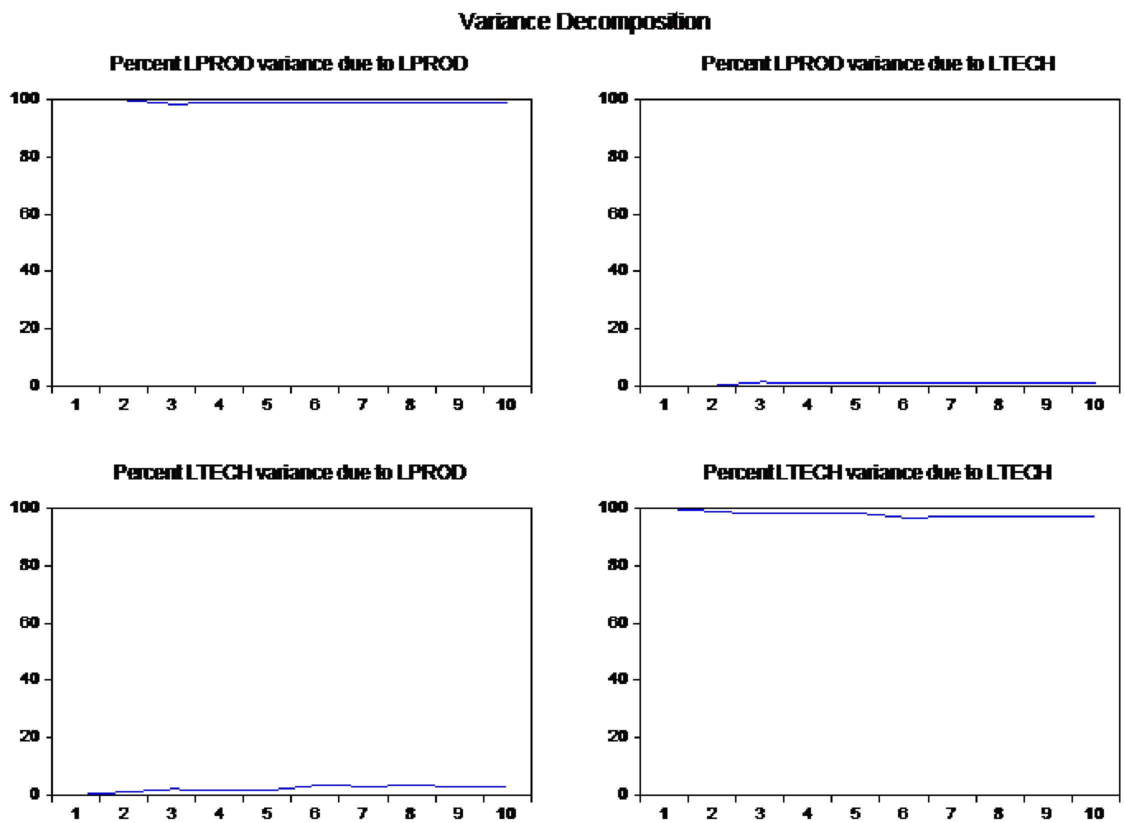

Figure 4.4: Variance Decomposition (Cholesky) – All SCBs

It is clear from figure 4.4 that the impact is minimal on both productivity and technology.

4.1.2: Impact of ICT diffusion on Productivity – SBI

This section examines the impact of ICT on the productivity of State Bank of India, which was taken as a representative of SB Group. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between productivity and ICT diffusion in SBI. The productivity of SBI and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as Lprod and Ltech respectively.

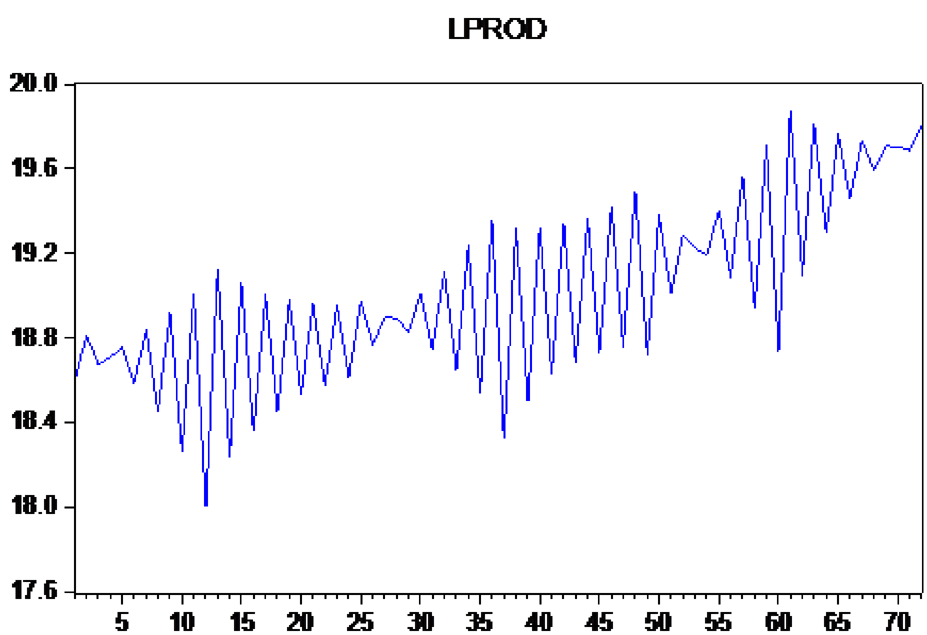

Figure 4.5: Productivity Pattern (in Log) – SBI

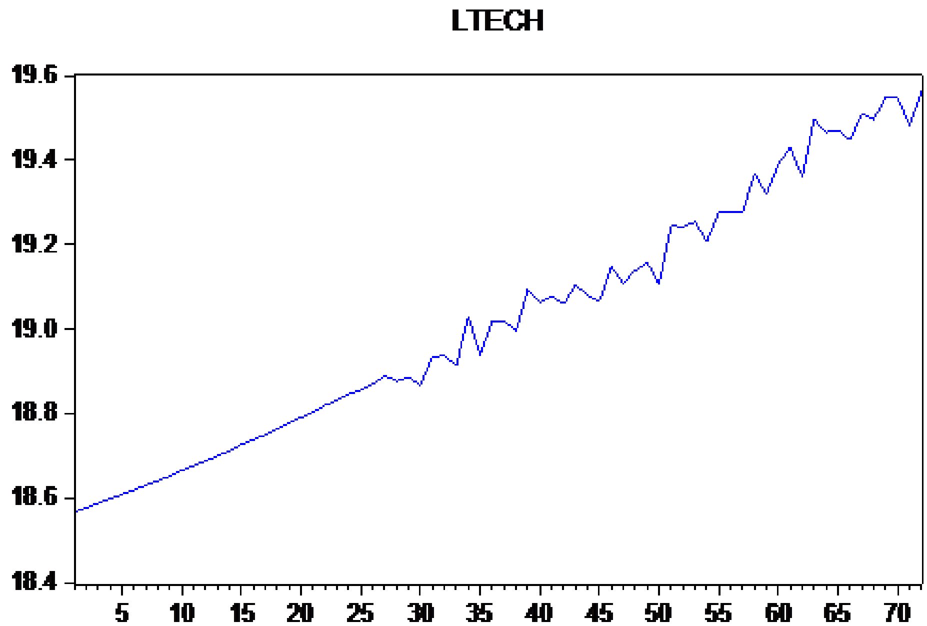

Figure 4.6: Technology Pattern (in Log) – SBI

The result of the unit root analysis made was given in Table 4.5. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.5: Test Result of Unit Root Test for SBI

Variable	Test Statistic	p value
Lprod	-1.614714	0.7771
Ltech	-2.001279	0.5902
Δ Lprod	-16.92192**	0.0001
Δ Ltech	-4.016182*	0.0132

** indicates significant at 1% level
* indicates significant at 5% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.6 and Table 4.7. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.6: Unrestricted Cointegration Rank Test (Trace) – SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.323188	34.40547	0.0003
At most 1	0.122723	8.641557	0.0628

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.7: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.323188	25.76391	0.0010
At most 1	0.122723	8.641557	0.0628

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LProd_t = 1.3258\,\Delta LProd_{t-1} + 0.2542\,\Delta LProd_{t-2} + 0.02986\Delta LProd_{t-3} + 0.1325\Delta LProd_{t-4} + 0.0056\Delta LProd_{t-5} + 0.2649\Delta LTech_{t-1} + 0.1743\,\Delta LTech_{t-2} + 0.3645\Delta LTech_{t-3} + 0.2487\Delta LTech_{t-4} + 0.058\Delta LTech_{t-5} + 0.0955(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.06496\,\Delta LProd_{t-1} + 0.01263\Delta LProd_{t-2} + 0.1112\Delta LProd_{t-3} + 0.1701\Delta LProd_{t-4} + 0.0724\Delta LProd_{t-5} + 1.1446\Delta LTech_{t-1} + 0.801\Delta LTech_{t-2} + 0.3727\Delta LTech_{t-3} + 0.3242\Delta LTech_{t-4} + 0.0354\,\Delta LTech_{t-5} + 0.084(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that Lprod adjusts to long run equilibrium whereas Ltech does not.

Table 4.8:LR test for binding restrictions α_{21}= 0 (rank = 1) – SBI

Chi-square(1)	15.44779
Probability	0.000085

Since the null hypothesis that α_{21}= 0 was rejected, it can be stated that there is a two way causational relation between productivity and technology, that is, technology and productivity are interdependent on each other.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We

estimate these quantities from the VAR model in Lprod and Ltech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

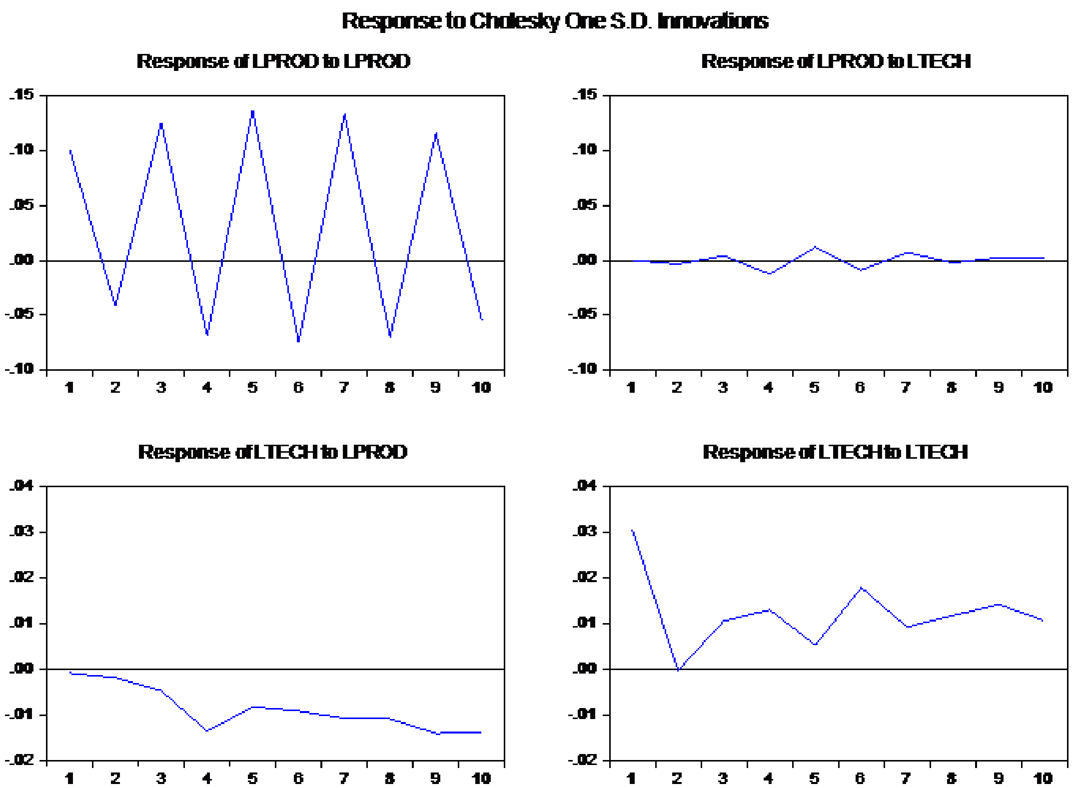

Figure 4.7: Impulse Response (Cholesky dof adjusted) – SBI

Figure 4.7 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that productivity has little impact on technology whereas technology has considerable impact on productivity.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.8.

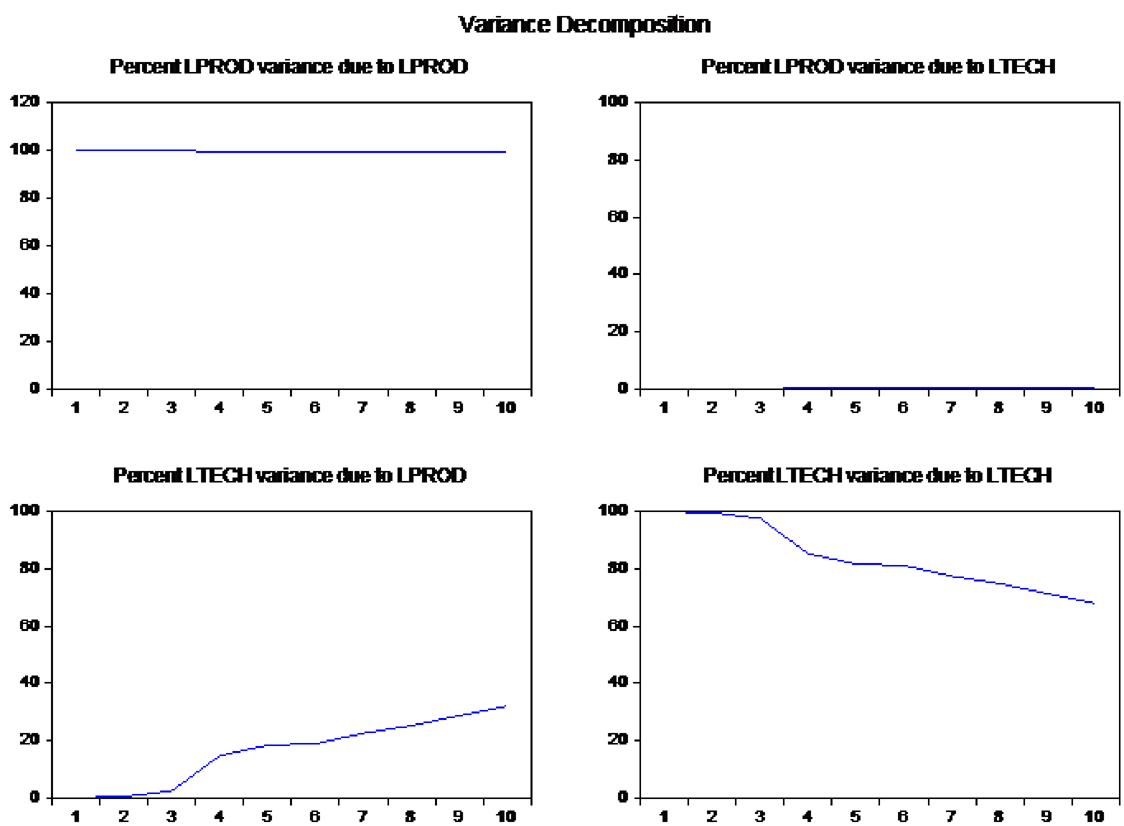

Figure 4.8: Variance Decomposition (Cholesky) – SBI

It is clear from figure 4.8 that there is some impact on both productivity and technology.

4.1.3: Impact of ICT diffusion on Productivity – PNB

This section examines the impact of ICT on the productivity of Punjab National Bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between productivity and ICT diffusion in banking sector. The productivity of Punjab National Bank and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as Lprod and Ltech respectively.

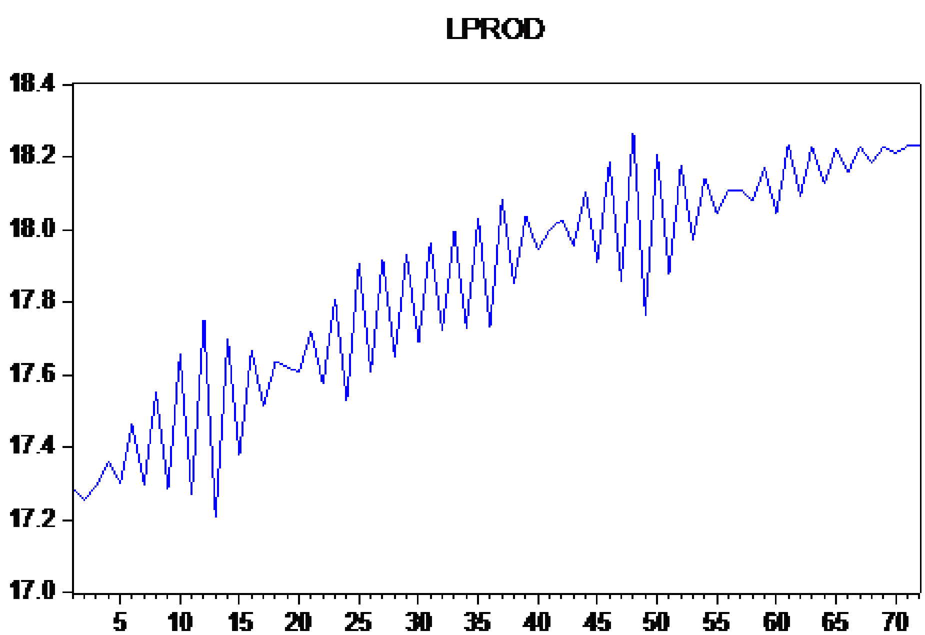

Figure 4.9: Productivity Pattern (in Log) – PNB

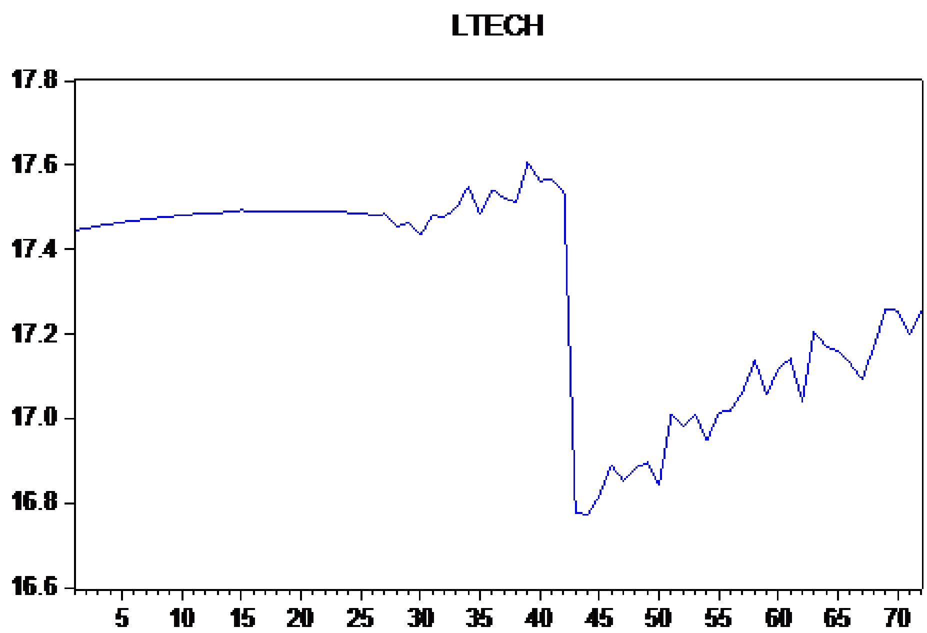

Figure 4.10: Technology Pattern (in Log) – PNB

The result of the unit root analysis made was given in Table 4.9. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.9: Test Result of Unit Root Test for PNB

Variable	Test Statistic	p value
Lprod	-1.441353	0.8398
Ltech	-2.265420	0.4467
Δ Lprod	-20.40064**	0.0001
Δ Ltech	-8.634422**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.10 and Table 4.11. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.10: Unrestricted Cointegration Rank Test (Trace) – PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.336908	32.08912	0.0007
At most 1	0.072588	4.973604	0.2863

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.11: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.336908	27.11552	0.0006
At most 1	0.072588	4.973604	0.2863

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LProd_t = {} & 1.55905\,\Delta LProd_{t-1} + 0.7209\Delta LProd_{t-2} + 0.40849\Delta LProd_{t-3} \\ & + 0.4079\Delta LProd_{t-4} + 0.08958\Delta LProd_{t-5} + 0.06948\Delta LTech_{t-1} \\ & + 0.00605\,\Delta LTech_{t-2} + 0.0775\Delta LTech_{t-3} + 0.002565\Delta LTech_{t-4} \\ & + 0.0645\Delta LTech_{t-5} + 0.01339(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$\begin{aligned}\Delta LTech_t = {} & 0.195777\,\Delta LProd_{t-1} + 0.485642\Delta LProd_{t-2} + 0.490385\Delta LProd_{t-3} \\ & + 0.608122\Delta LProd_{t-4} + 0.468685\Delta LProd_{t-5} \\ & + 0.025719\Delta LTech_{t-1} + 0.04654\Delta LTech_{t-2} + 0.037871\Delta LTech_{t-3} \\ & + 0.12095\Delta LTech_{t-4} + 0.074613\Delta LTech_{t-5} \\ & + 0.009921(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}\end{aligned}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that Lprod adjusts to long run equilibrium whereas Ltech does not.

Table 4.12:LR test for binding restrictions (rank = 1) – PNB

Chi-square(1)	1.586479
Probability	0.207830

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between productivity and technology. Therefore only the first equation where productivity is taken as the dependent variable is relevant here, that is, it is true that productivity depends on technology, but on the basis of data collected the opposite is not true.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We estimate these quantities from the VAR model in Lprod and Ltech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

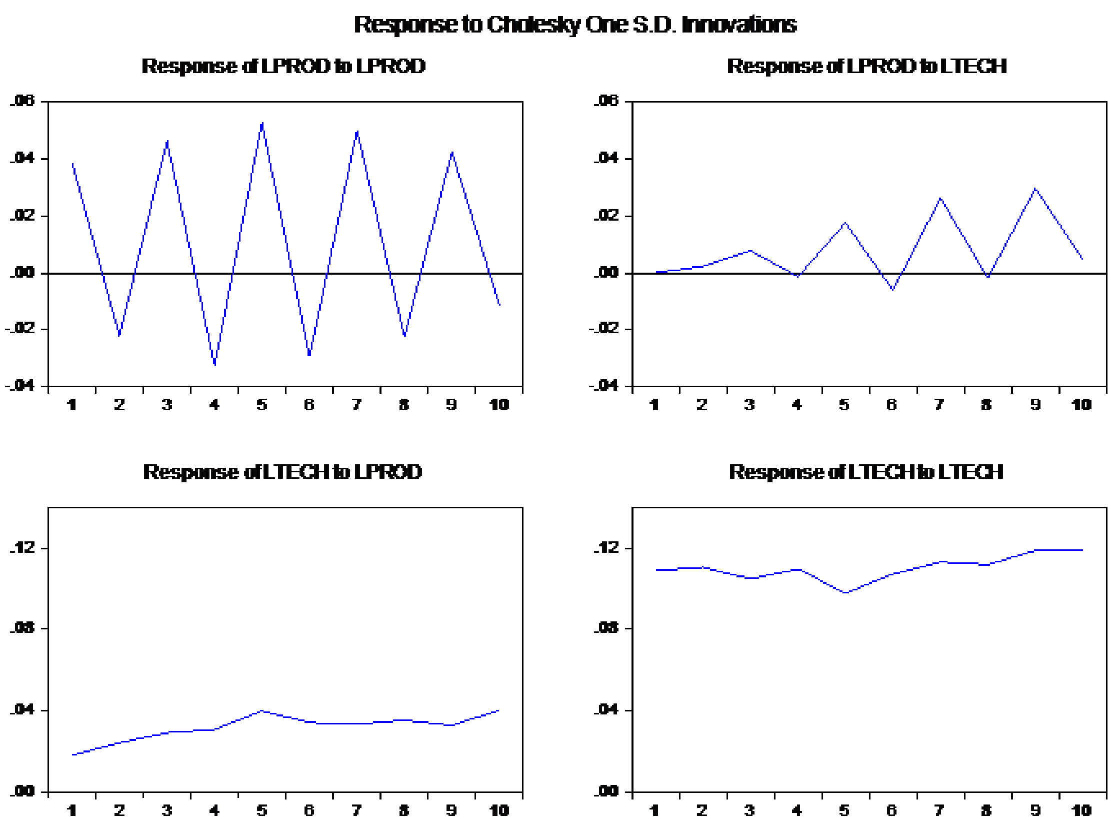

Figure 4.11: Impulse Response (Cholesky dof adjusted) – PNB

Figure 4.11 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that productivity has little impact on technology whereas technology has considerable impact on productivity.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.12.

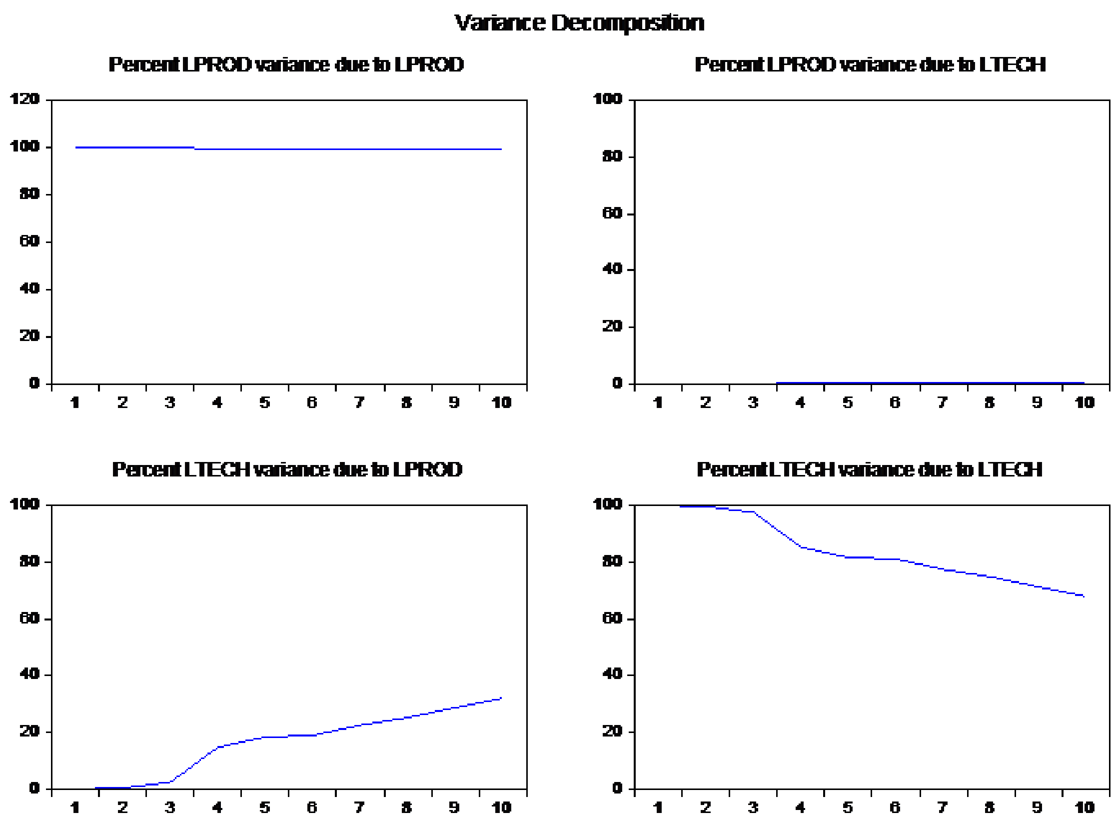

Figure 4.12: Variance Decomposition (Cholesky) – PNB

It is clear from figure 4.12 that the impact is low in the case of LPROD variance due to LTECH and more in the case of LTECH variance due to LPROD.

4.1.4: Impact of ICT diffusion on Productivity – Federal Bank

This section examines the impact of ICT on the productivity of Federal bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between productivity and ICT diffusion in Federal Bank. The productivity of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as Lprod and Ltech respectively.

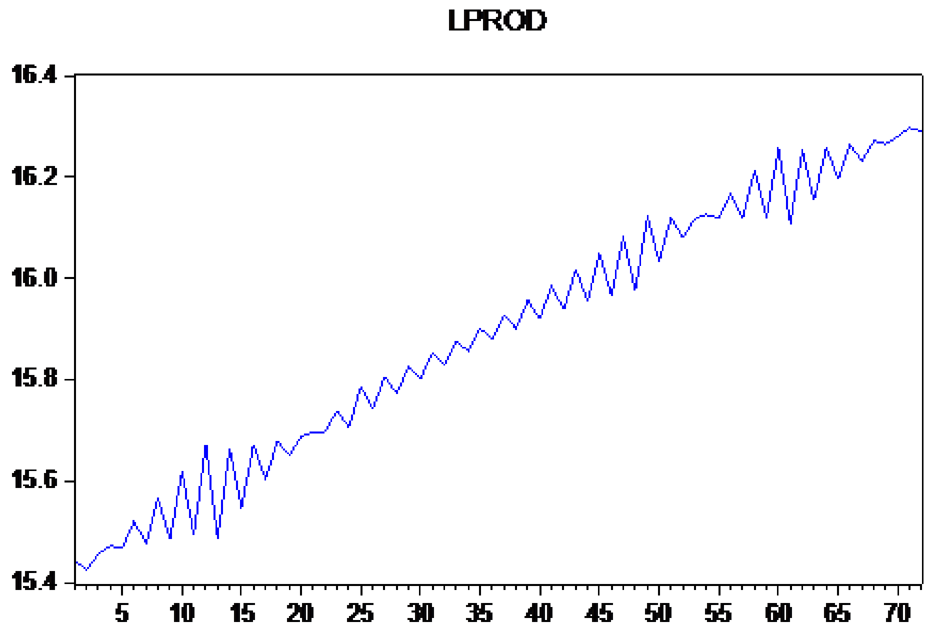

Figure 4.13: Productivity Pattern (in Log) – Federal Bank

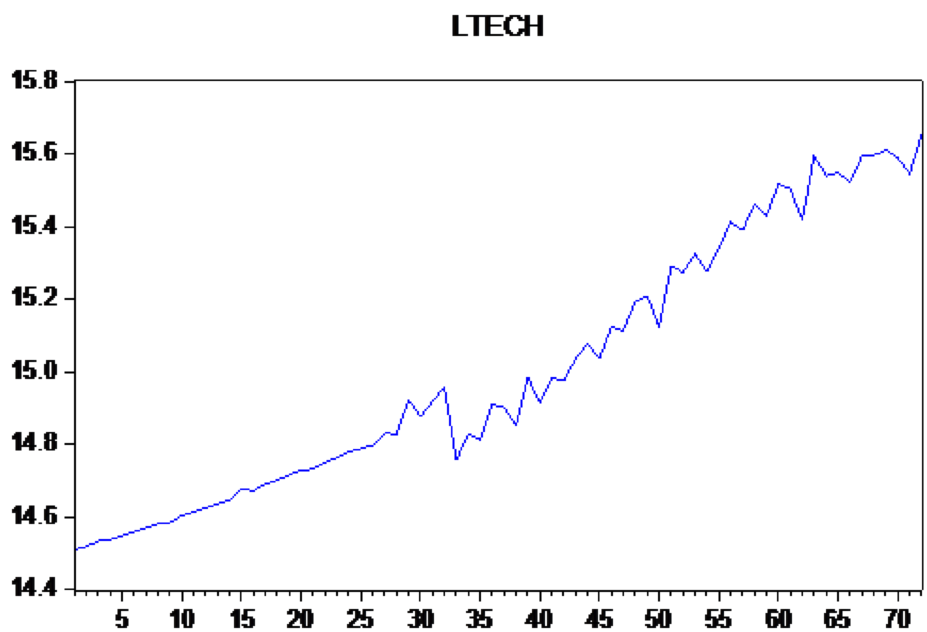

Figure 4.14: Technology Pattern (in Log) – Federal Bank

The result of the unit root analysis made was given in Table 4.13. The results indicate that the null hypothesis of unit root is rejected at 1%

significance level for both the variables in first difference, while it is accepted in levels.

Table 4.13: Test Result of Unit Root Test for Federal Bank

Variable	Test Statistic	p value
Lprod	-0.412577	0.9852
Ltech	-1.944006	0.6203
Δ Lprod	-20.36543**	0.0001
Δ Ltech	-9.470753**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.14 and Table 4.15. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.14: Unrestricted Cointegration Rank Test (Trace) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.303830	28.27464	0.0032
At most 1	0.064096	4.371968	0.3596

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.15: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.303830	23.90267	0.0022
At most 1	0.064096	4.371968	0.3596

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LProd_t = {} & 1.57087\,\Delta LProd_{t-1} + 0.65098\Delta LProd_{t-2} + 0.33997\Delta LProd_{t-3} \\ & + 0.39417\Delta LProd_{t-4} + 0.0823\Delta LProd_{t-5} + 0.024879\Delta LTech_{t-1} \\ & + 0.025673\,\Delta LTech_{t-2} + 0.030972\Delta LTech_{t-3} \\ & + 0.014624\Delta LTech_{t-4} + 0.005056\Delta LTech_{t-5} \\ & + 0.01702(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$\begin{aligned}\Delta LTech_t = {} & 0.13863\,\Delta LProd_{t-1} + 0.4438\Delta LProd_{t-2} + 0.07949\Delta LProd_{t-3} \\ & + 0.626401\Delta LProd_{t-4} + 0.431669\Delta LProd_{t-5} + 0.64546\Delta LTech_{t-1} \\ & + 0.2657\Delta LTech_{t-2} + 0.0255\Delta LTech_{t-3} + 0.106697\Delta LTech_{t-4} \\ & + 0.427344\Delta LTech_{t-5} + 0.006078(LProd_{t-1} - \propto - \beta LTech_{t-1}) \\ & + u_{2t}\end{aligned}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that $\alpha_{21} = 0$

which implies that Lprod adjusts to long run equilibrium whereas Ltech does not.

Table 4.16:LR test for binding restrictions (rank = 1) – Federal Bank

Chi-square(1)	0.246415
Probability	0.619611

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between productivity and technology. Therefore only the first equation where productivity is taken as the dependent variable is relevant here, that is, it is true that productivity depends on technology, but on the basis of data collected the opposite is not true.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We estimate these quantities from the VAR model in Lprod and Ltech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

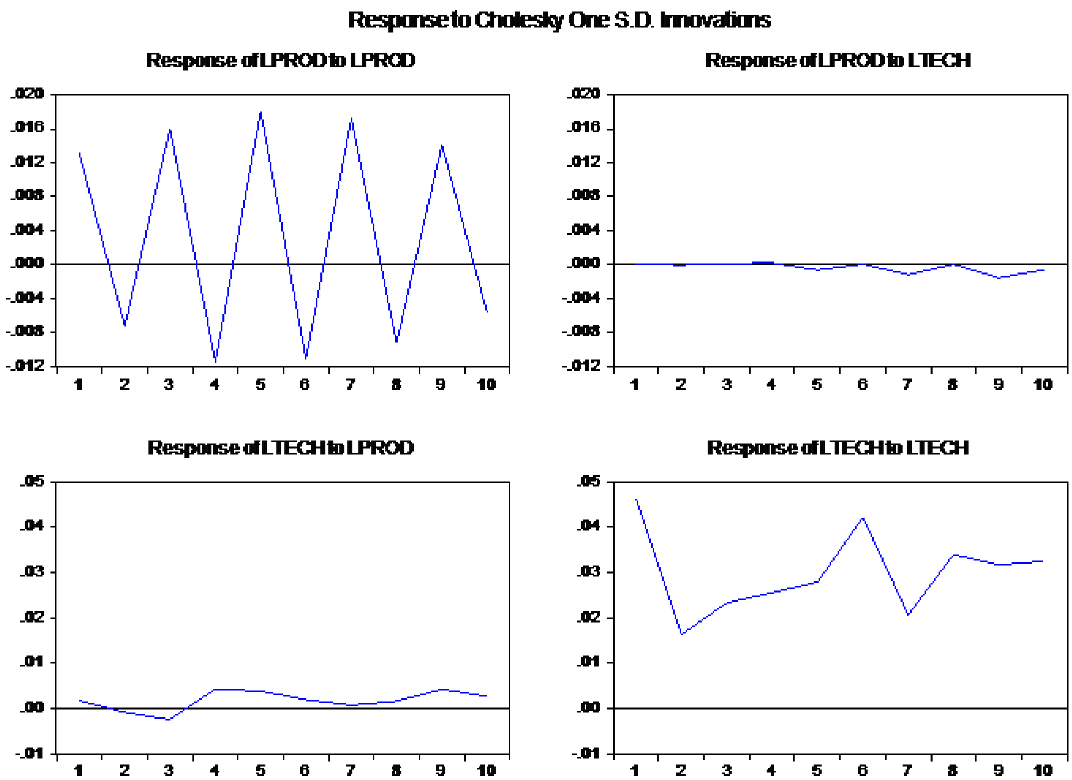

Figure 4.15: Impulse Response (Cholesky dof adjusted) – Federal Bank

Figure 4.15 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that the concerned variables have little impact on each other.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.16.

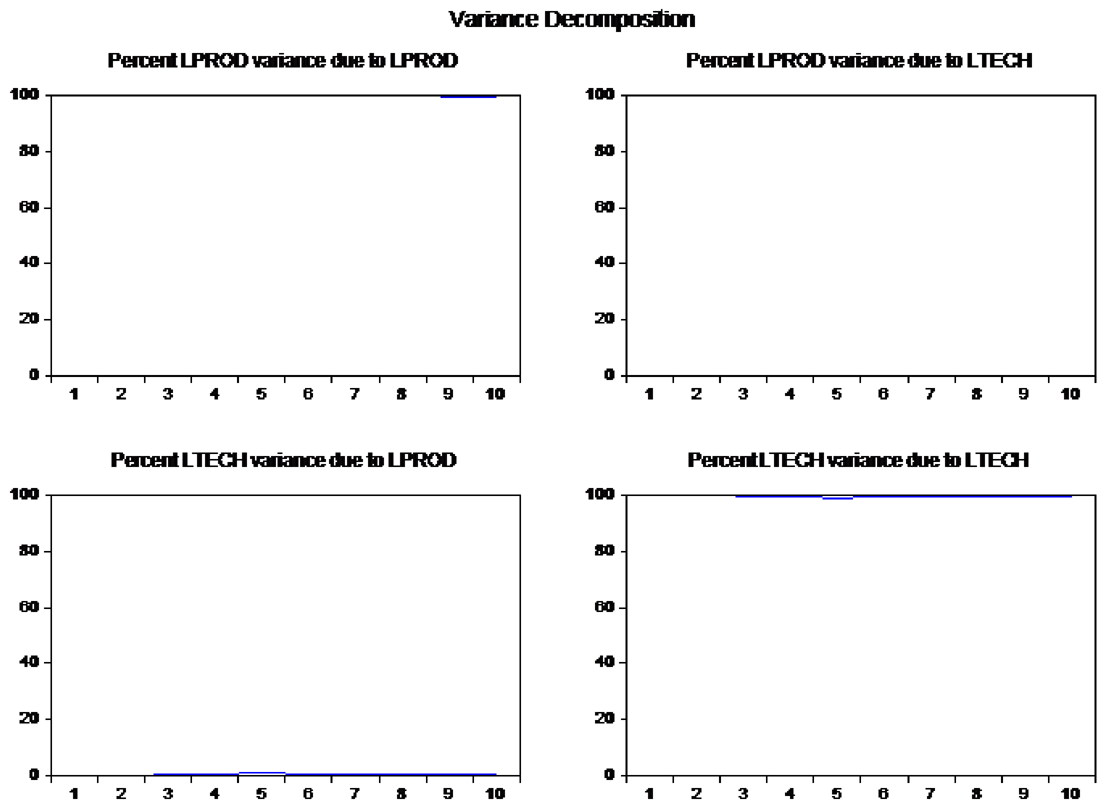

Figure 4.16: Variance Decomposition (Cholesky) – Federal Bank

It is clear from figure 4.16 that the impact is low in the case of LPROD variance due to LTECH and in the case of LTECH variance due to LPROD.

4.1.5: Impact of ICT diffusion on Productivity – HDFC Bank

This section examines the impact of ICT on the productivity of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between productivity and ICT diffusion in banking sector. The productivity of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as Lprod and Ltech respectively.

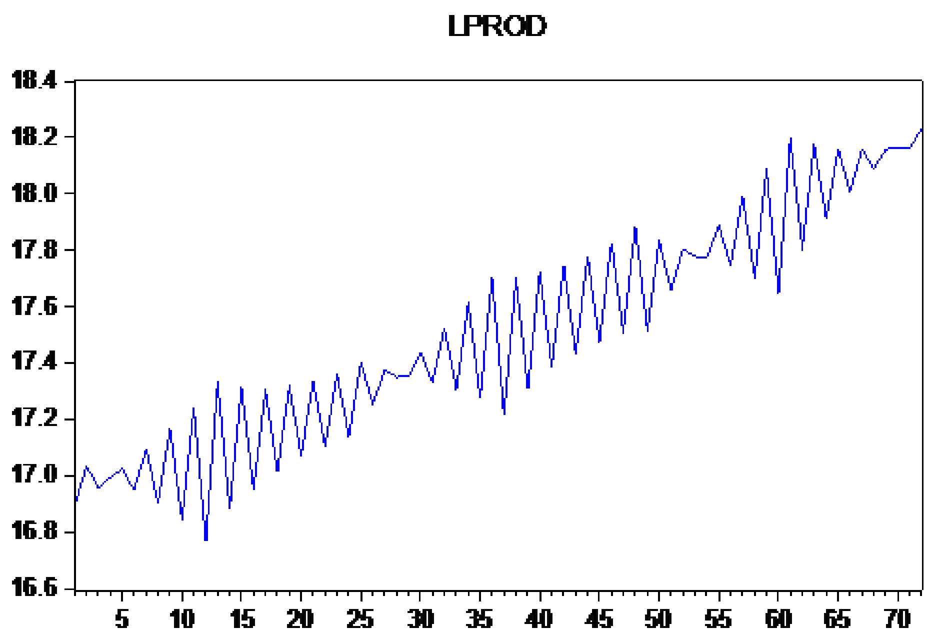

Figure 4.17: Productivity Pattern (in Log) – HDFC

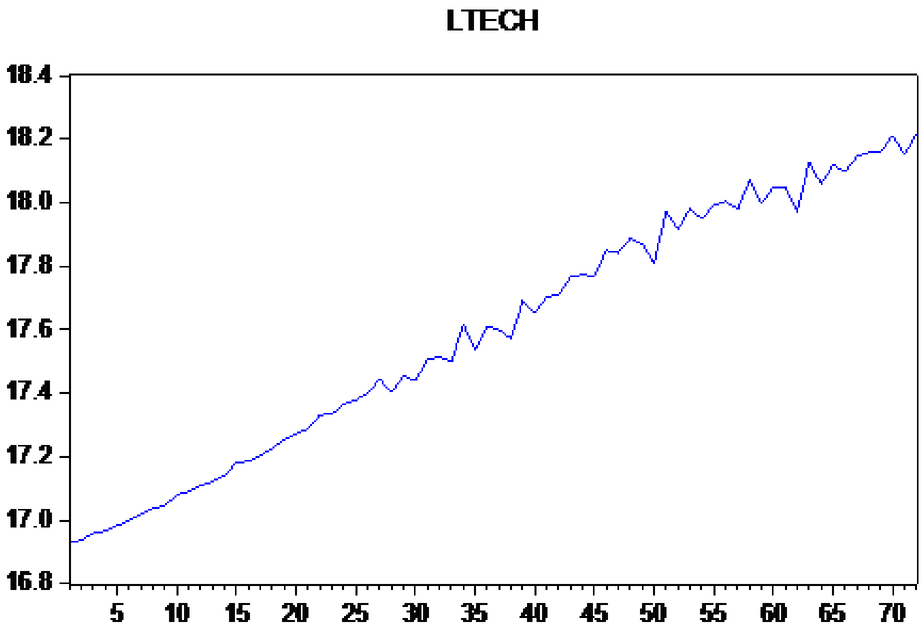

Figure 4.18: Technology Pattern (in Log) – HDFC

The result of the unit root analysis made was given in Table 4.17. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.17: Test Result of Unit Root Test for HDFC

Variable	Test Statistic	p value
Lprod	-2.349765	0.4021
Ltech	-0.095944	0.9940
Δ Lprod	-20.57836**	0.0001
Δ Ltech	-7.080680**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.18 and Table 4.19. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.18: Unrestricted Cointegration Rank Test (Trace) – HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.283646	28.81743	0.0026
At most 1	0.097915	6.801057	0.1373

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.19: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.283646	22.01637	0.0048
At most 1	0.097915	6.801057	0.1373

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LProd_t = 1.43572\,\Delta LProd_{t-1} + 0.37604\Delta LProd_{t-2} + 0.119037\Delta LProd_{t-3} + 0.020918\Delta LProd_{t-4} + 0.05878\Delta LProd_{t-5} + 0.26712\Delta LTech_{t-1} + 0.4447\,\Delta LTech_{t-2} + 0.54233\Delta LTech_{t-3} + 0.4015\Delta LTech_{t-4} + 0.1689\Delta LTech_{t-5} + 0.10859(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.143096\,\Delta LProd_{t-1} + 0.1719\Delta LProd_{t-2} + 0.02612\Delta LProd_{t-3} + 0.12276\Delta LProd_{t-4} + 0.03638\Delta LProd_{t-5} + 1.01214\Delta LTech_{t-1} + 0.50177\Delta LTech_{t-2} + 0.15087\Delta LTech_{t-3} + 0.10807\Delta LTech_{t-4} + 0.218318\Delta LTech_{t-5} + 0.05919(LProd_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that Lprod adjusts to long run equilibrium whereas Ltech does not.

Table 4.20:LR test for binding restrictions (rank = 1) – HDFC

Chi-square(1)	6.614075
Probability	0.070118

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between productivity and technology. Therefore only the first equation where productivity is taken as the dependent variable is relevant here, that is, it is true that productivity depends on technology, but on the basis of data collected the opposite is not true.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

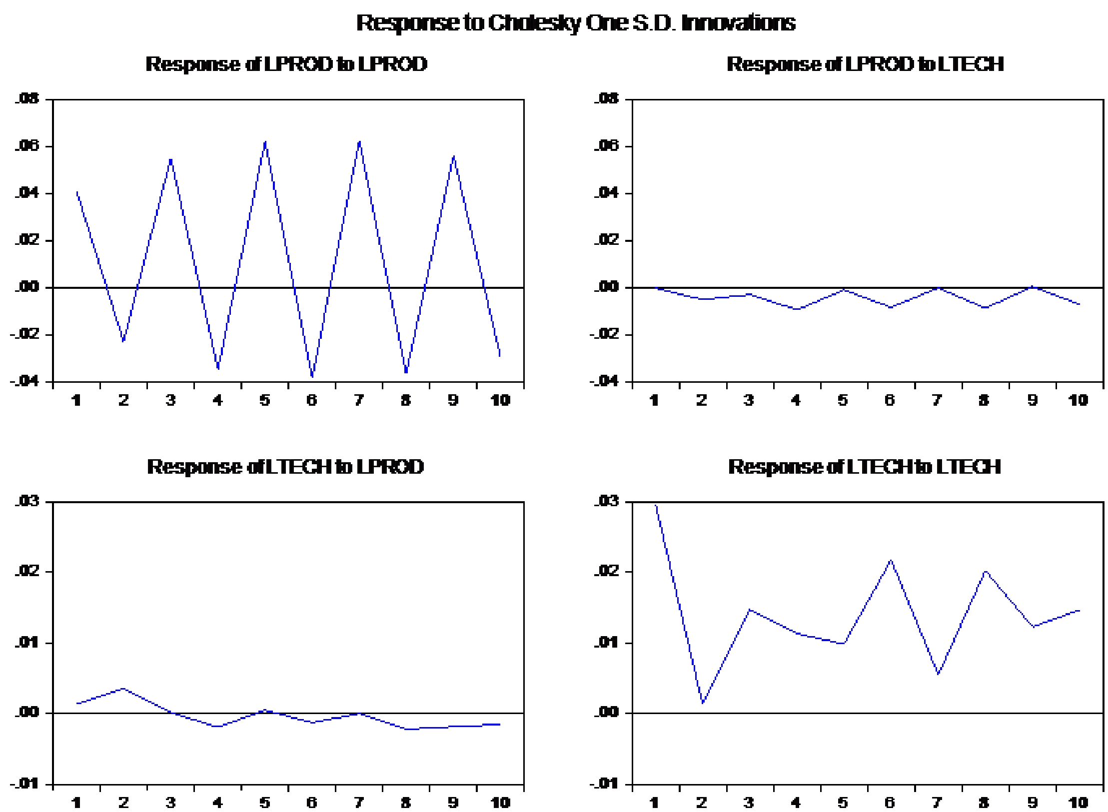

Figure 4.19: Impulse Response (Cholesky dof adjusted) – HDFC

Figure 4.19 clearly indicates that the variables concerned are responding to a standard deviation shock.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.20.

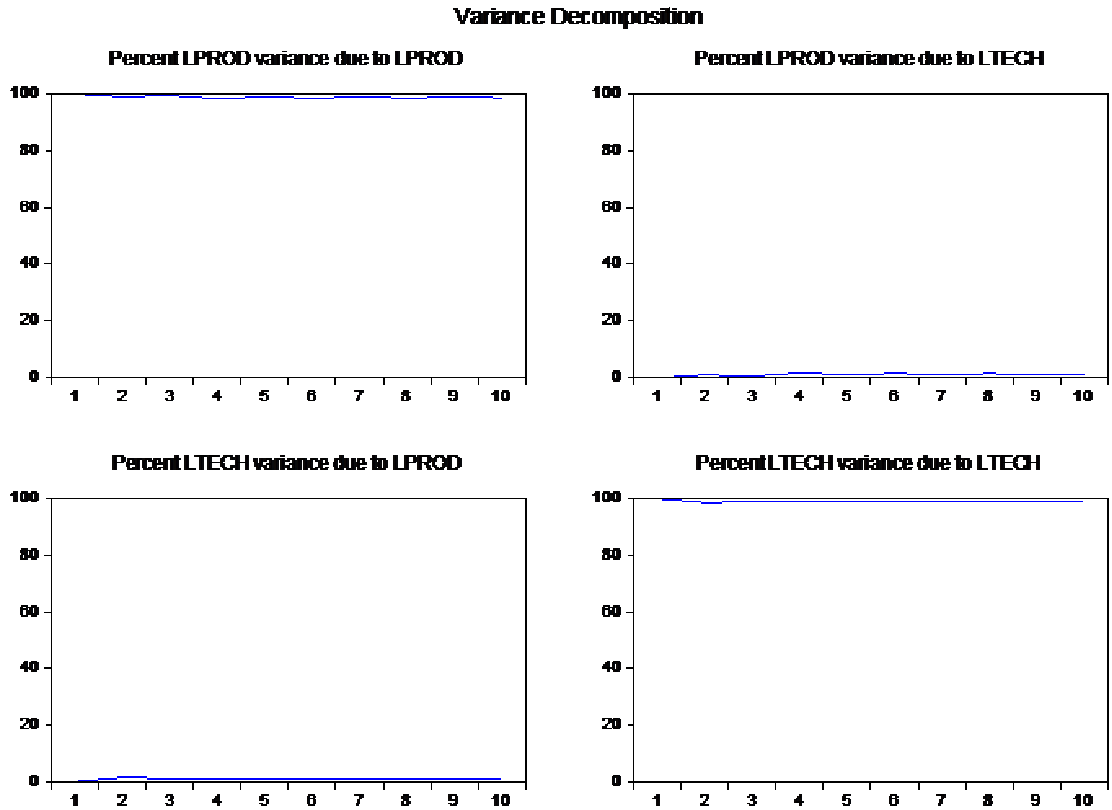

Figure 4.20: Variance Decomposition (Cholesky) – HDFC

It is clear from figure 4.20 that the impact is low in the case of LPROD variance due to LTECH and in the case of LTECH variance due to LPROD.

SECTION II

4.2: Profitability

Profitability in the banking sector is measured in terms of return on assets (ROA) and return on equity (ROE). Return on asset is defined as the ratio of net profit to total assets. That is

$$ROA = \frac{Net\ Profit}{Average\ Total\ Assets}$$

For banking sector, this ratio will give an idea regarding the returns they receive in proportion to total asset held. Return on equity is defined as the ratio of net profit to average total equity. That is,

$$ROE = \frac{\text{Net Profit}}{\text{Average Total Equity}}$$

The study uses monthly data for the period from January 2009 to April 2015. The data regarding ROA and ROE used for the analysis of profitability are given in Appendix B.

4.2.1: Impact of ICT diffusion on ROA – All SCBs

This section examines the impact of ICT on the return on assets (ROA) of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROA and ICT diffusion in banking sector. The ROA of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROA and LTech respectively.

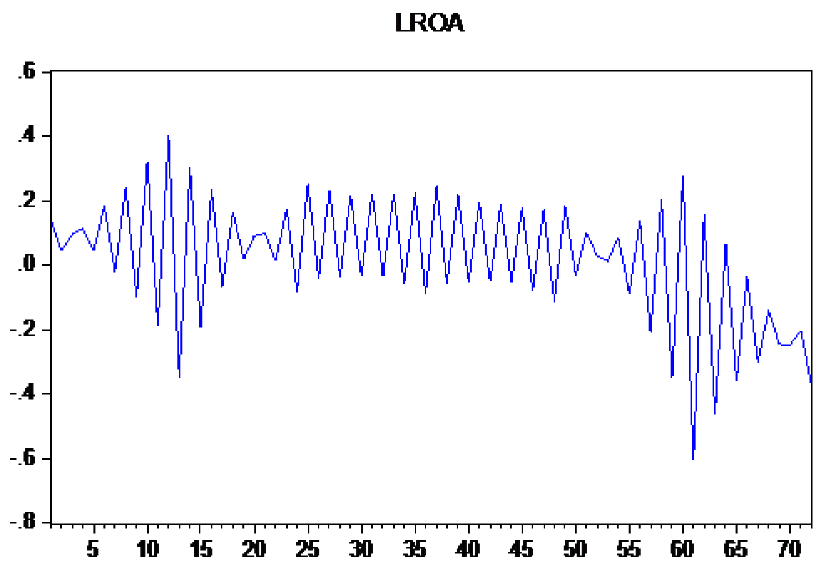

Figure 4.21: ROA Pattern (in Log) - All SCBs

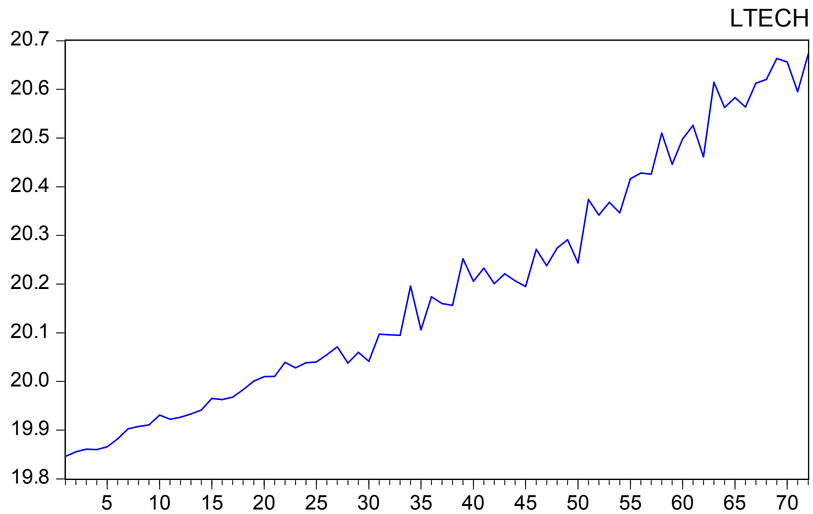

Figure 4.22: Technology Pattern (in Log) - All SCBs

In this regard, the error correction model was estimated as:

$$\Delta LROA_t = \beta_{10} + \beta_{11}\Delta LROA_{t-1} + \beta_{12}\Delta LROA_{t-2} + \beta_{13}\Delta LROA_{t-3} + \beta_{14}\Delta LROA_{t-4} + \beta_{15}\Delta LROA_{t-5} + \beta_{16}\Delta LTech_{t-1} + \beta_{17}\Delta LTech_{t-2} + \beta_{18}\Delta LTech_{t-3} + \beta_{19}\Delta LTech_{t-4} + \beta_{110}\Delta LTech_{t-5} + \alpha_{11}(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = \beta_{20} + \beta_{21}\Delta LROA_{t-1} + \beta_{22}\Delta LROA_{t-2} + \beta_{23}\Delta LROA_{t-3} + \beta_{24}\Delta LROA_{t-4} + \beta_{25}\Delta LROA_{t-5} + \beta_{26}\Delta LTech_{t-1} + \beta_{27}\Delta LTech_{t-2} + \beta_{28}\Delta LTech_{t-3} + \beta_{29}\Delta LTech_{t-4} + \beta_{210}\Delta LTech_{t-5} + \alpha_{21}(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

The equation with $\alpha_{21} = 0$ implies that LROA adjusts to long run equilibrium whereas LTech does not. In other words, there is only one way causality from LTech to LROA at zero frequency. That is, shocks in technology can influence the long run forecast of ROA and not vice versa. If so,

$$\lim_{h\to\infty} \frac{\partial E(LROA_{t+h})}{\partial E(LTech_t)} \neq 0$$

$$\lim_{h\to\infty} \frac{\partial E(LTech_{t+h})}{\partial E(LROA_t)} = 0$$

This implies that the conditional forecast of ROA h period ahead depends only on technology.

There are five steps involved in testing the long run association between ROA and technology:

(i) Examining time series properties of ROA and ICT diffusion. That is, both ROA and ICT are tested for stationarity. The Augmented Dickey-Fuller (ADF) unit root test was used for this purpose.

(ii) Test whether there is any cointegration between ROA and ICT diffusion. Johansen system cointegration test was applied here.

(iii) Test to know whether the restriction imposed on the error correction mechanism is valid or not.

(iv) Examining the dynamic behavior of one variable after a standard deviation shock in other variable by using the impulse response function.

(v) Evaluating the proportion of forecast error variance of ROA and ICT diffusion to know whether the forecast error variance of ROA is increasingly explained by shocks in ICT diffusion as the forecast horizon increases.

The result of the analysis made on procedure (i) was given in Table 4.21. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.21: Test Result of Unit Root Test for All SCBs

Variable	Test Statistic	p value
LROA	-0.128744	0.9934
LTech	-0.4915	0.9814
Δ LROA	-18.28546**	0.0001
Δ LTech	-4.241190**	0.0071

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of the analysis made on procedure (ii) was given in Table 4.22 and Table 4.23. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.22: Unrestricted Cointegration Rank Test (Trace) - All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.224788	20.60453	0.0449
At most 1	0.055945	3.799683	0.4428

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.23: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.224788	16.80485	0.0359
At most 1	0.055945	3.799683	0.4428

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LROA_t = {} & 1.36928\Delta LROA_{t-1} + 0.27788\Delta LROA_{t-2} + 0.035403\Delta LROA_{t-3} \\ & + 0.08605\Delta LROA_{t-4} + 0.056612\Delta LROA_{t-5} + 0.026002\Delta LTech_{t-1} \\ & + 0.163578\Delta LTech_{t-2} + 0.024477\Delta LTech_{t-3} + 0.22438\Delta LTech_{t-4} \\ & + 0.04158\Delta LTech_{t-5} + 0.04447(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$\Delta LTech_t = 0.02846\Delta LROA_{t-1} + 0.0835\Delta LROA_{t-2} + 0.1719\Delta LROA_{t-3} + 0.07125\Delta LROA_{t-4} + 0.017632\Delta LROA_{t-5} + 0.94113\Delta LTech_{t-1} + 0.50099\Delta LTech_{t-2} + 0.27545\Delta LTech_{t-3} + 0.34966\Delta LTech_{t-4} + 0.026775\Delta LTech_{t-5} + 0.085448(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that $\alpha_{21}= 0$ which implies that LROA adjusts to long run equilibrium whereas LTech does not.

Table 4.24:LR test for binding restrictions $\alpha_{21}= 0$ (rank = 1) - All SCBs

Chi-square(1)	11.85590
Probability	0.000575

Since the null hypothesis that $\alpha_{21}= 0$ was rejected, it can be stated that there is a two way causational relation between productivity and technology, that is, technology and ROA are interdependent on each other.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We estimate these quantities from the VAR model in LROA and LTech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

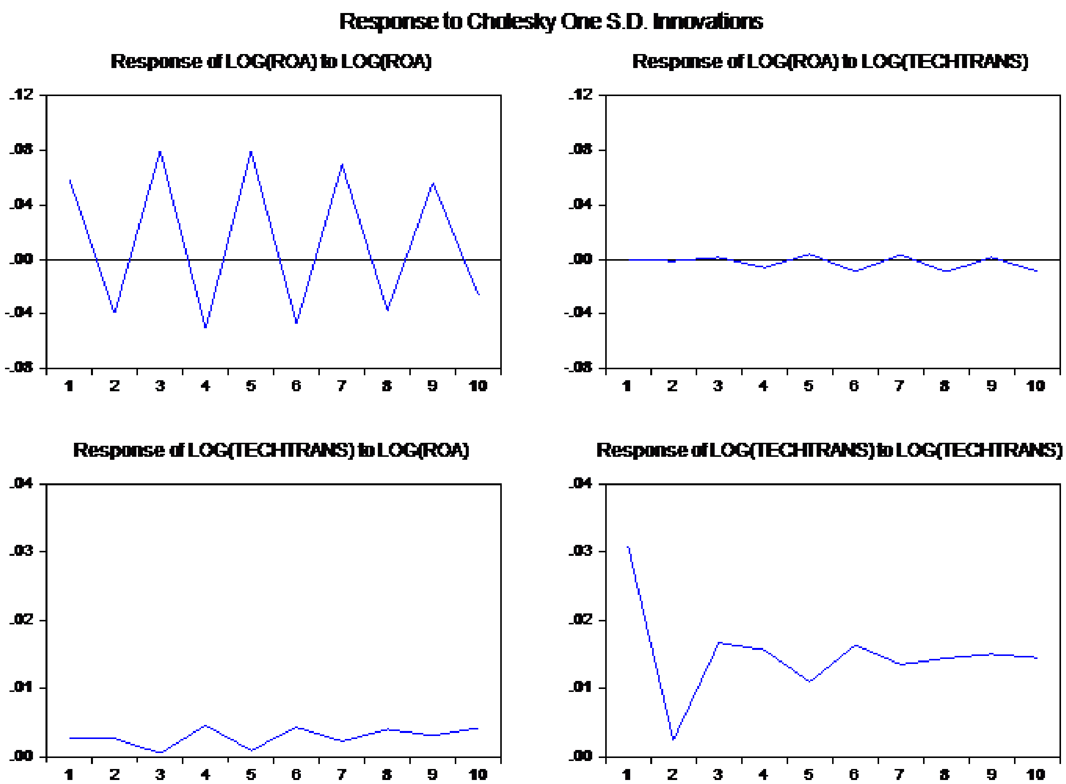

Figure 4.23: Impulse Response (Cholesky dof adjusted) - All SCBs

Figure 4.23 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROA has little impact on technology whereas technology has considerable impact on ROA.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.24.

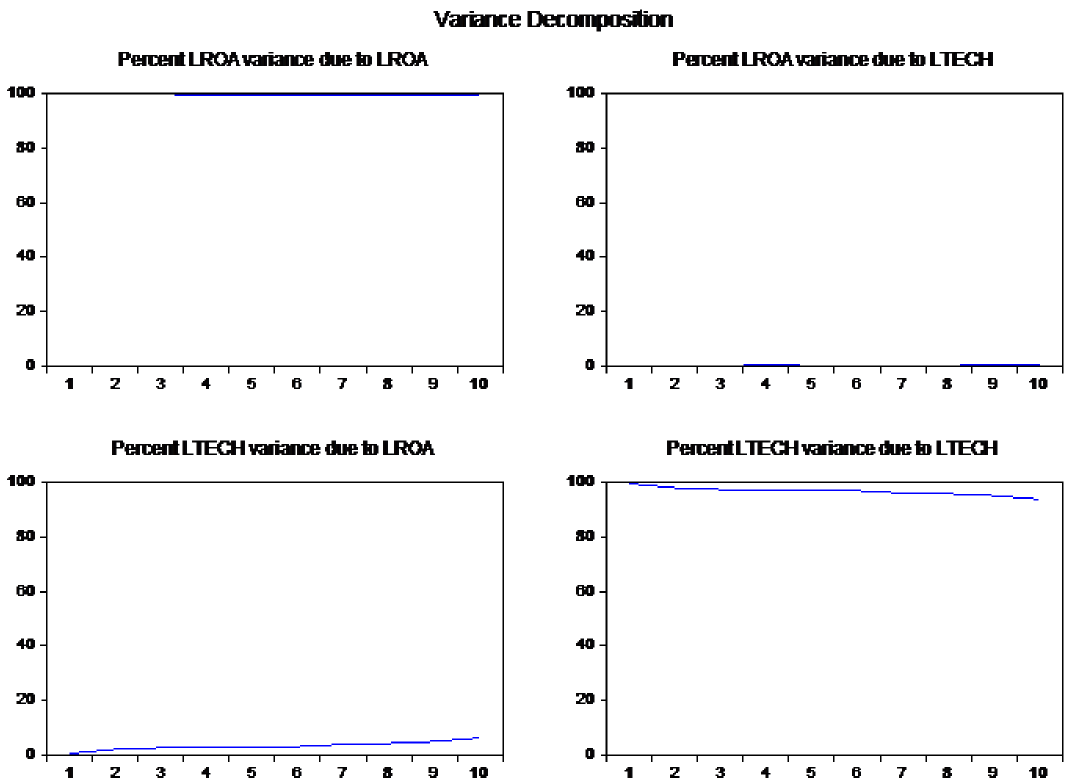

Figure 4.24: Variance Decomposition (Cholesky) - All SCBs

It is clear from figure 4.24 that the impact is minimal on both ROA and technology.

4.2.2: Impact of ICT diffusion on ROA – SBI

This section examines the impact of ICT on the ROA of State Bank of India, which was taken as a representative of SB Group. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROA and ICT diffusion in SBI. The ROA of SBI and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROA and LTech respectively.

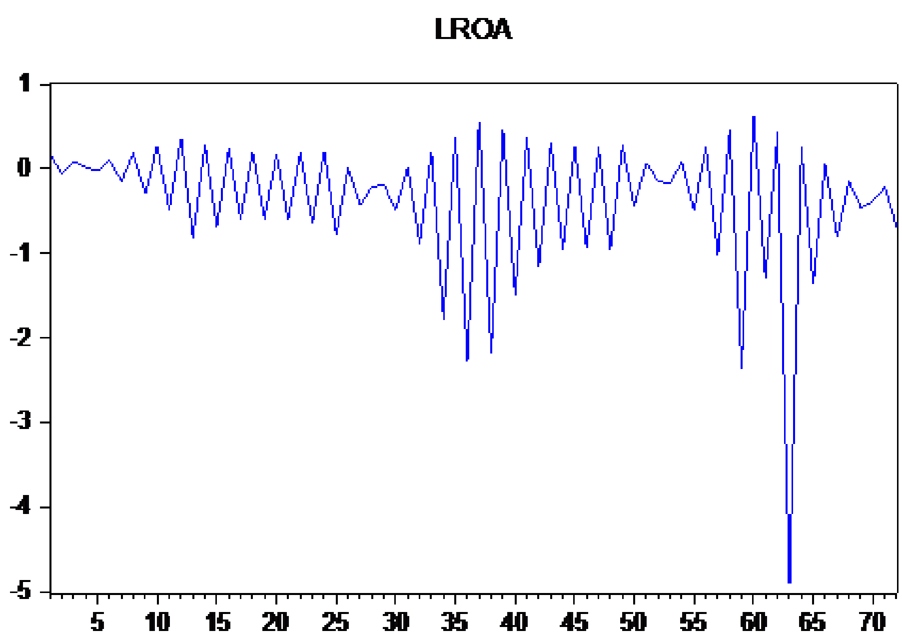

Figure 4.25: ROA Pattern (in Log) - SBI

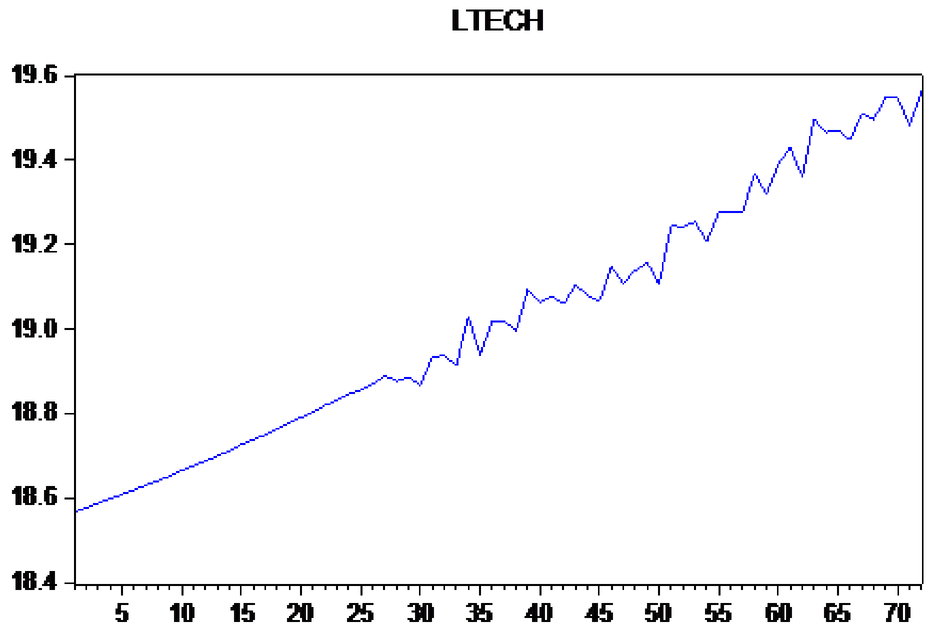

Figure 4.26: Technology Pattern (in Log) - SBI

The result of the unit root analysis made was given in Table 4.25. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.25: Test Result of Unit Root Test for SBI

Variable	Test Statistic	p value
LROA	-4.486891	0.0731
LTech	-2.001279	0.5902
Δ LROA	-8.639448**	0.0000
Δ LTech	-4.016182*	0.0132

** indicates significant at 1% level
* indicates significant at 5% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.26 and Table 4.27. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.26: Unrestricted Cointegration Rank Test (Trace) - SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.292928	32.77424	0.0006
At most 1*	0.139254	9.897112	0.0363

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.27: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.292928	22.87713	0.0034
At most 1*	0.139254	9.897112	0.0363

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROA_t = 1.05931\Delta LROA_{t-1} + 0.52004\Delta LROA_{t-2} + 0.65568\Delta LROA_{t-3} + 0.14736\Delta LROA_{t-4} + 0.166352\Delta LROA_{t-5} + 0.57852\Delta LTech_{t-1} + 5.91844\Delta LTech_{t-2} + 6.98105\Delta LTech_{t-3} + 0.06791\ \Delta LTech_{t-4} + 0.33297\Delta LTech_{t-5} + 0.04534(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.00533\Delta LROA_{t-1} + 0.01337\Delta LROA_{t-2} + 0.002719\Delta LROA_{t-3} + 0.00471\Delta LROA_{t-4} + 0.0088\Delta LROA_{t-5} + 1.01232\Delta LTech_{t-1} + 0.62999\Delta LTech_{t-2} + 0.31345\Delta LTech_{t-3} + 0.45335\Delta LTech_{t-4} + 0.09551\Delta LTech_{t-5} + 0.01115(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

Since there are two cointegrating equations, there is no need for testing to know whether there is a two way causation or a one way causation (procedure (iii)), with the restriction that α_{21}= 0 or α_{11}= 0. Here both the equations will hold as a result of two cointegrating equations.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

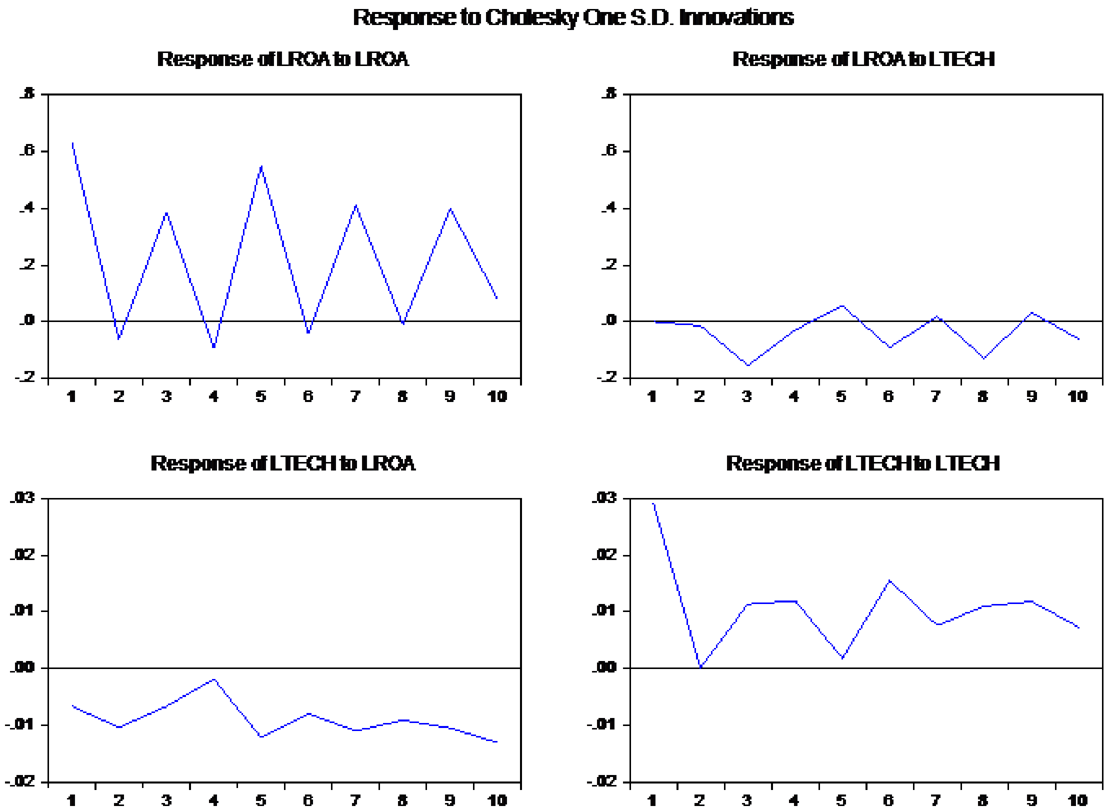

Figure 4.27: Impulse Response (Cholesky dof adjusted) - SBI

Figure 4.27 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROA has little impact on technology whereas technology has considerable impact on ROA.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.28.

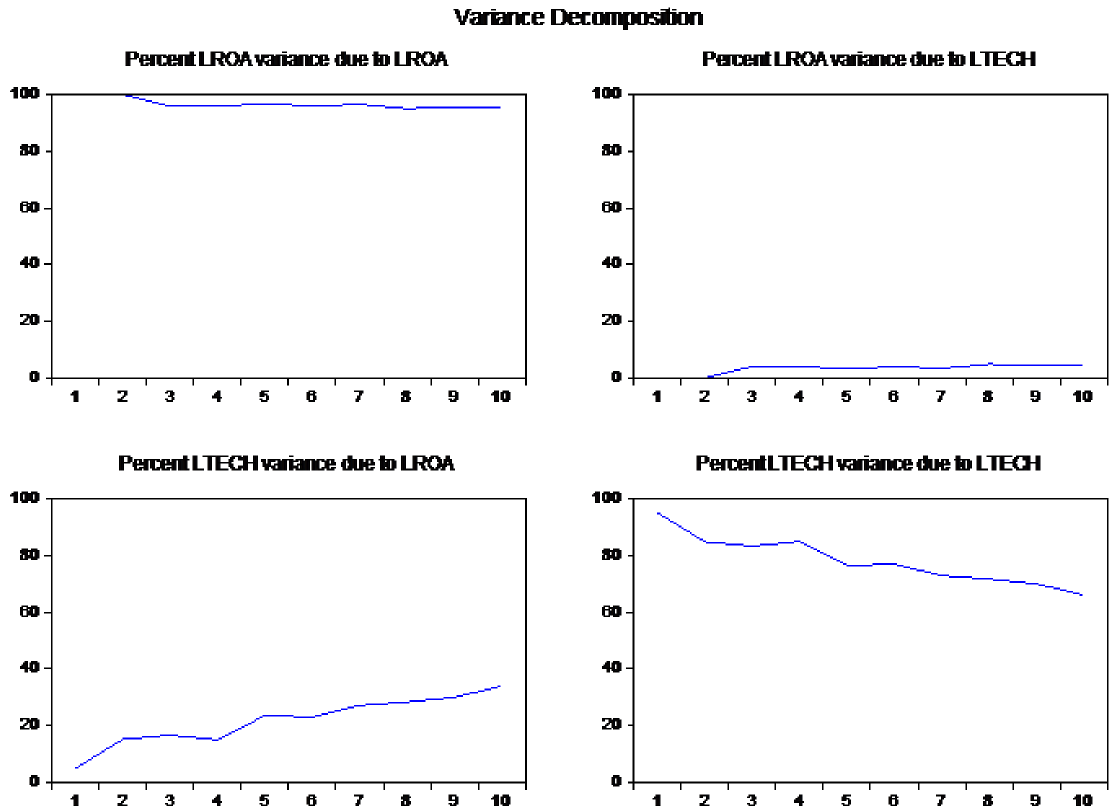

Figure 4.28: Variance Decomposition (Cholesky) - SBI

It is clear from figure 4.28 that there is some impact on both ROA and technology.

4.2.3: Impact of ICT diffusion on ROA – PNB

This section examines the impact of ICT on the ROA of Punjab National Bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between

ROA and ICT diffusion in banking sector. The ROA of Punjab National Bank and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROA and LTech respectively.

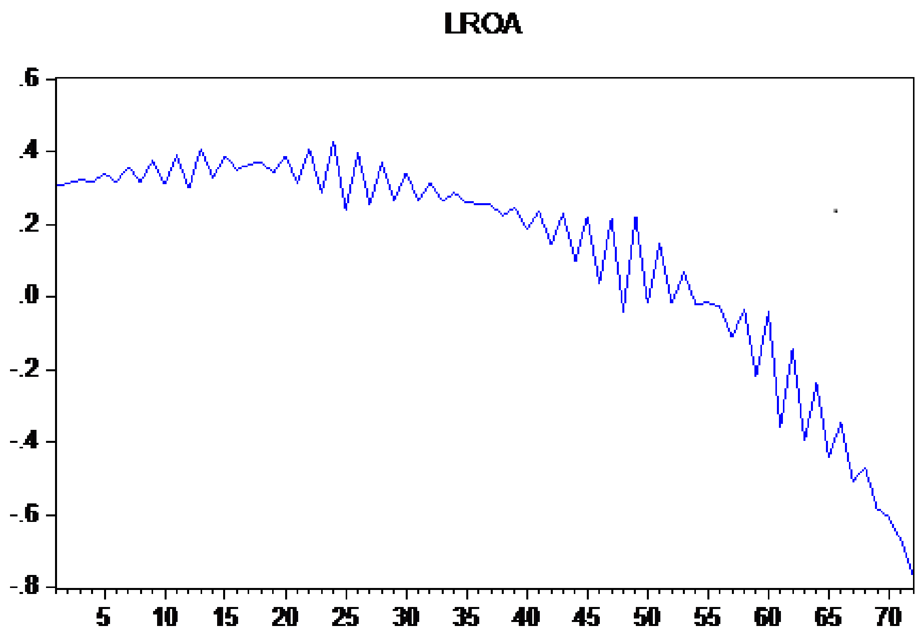

Figure 4.29: ROA Pattern (in Log) - PNB

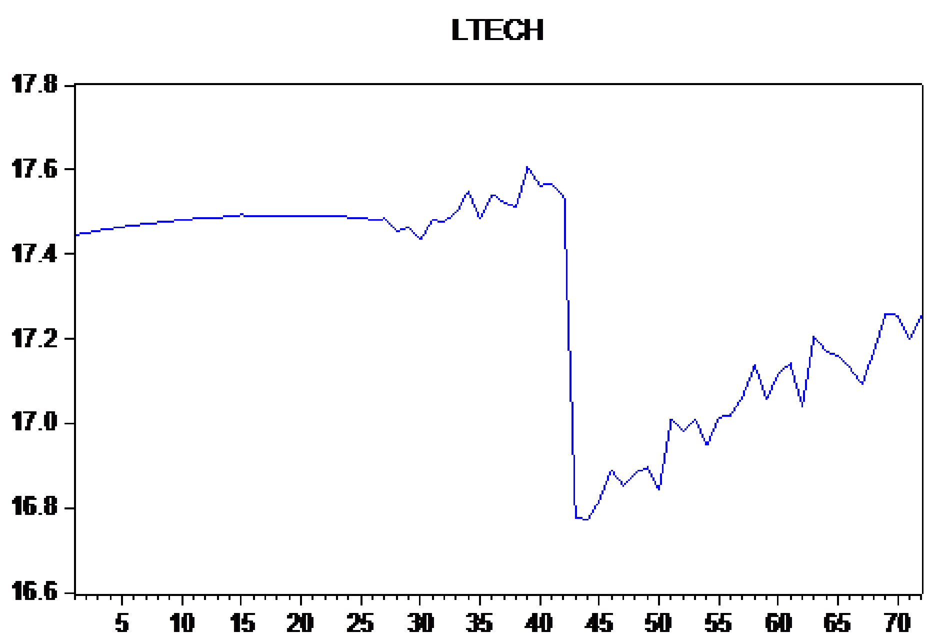

Figure 4.30: Technology Pattern (in Log) - PNB

The result of the unit root analysis made was given in Table 4.28. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.28: Test Result of Unit Root Test for PNB

Variable	Test Statistic	p value
LROA	7.241234	1.0000
LTech	-2.265420	0.4467
Δ LROA	-13.32365**	0.0001
Δ LTech	-8.634422**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.29 and Table 4.30. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.29: Unrestricted Cointegration Rank Test (Trace) - PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value

None *	0.226481	20.51878	0.0461
At most 1	0.052649	3.569654	0.4800

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.30: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.226481	16.94913	0.0340
At most 1	0.052649	3.569654	0.4800

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LROA_t = {} & 1.44649\Delta LROA_{t-1} + 0.28272\Delta LROA_{t-2} + 0.092101\Delta LROA_{t-3} \\ & + 0.054833\Delta LROA_{t-4} + 0.152956\Delta LROA_{t-5} + 0.029624\Delta LTech_{t-1} \\ & + 0.00118\Delta LTech_{t-2} + 0.051128\Delta LTech_{t-3} + 0.01311\Delta LTech_{t-4} \\ & + 0.065288\Delta LTech_{t-5} + 0.156342\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) \\ & + u_{1t}\end{aligned}$$

$$\begin{aligned}\Delta LTech_t = {} & 0.583364\Delta LROA_{t-1} + 0.436026\Delta LROA_{t-2} + 0.148408\Delta LROA_{t-3} \\ & + 0.251681\Delta LROA_{t-4} + 0.077833\Delta LROA_{t-5} + 0.03854\Delta LTech_{t-1} \\ & + 0.07967\Delta LTech_{t-2} + 0.001147\Delta LTech_{t-3} + 0.16277\Delta LTech_{t-4} \\ & + 0.069946\Delta LTech_{t-5} + 0.09407(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}\end{aligned}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that LROA adjusts to long run equilibrium whereas LTech does not.

Table 4.31:LR test for binding restrictions (rank = 1) - PNB

Chi-square(1)	0.186299
Probability	0.666015

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between ROA and technology. Therefore only the first equation where ROA is taken as the dependent variable is relevant here, that is, it is true that ROA depends on technology, but on the basis of data collected the opposite is not true.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

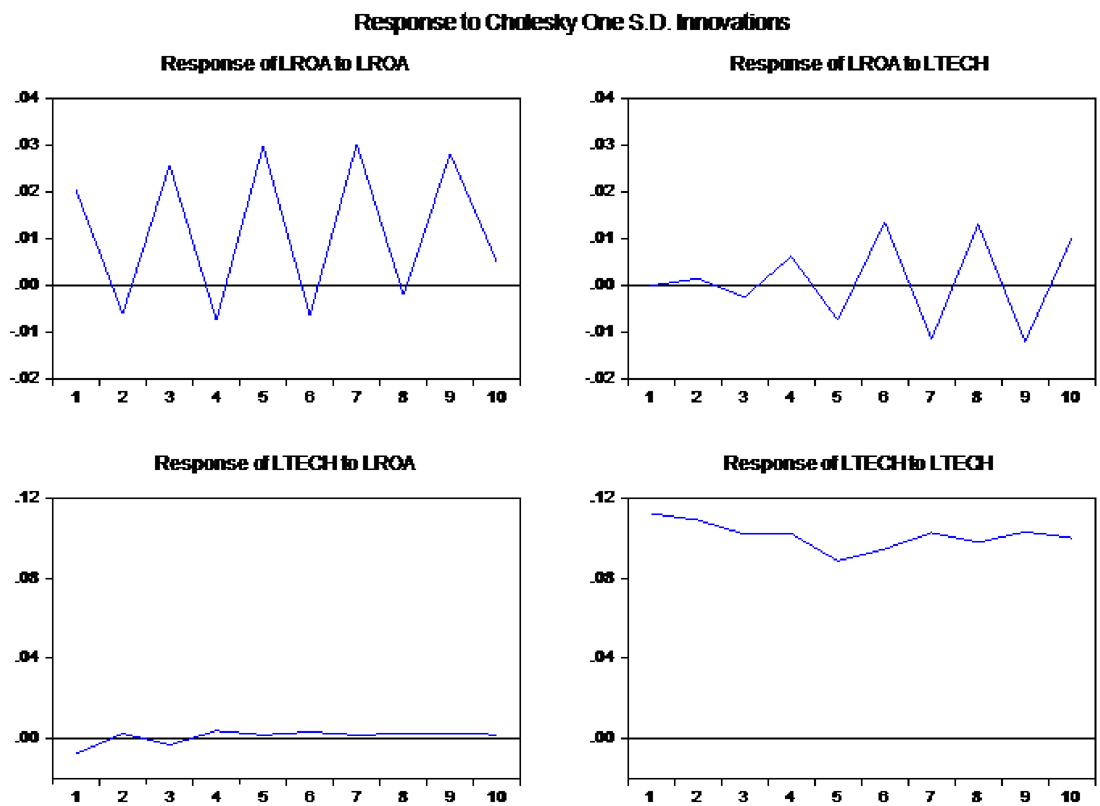

Figure 4.31: Impulse Response (Cholesky dof adjusted) - PNB

Figure 4.31 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROA has little impact on technology whereas technology has considerable impact on ROA.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.32.

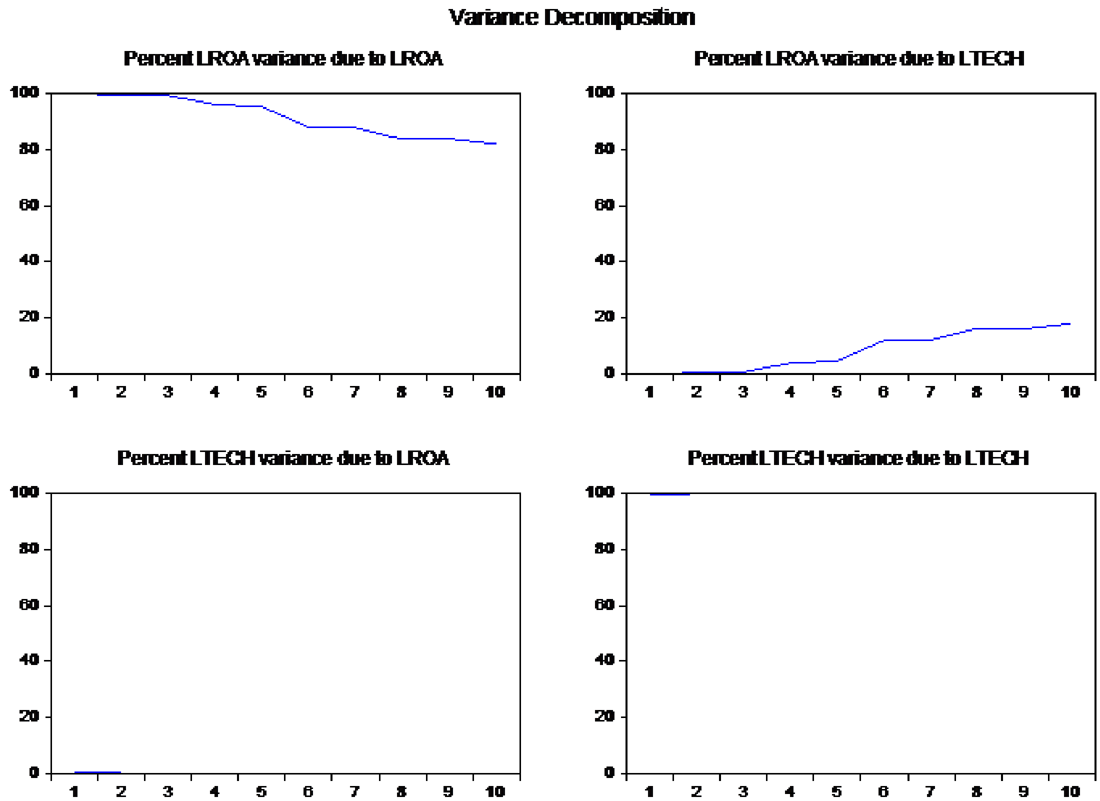

Figure 4.32: Variance Decomposition (Cholesky) - PNB

It is clear from figure 4.32 that the impact is low in the case of LROA variance due to LTECH and more in the case of LTECH variance due to LROA.

4.2.4: Impact of ICT diffusion on ROA – Federal Bank

This section examines the impact of ICT on the ROA of Federal bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROA and ICT diffusion in Federal Bank. The ROA of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROA and LTech respectively.

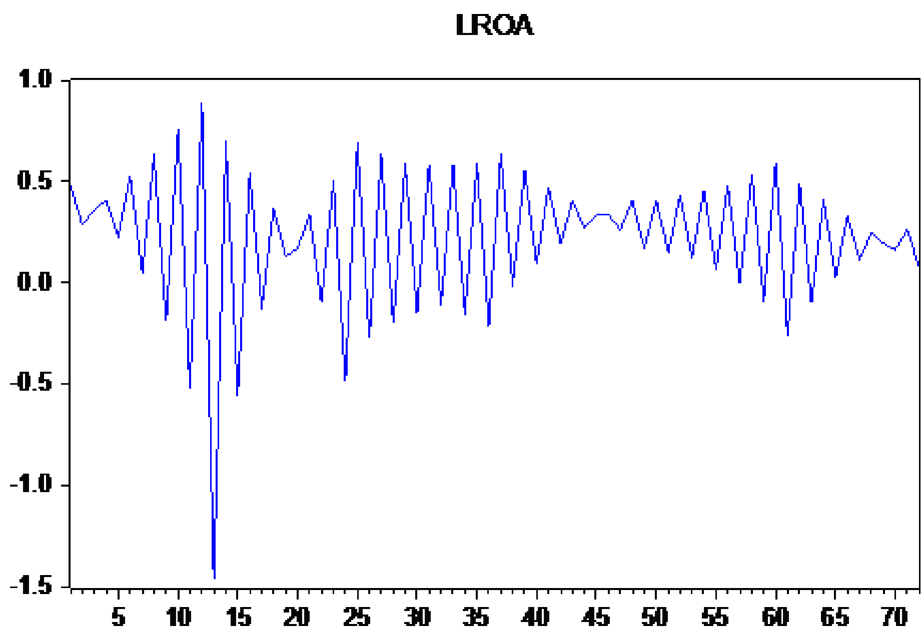

Figure 4.33: ROA Pattern (in Log) – Federal Bank

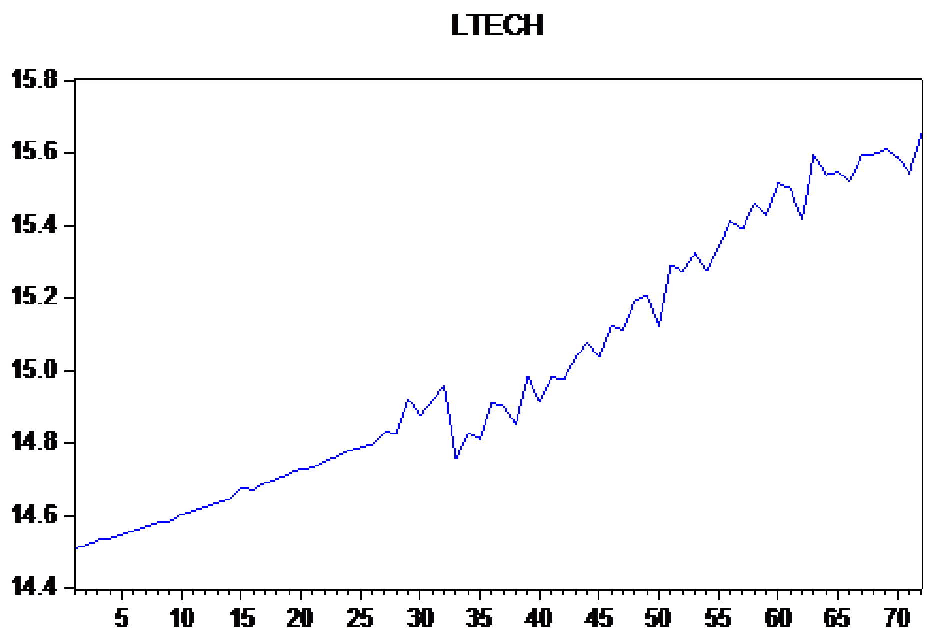

Figure 4.34: Technology Pattern (in Log) – Federal Bank

The result of the unit root analysis made was given in Table 4.32. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.32: Test Result of Unit Root Test for Federal Bank

Variable	Test Statistic	p value
LROA	-4.081525	0.0504
LTech	-1.944006	0.6203
Δ LROA	-12.36614**	0.0001
Δ LTech	-9.470753**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.33 and Table 4.34. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.33: Unrestricted Cointegration Rank Test (Trace) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.302512	31.30292	0.0010
At most 1	0.101419	7.164845	0.1180

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.34: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.302512	24.13807	0.0020
At most 1	0.101419	7.164845	0.1180

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROA_t = 1.14735\,\Delta LROA_{t-1} + 0.23713\Delta LROA_{t-2} + 0.11197\Delta LROA_{t-3} + 0.18709\Delta LROA_{t-4} + 0.292212\Delta LTech_{t-1} + 0.649469\Delta LTech_{t-2} + 0.724568\Delta LTech_{t-3} + 0.347399\Delta LTech_{t-4} + 0.17435\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.09379\,\Delta LROA_{t-1} + 0.07581\Delta LROA_{t-2} + 0.07165\Delta LROA_{t-3} + 0.03159\Delta LROA_{t-4} + 0.75934\Delta LTech_{t-1} + 0.38838\Delta LTech_{t-2} + 0.22518\Delta LTech_{t-3} + 0.24268\Delta LTech_{t-4} + 0.127219\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that LROA adjusts to long run equilibrium whereas LTech does not.

Table 4.35:LR test for binding restrictions α_{21}= 0(rank = 1) – Federal Bank

Chi-square(1)	14.36624
Probability	0.000150

Since the null hypothesis that α_{21}= 0 was rejected, it can be stated that there is a two way causational relation between productivity and technology, that is, technology and ROA are interdependent on each other..

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We

estimate these quantities from the VAR model in LROA and LTech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

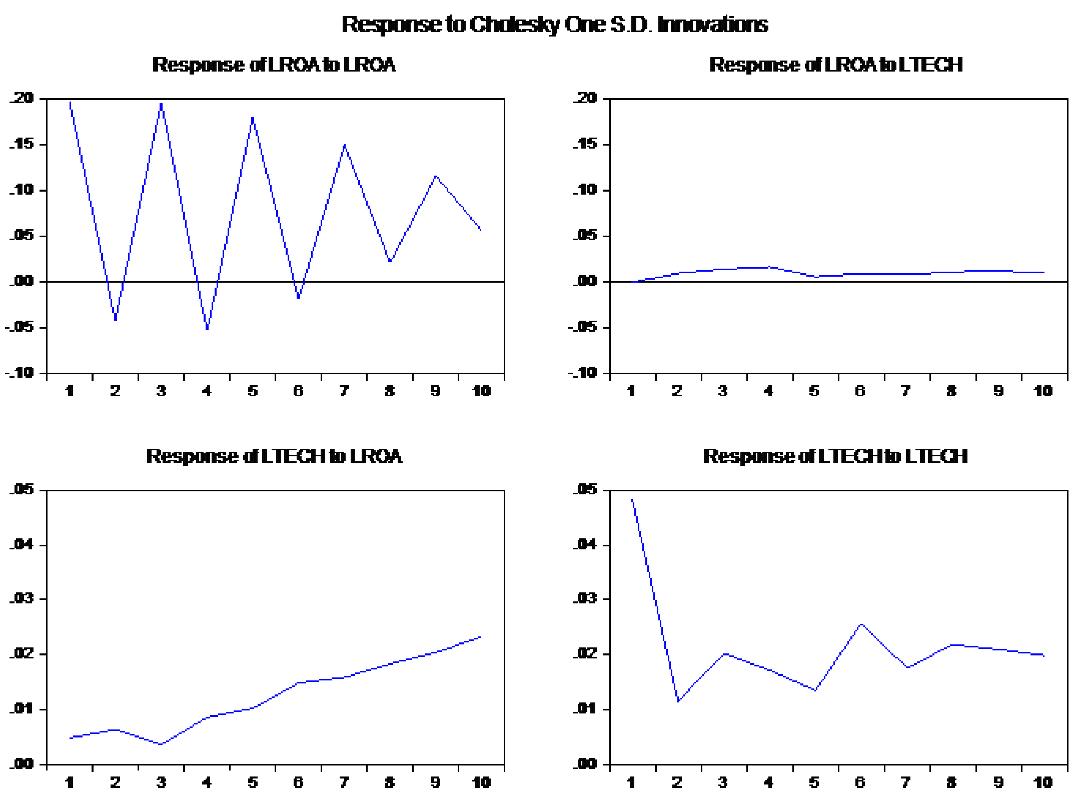

Figure 4.35: Impulse Response (Cholesky dof adjusted) – Federal Bank

Figure 4.35 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that the concerned variables have little impact on each other.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.36.

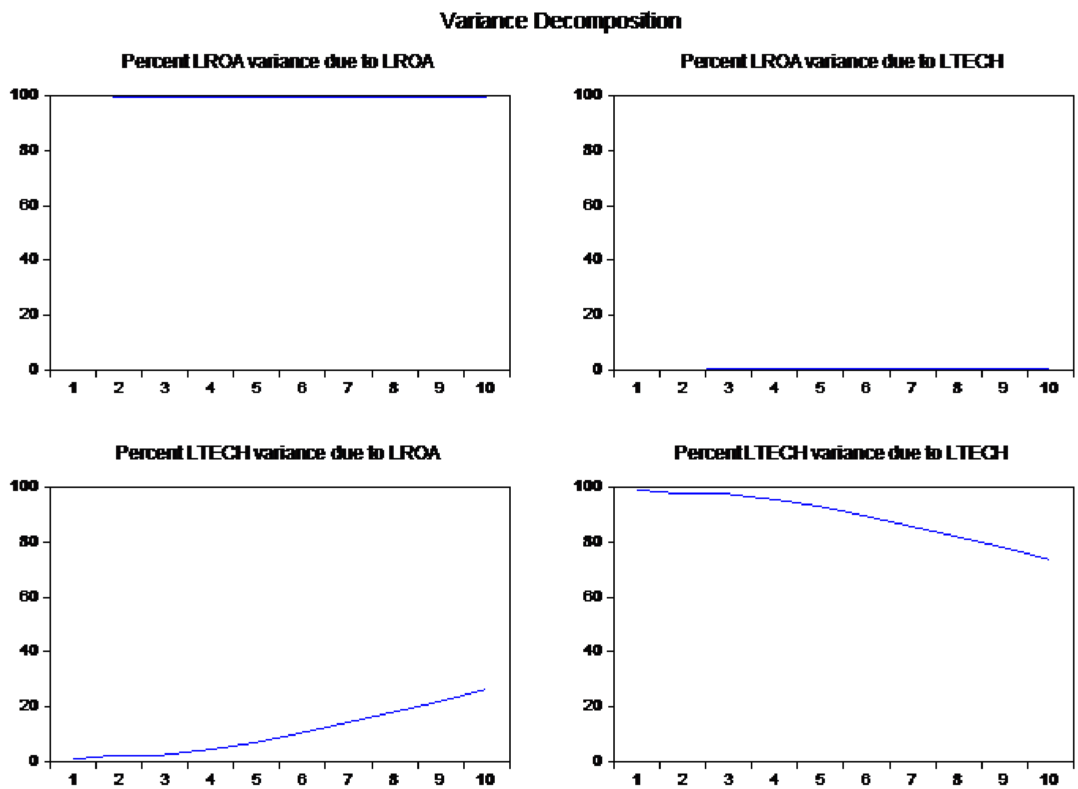

Figure 4.36: Variance Decomposition (Cholesky) – Federal Bank

It is clear from figure 4.36 that the impact is low in the case of LROA variance due to LTECH and in the case of LTECH variance due to LROA.

4.2.5: Impact of ICT diffusion on ROA – HDFC Bank

This section examines the impact of ICT on the ROA of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROA and ICT diffusion in banking sector. The ROA of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROA and LTech respectively.

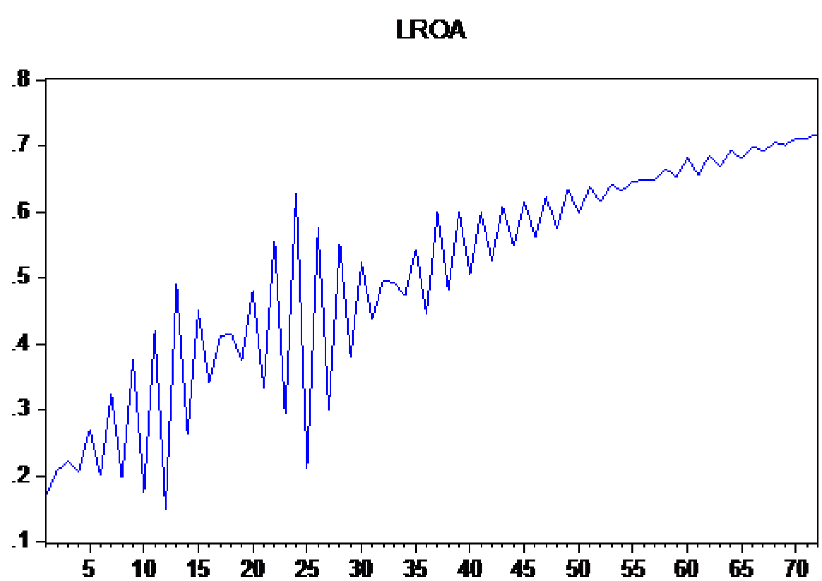

Figure 4.37: ROA Pattern (in Log) – HDFC

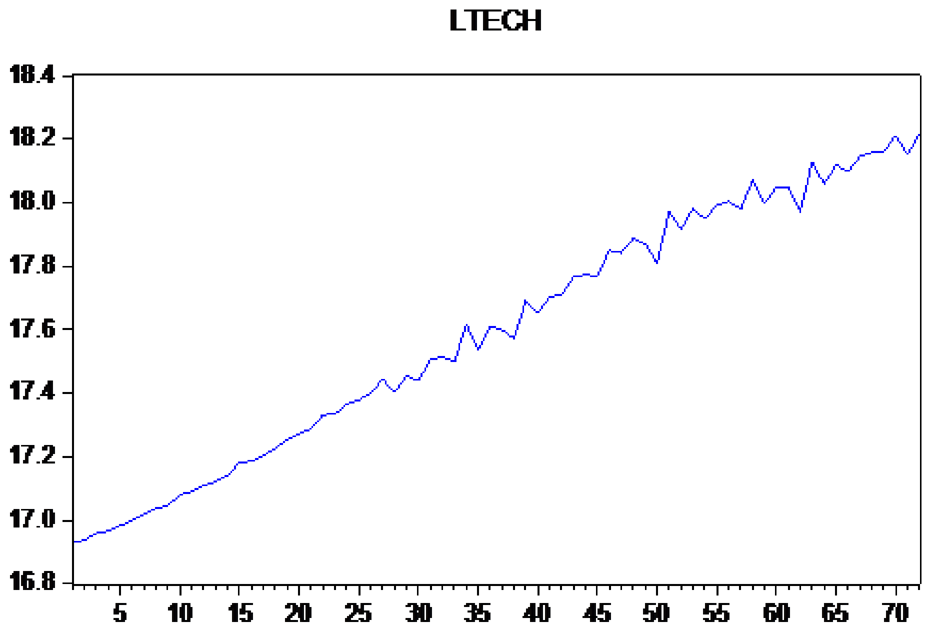

Figure 4.38: Technology Pattern (in Log) – HDFC

The result of the unit root analysis made was given in Table 4.36. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.36: Test Result of Unit Root Test for HDFC

Variable	Test Statistic	p value
LROA	-2.139684	0.5147
LTech	-0.095944	0.9940
Δ LROA	-19.47572**	0.0001
Δ LTech	-7.080680**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.37 and Table 4.38. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.37: Unrestricted Cointegration Rank Test (Trace) - HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.248271	30.24569	0.0015
At most 1*	0.158769	11.41064	0.0184

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.38: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.248271	18.83505	0.0167
At most 1*	0.158769	11.41064	0.0184

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROA_t = 1.47628\Delta LROA_{t-1} + 0.40418\Delta LROA_{t-2} + 0.07965\Delta LROA_{t-3} + 0.13228\Delta LROA_{t-4} + 0.064505\Delta LROA_{t-5} + 0.011704\Delta LTech_{t-1} + 0.04122\Delta LTech_{t-2} + 0.02998\Delta LTech_{t-3} + 0.020499\Delta LTech_{t-4} + 0.00541\Delta LTech_{t-5} + 0.100388(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.31036\Delta LROA_{t-1} + 0.21144\Delta LROA_{t-2} + 0.0387\Delta LROA_{t-3} + 0.03654\Delta LROA_{t-4} + 0.03741\Delta LROA_{t-5} + 0.95967\Delta LTech_{t-1} + 0.56715\Delta LTech_{t-2} + 0.28055\Delta LTech_{t-3} + 0.22829\,\Delta LTech_{t-4} + 0.149803\Delta LTech_{t-5} + 0.250664\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

Since there are two cointegrating equations, there is no need for testing to know whether there is a two way causation or a one way causation (procedure (iii)), with the restriction that α_{21}= 0 or α_{11}= 0. Here both the equations will hold as a result of two cointegrating equations

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

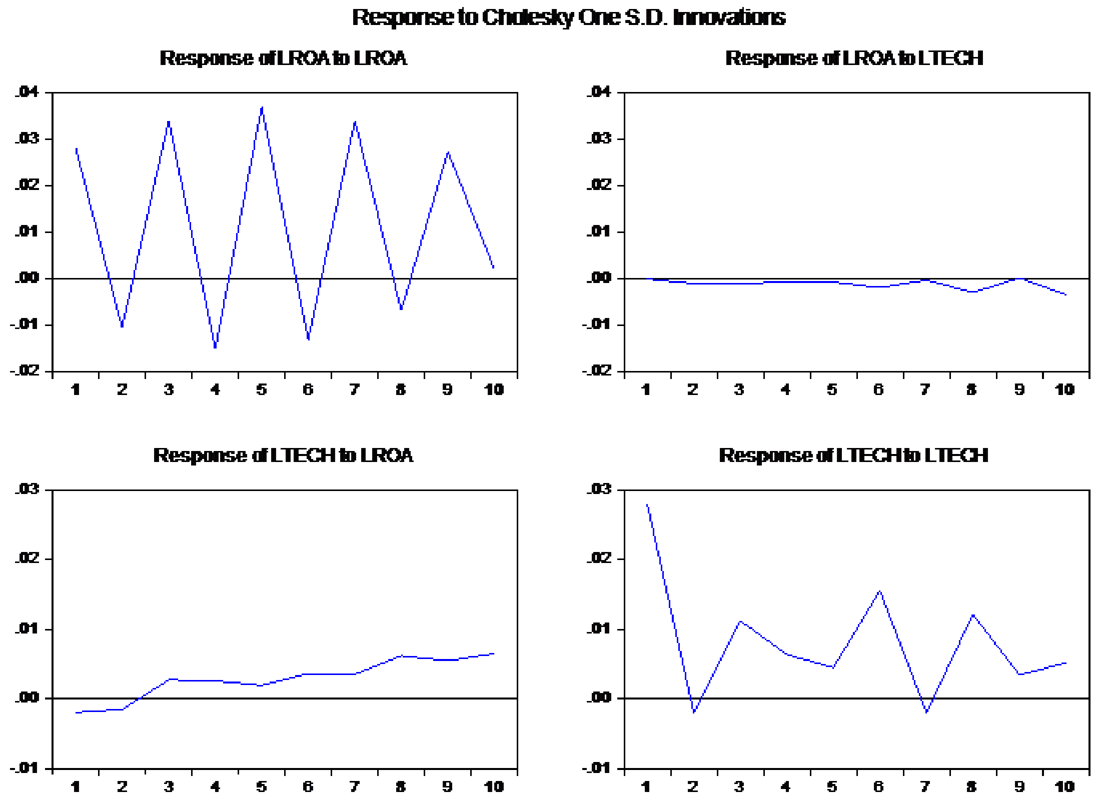

Figure 4.39: Impulse Response (Cholesky dof adjusted) – HDFC

Figure 4.39 clearly indicates that the variables concerned are responding to a standard deviation shock.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.40.

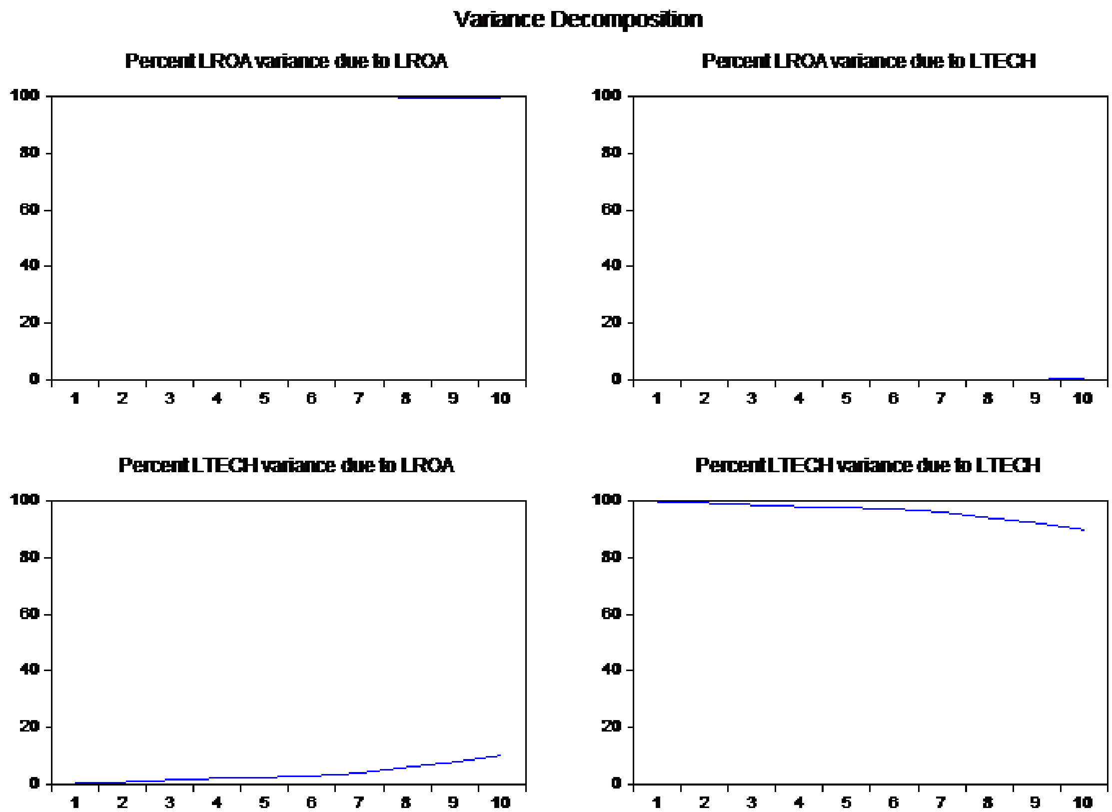

Figure 4.40: Variance Decomposition (Cholesky) – HDFC

It is clear from figure 4.40 that the impact is low in the case of LROA variance due to LTECH and in the case of LTECH variance due to LROA.

4.2.6: Impact of ICT diffusion on ROE – All SCBs

This section examines the impact of ICT on the return on assets (ROE) of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROE and ICT diffusion in banking sector. The ROE of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROE and LTech respectively.

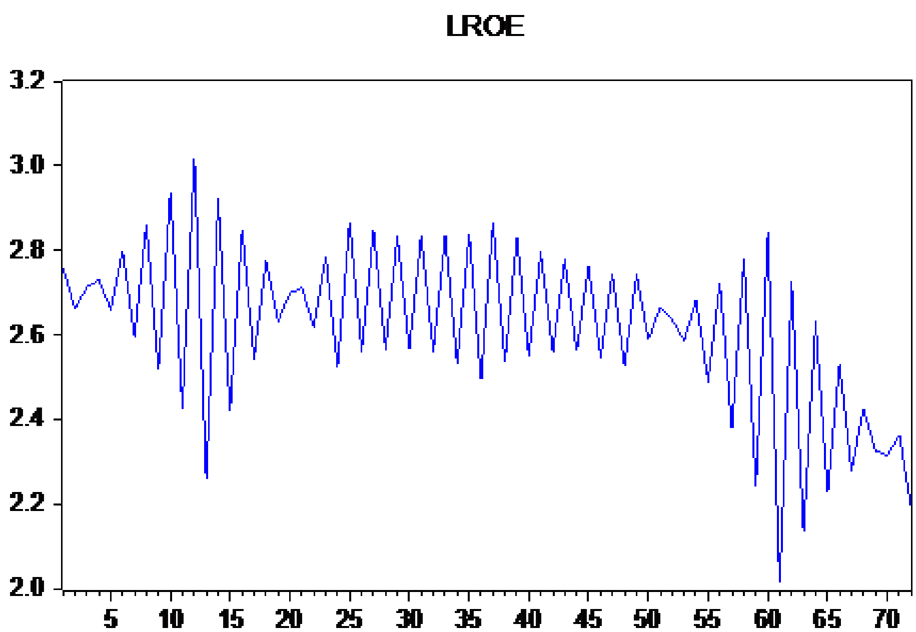

Figure 4.41: ROE Pattern (in Log) - All SCBs

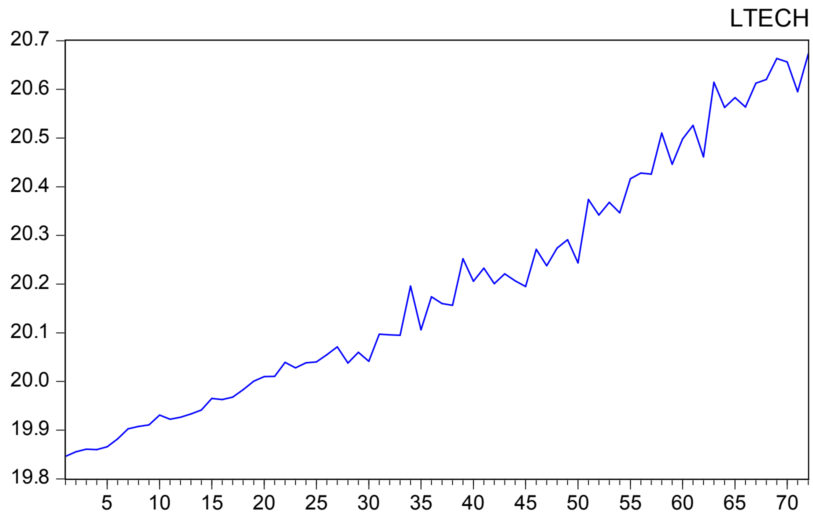

Figure 4.42: Technology Pattern (in Log) - All SCBs

In this regard, the error correction model was estimated as:

$$\Delta LROE_t = \beta_{10} + \beta_{11}\Delta LROE_{t-1} + \beta_{12}\Delta LROE_{t-2} + \beta_{13}\Delta LROE_{t-3} + \beta_{14}\Delta LROE_{t-4} + \beta_{15}\Delta LROE_{t-5} + \beta_{16}\Delta LTech_{t-1} + \beta_{17}\Delta LTech_{t-2} + \beta_{18}\Delta LTech_{t-3} + \beta_{19}\Delta LTech_{t-4} + \beta_{110}\Delta LTech_{t-5} + \alpha_{11}(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = \beta_{20} + \beta_{21}\Delta LROE_{t-1} + \beta_{22}\Delta LROE_{t-2} + \beta_{23}\Delta LROE_{t-3} + \beta_{24}\Delta LROE_{t-4} + \beta_{25}\Delta LROE_{t-5} + \beta_{26}\Delta LTech_{t-1} + \beta_{27}\Delta LTech_{t-2} + \beta_{28}\Delta LTech_{t-3} + \beta_{29}\Delta LTech_{t-4} + \beta_{210}\Delta LTech_{t-5} + \alpha_{21}(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

The equation with $\alpha_{21} = 0$ implies that LROE adjusts to long run equilibrium whereas LTech does not. In other words, there is only one way causality from LTech to LROE at zero frequency. That is, shocks in technology can influence the long run forecast of ROE and not vice versa. If so,

$$\lim_{h\to\infty} \frac{\partial E(LROE_{t+h})}{\partial E(LTech_t)} \neq 0$$

$$\lim_{h\to\infty} \frac{\partial E(LTech_{t+h})}{\partial E(LROA_t)} = 0$$

This implies that the conditional forecast of ROE h period ahead depends only on technology.

There are five steps involved in testing the long run association between ROE and technology:

(i) Examining time series properties of ROE and ICT diffusion. That is, both ROE and ICT are tested for stationarity. The Augmented Dickey-Fuller (ADF) unit root test was used for this purpose.

(ii) Test whether there is any cointegration between ROE and ICT diffusion. Johansen system cointegration test was applied here.

(iii) Test to know whether the restriction imposed on the error correction mechanism is valid or not.

(iv) Examining the dynamic behavior of one variable after a standard deviation shock in other variable by using the impulse response function.

(v) Evaluating the proportion of forecast error variance of ROE and ICT diffusion to know whether the forecast error variance of ROE is increasingly explained by shocks in ICT diffusion as the forecast horizon increases.

The result of the analysis made on procedure (i) was given in Table 4.39. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.39: Test Result of Unit Root Test for All SCBs

Variable	Test Statistic	p value
LROE	0.153520	0.9972
LTech	-0.4915	0.9814
Δ LROE	-18.61199**	0.0001
Δ LTech	-4.241190**	0.0071

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of the analysis made on procedure (ii) was given in Table 4.40 and Table 4.41. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.40: Unrestricted Cointegration Rank Test (Trace) - All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.220946	20.75677	0.0427
At most 1	0.062766	4.278240	0.3722

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.41: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - All SCBs

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.220946	16.47853	0.0405
At most 1	0.062766	4.278240	0.3722

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\begin{aligned}\Delta LROE_t = {} & 1.37932\Delta LROE_{t-1} + 0.27484\Delta LROE_{t-2} + 0.065416\Delta LROE_{t-3} \\ & + 0.05522\Delta LROE_{t-4} + 0.065969\Delta LROE_{t-5} + 0.024746\Delta LTech_{t-1} \\ & + 0.129956\Delta LTech_{t-2} + 0.02139\Delta LTech_{t-3} + 0.24147\Delta LTech_{t-4} \\ & + 0.05418\Delta LTech_{t-5} + 0.04075(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}\end{aligned}$$

$$
\begin{aligned}
\Delta LTech_t = {} & 0.02182\Delta LROE_{t-1} + 0.0859\Delta LROE_{t-2} + 0.1763\Delta LROE_{t-3} \\
& + 0.06933\Delta LROE_{t-4} + 0.020012\Delta LROE_{t-5} + 0.93922\Delta LTech_{t-1} \\
& + 0.49973\Delta LTech_{t-2} + 0.27368\Delta LTech_{t-3} + 0.34874\Delta LTech_{t-4} \\
& + 0.026643\Delta LTech_{t-5} + 0.076316(LROA_{t-1} - \propto - \beta LTech_{t-1}) \\
& + u_{2t}
\end{aligned}
$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that LROE adjusts to long run equilibrium whereas LTech does not.

Table 4.42:LR test for binding restrictions α_{21}= 0 (rank = 1) - All SCBs

Chi-square(1)	11.01366
Probability	0.000904

Since the null hypothesis that α_{21}= 0 was rejected, it can be stated that there is a two way causational relation between productivity and technology, that is, technology and ROE are interdependent on each other.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We estimate these quantities from the VAR model in LROE and LTech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

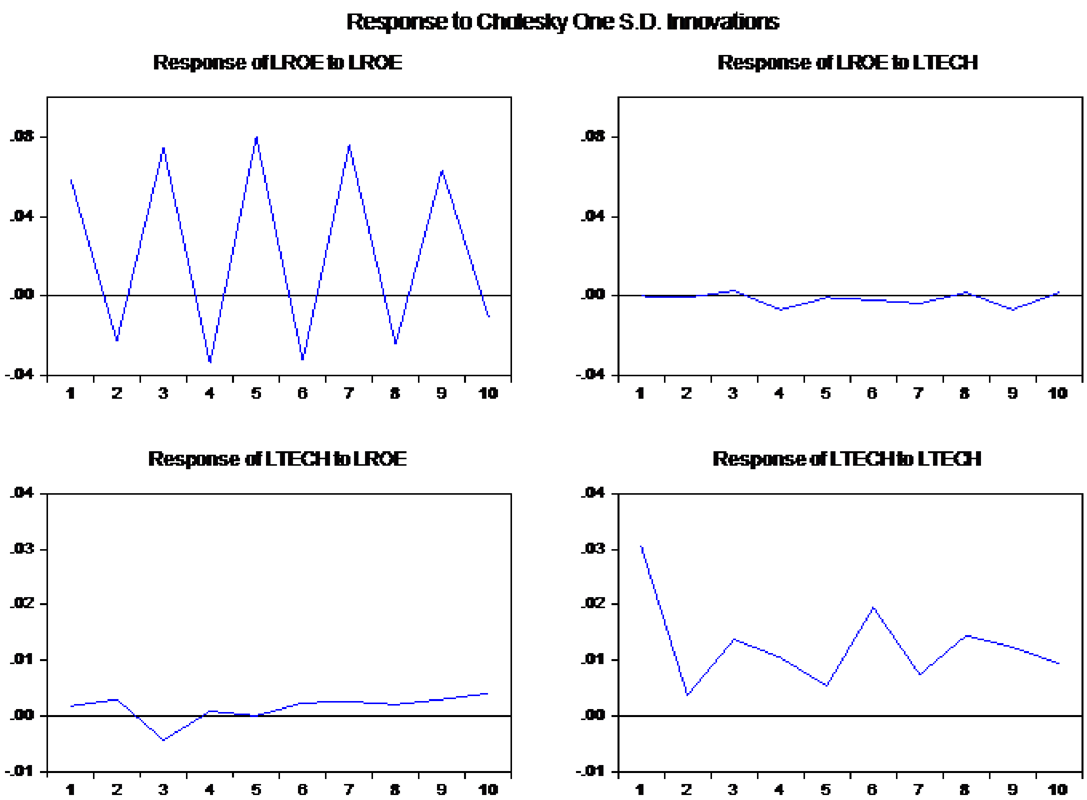

Figure 4.43: Impulse Response (Cholesky dof adjusted) - All SCBs

Figure 4.43 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROE has little impact on technology whereas technology has considerable impact on ROE.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.44.

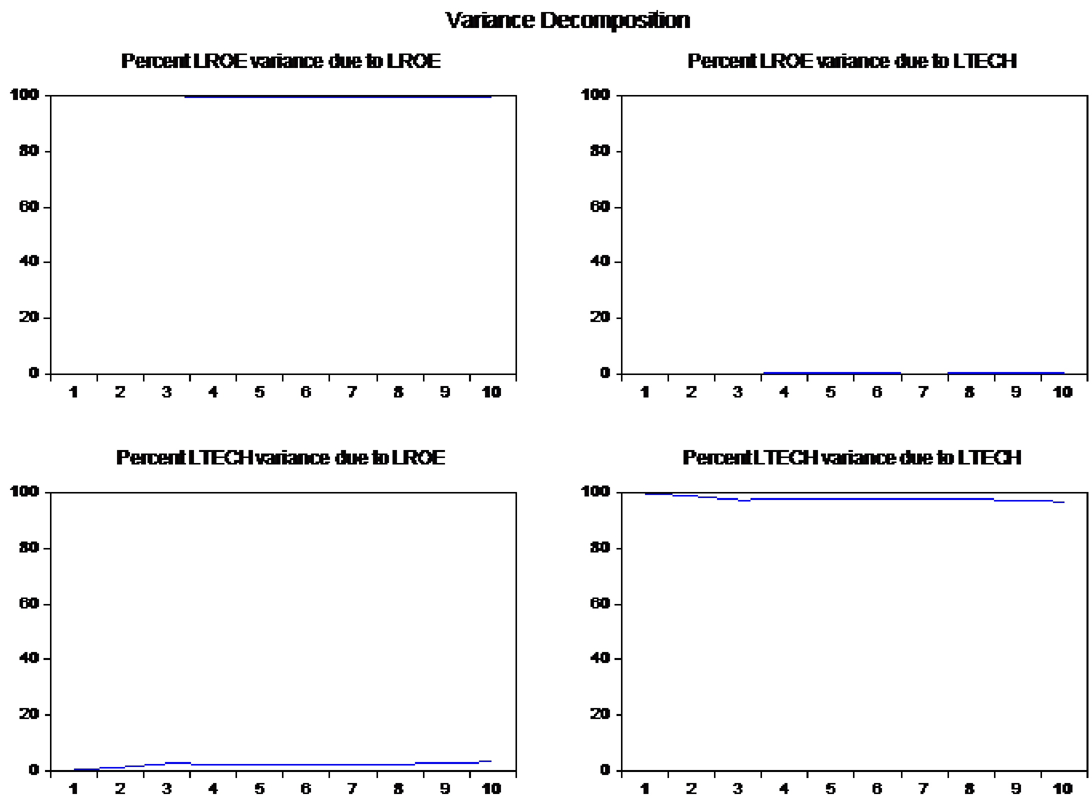

Figure 4.44: Variance Decomposition (Cholesky) - All SCBs

It is clear from figure 4.44 that the impact is minimal on both ROE and technology.

4.2.7: Impact of ICT diffusion on ROE – SBI

This section examines the impact of ICT on the ROE of State Bank of India, which was taken as a representative of SB Group. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROE and ICT diffusion in SBI. The ROE of SBI and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROE and LTech respectively.

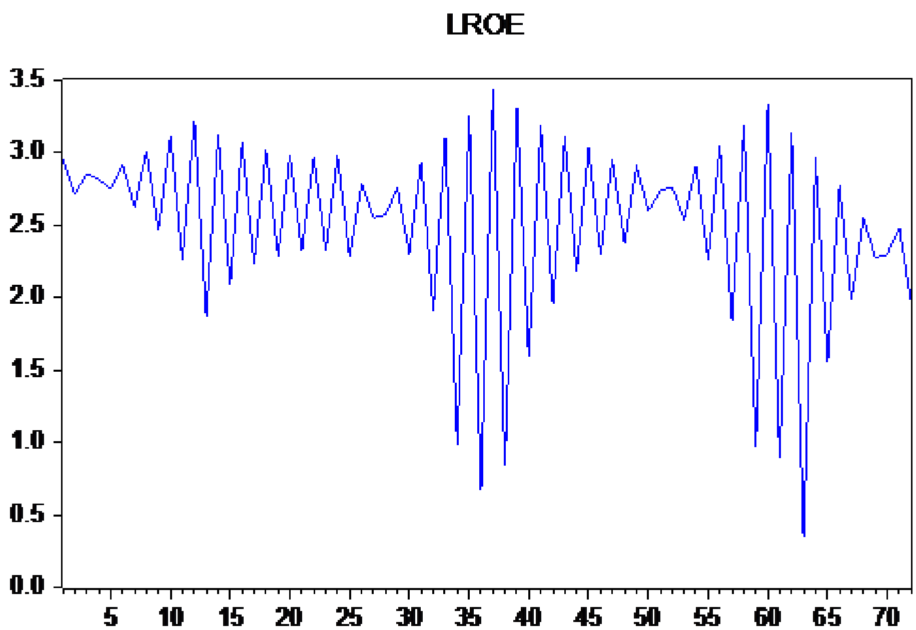

Figure 4.45: ROE Pattern (in Log) - SBI

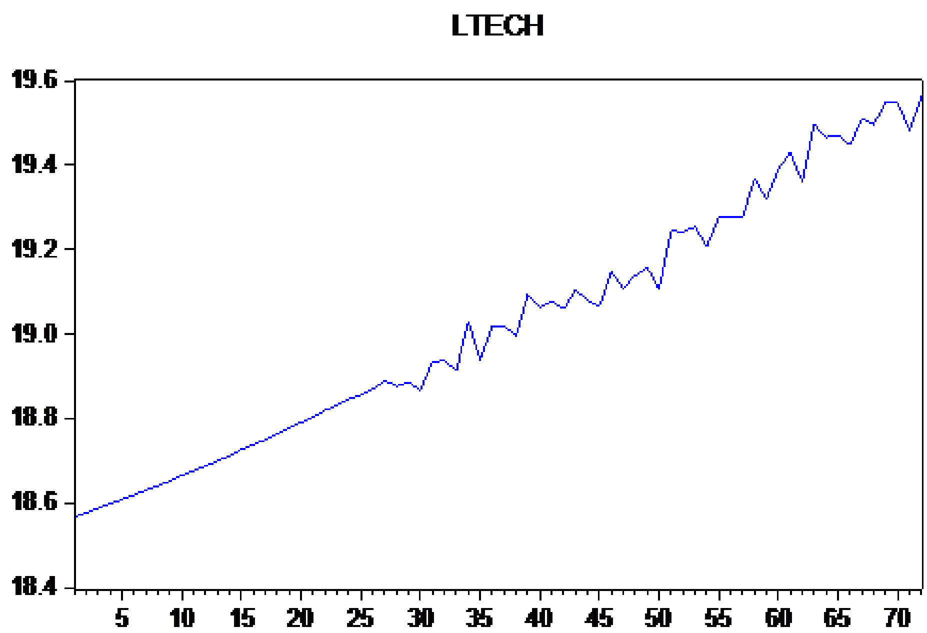

Figure 4.46: Technology Pattern (in Log) - SBI

The result of the unit root analysis made was given in Table 4.43. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.43: Test Result of Unit Root Test for SBI

Variable	Test Statistic	p value
LROE	-3.018063	0.1350
LTech	-2.001279	0.5902
Δ LROE	-4.516109**	0.0029
Δ LTech	-4.016182*	0.0132

** indicates significant at 1% level
* indicates significant at 5% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.44 and Table 4.45. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.44: Unrestricted Cointegration Rank Test (Trace) - SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.302432	35.13033	0.0002
At most 1*	0.158124	11.36011	0.0189

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.45: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - SBI

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.302432	23.77022	0.0024
At most 1*	0.158124	11.36011	0.0189

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROE_t = 1.08031\Delta LROE_{t-1} + 0.17836\Delta LROE_{t-2} + 0.134119\Delta LROE_{t-3} + 0.02896\Delta LROE_{t-4} + 0.166811\Delta LROE_{t-5} + 1.005256\Delta LTech_{t-1} + 0.658662\Delta LTech_{t-2} + 0.69686\Delta LTech_{t-3} + 0.657697\Delta LTech_{t-4} + 0.892364\Delta LTech_{t-5} + 0.010842(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.02944\Delta LROE_{t-1} + 0.05835\,\Delta LROE_{t-2} + 0.0124\Delta LROE_{t-3} + 0.00946\,\Delta LROE_{t-4} + 0.0191\Delta LROE_{t-5} + 1.07967\Delta LTech_{t-1} + 0.80274\Delta LTech_{t-2} + 0.44474\Delta LTech_{t-3} + 0.49296\Delta LTech_{t-4} + 0.13089\Delta LTech_{t-5} + 0.01372(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

Since there are two cointegrating equations, there is no need for testing to know whether there is a two way causation or a one way causation (procedure (iii)), with the restriction that α_{21}= 0 or α_{11}= 0. Here both the equations will hold as a result of two cointegrating equations.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

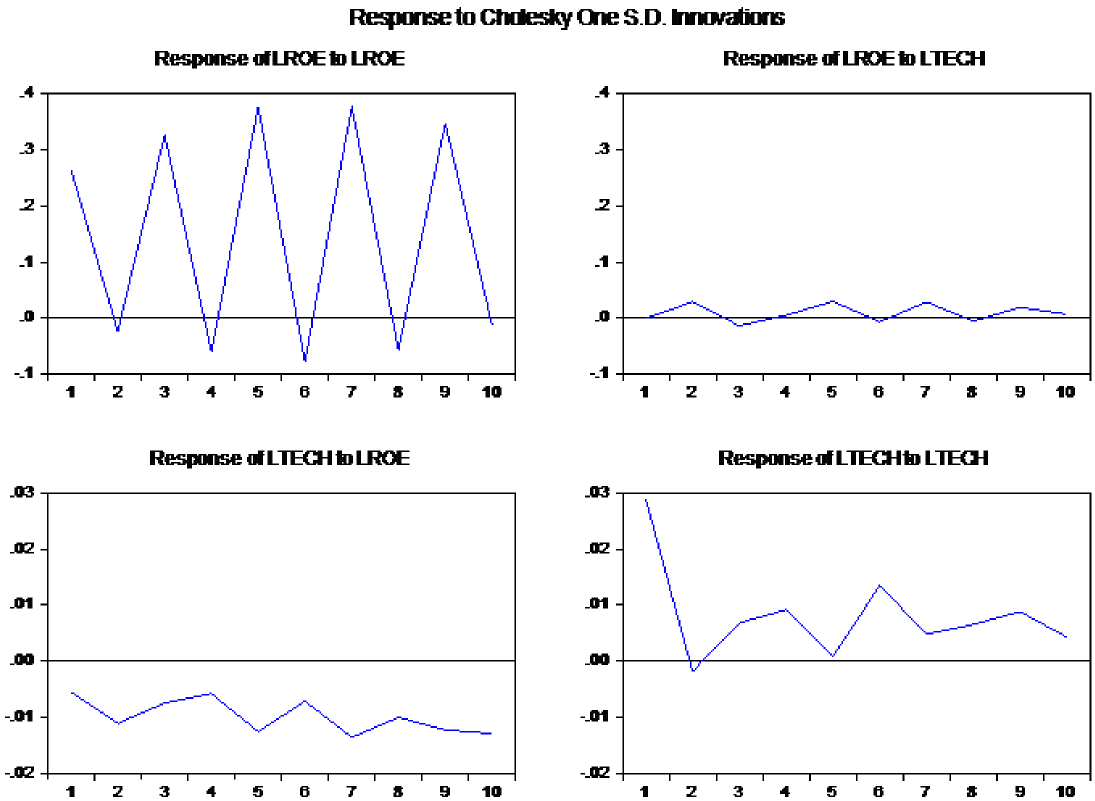

Figure 4.47: Impulse Response (Cholesky dof adjusted) - SBI

Figure 4.47 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROE has little impact on technology whereas technology has considerable impact on ROE.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.48.

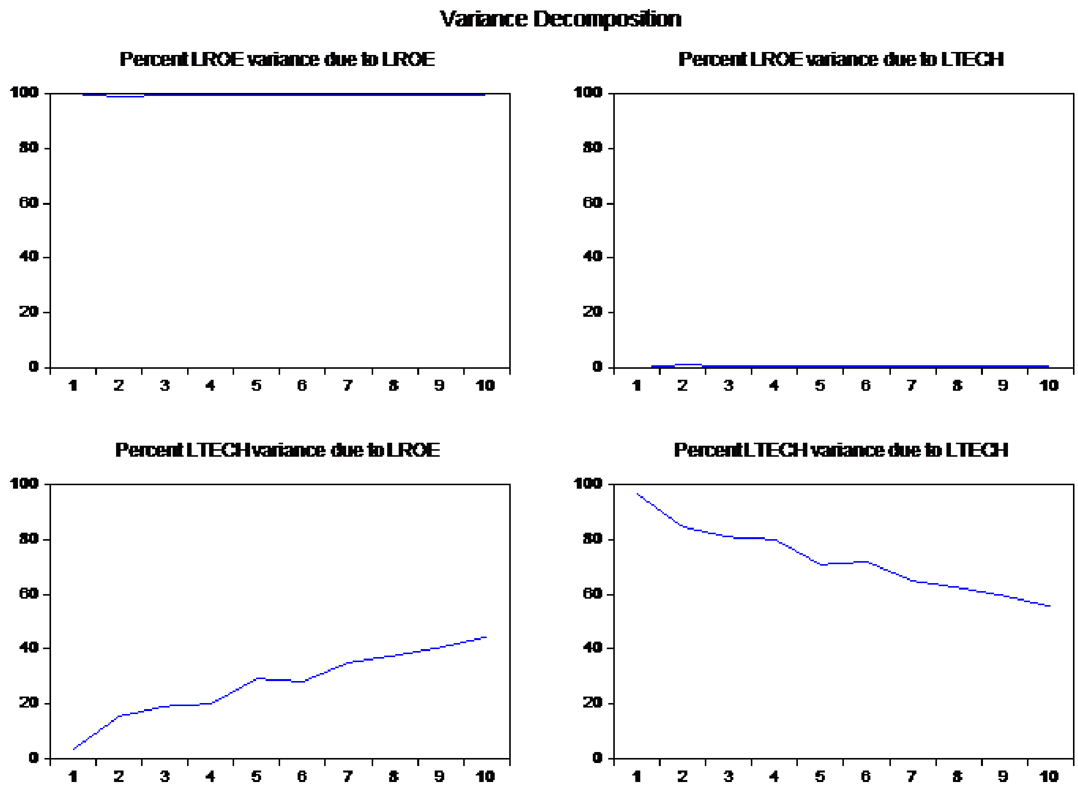

Figure 4.48: Variance Decomposition (Cholesky) - SBI

It is clear from figure 4.48 that there is some impact on both ROE and technology.

4.2.8: Impact of ICT diffusion on ROE – PNB

This section examines the impact of ICT on the ROE of Punjab National Bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between

ROE and ICT diffusion in banking sector. The ROE of Punjab National Bank and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROE and LTech respectively.

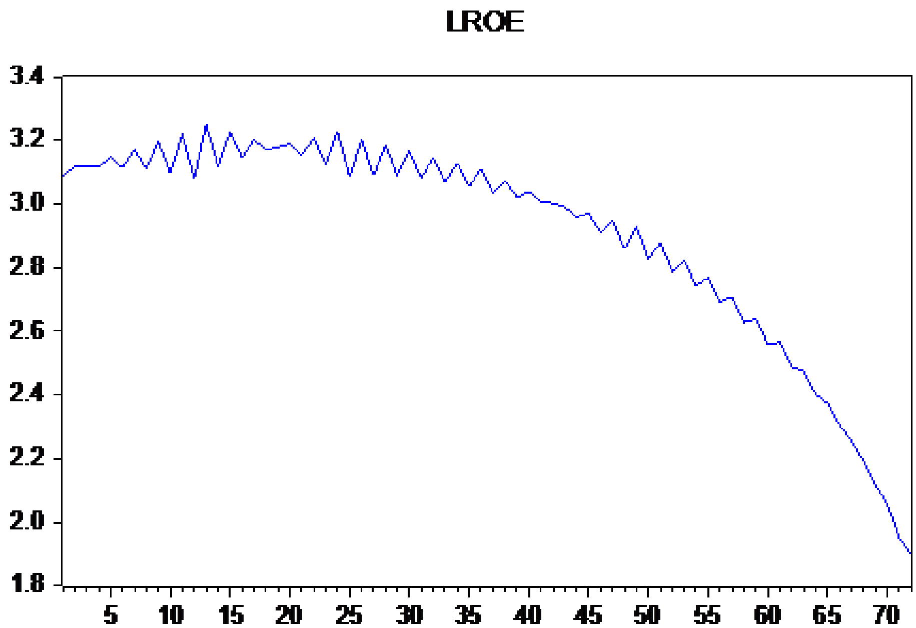

Figure 4.49: ROE Pattern (in Log) - PNB

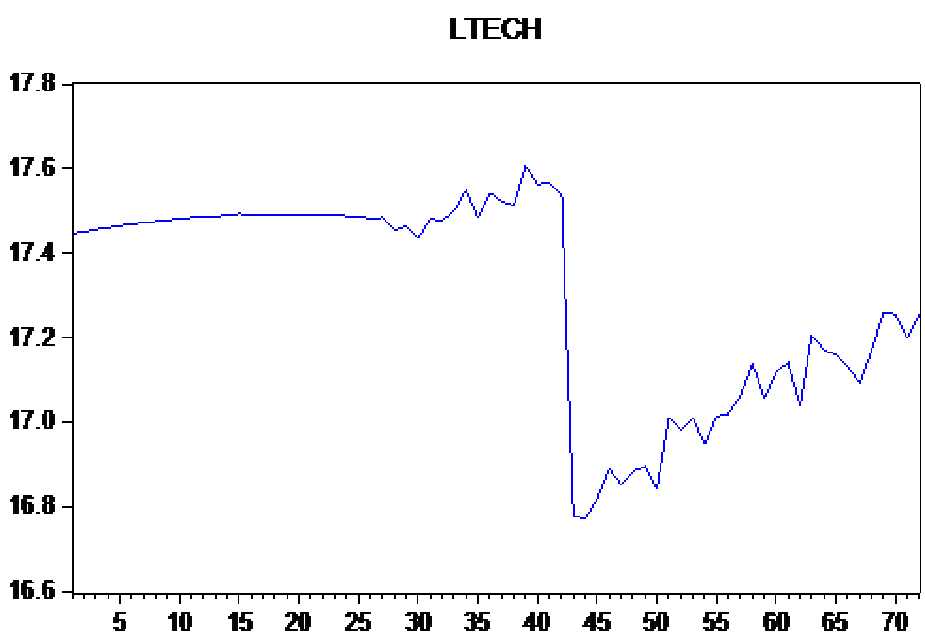

Figure 4.50: Technology Pattern (in Log) - PNB

The result of the unit root analysis made was given in Table 4.46. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.46: Test Result of Unit Root Test for PNB

Variable	Test Statistic	p value
LROE	3.701936	1.0000
LTech	-2.265420	0.4467
Δ LROE	-48.98837**	0.0001
Δ LTech	-8.634422**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.47 and Table 4.48. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.47: Unrestricted Cointegration Rank Test (Trace) - PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.675621	80.69492	0.0000
At most 1	0.042710	3.011767	0.5785

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.48: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - PNB

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.675621	77.68315	0.0000
At most 1	0.042710	3.011767	0.5785

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROE_t = 1.44229\Delta LROE_{t-1} + 0.38894\Delta LROE_{t-2} + 0.017874\Delta LTech_{t-1} + 0.00314\Delta LTech_{t-2} + 0.184385\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.678305\Delta LROE_{t-1} + 0.738716\Delta LROE_{t-2} + 0.04963\Delta LTech_{t-1} + 0.06451\Delta LTech_{t-2} + 0.0991\,(LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that LROE adjusts to long run equilibrium whereas LTech does not.

Table 4.49:LR test for binding restrictions (rank = 1) - PNB

Chi-square(1)	0.920196
Probability	0.337424

Since the null hypothesis that α_{21}= 0 was accepted, it can be stated that there is only a one way causational relation between ROE and technology. Therefore only the first equation where ROE is taken as the dependent variable is relevant here, that is, it is true that ROE depends on technology, but on the basis of data collected the opposite is not true.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

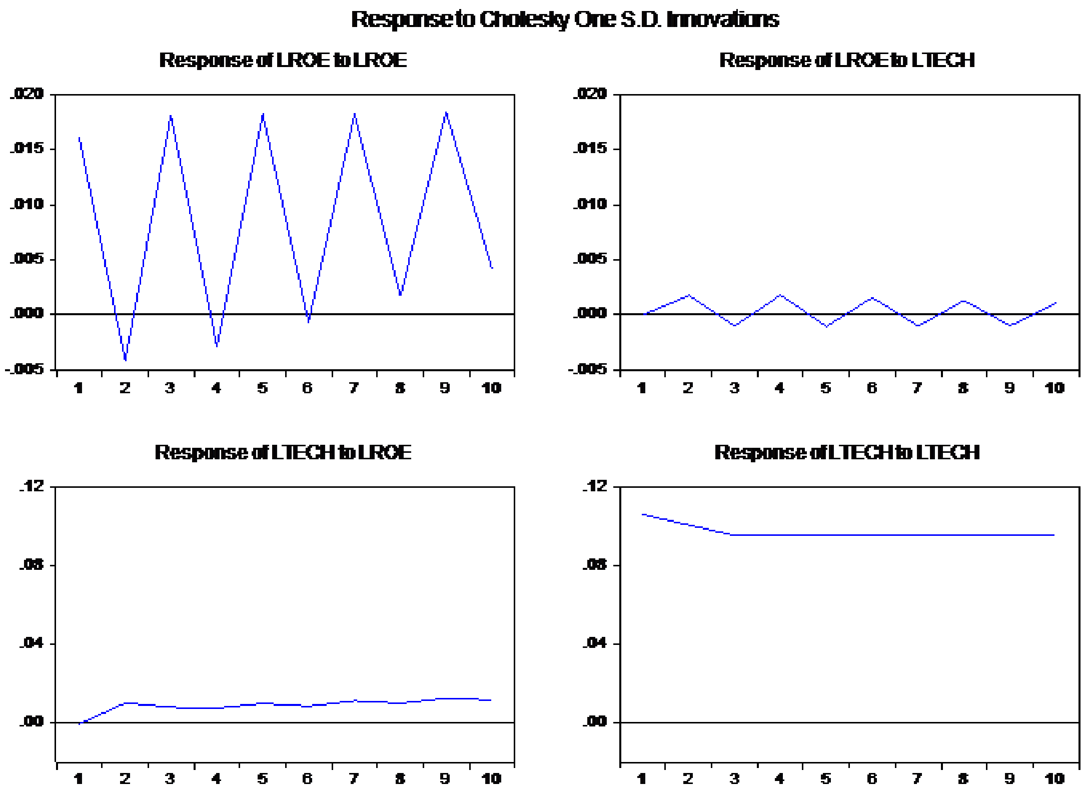

Figure 4.51: Impulse Response (Cholesky dof adjusted) - PNB

Figure 4.51 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that ROE has little impact on technology whereas technology has considerable impact on ROE.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.52.

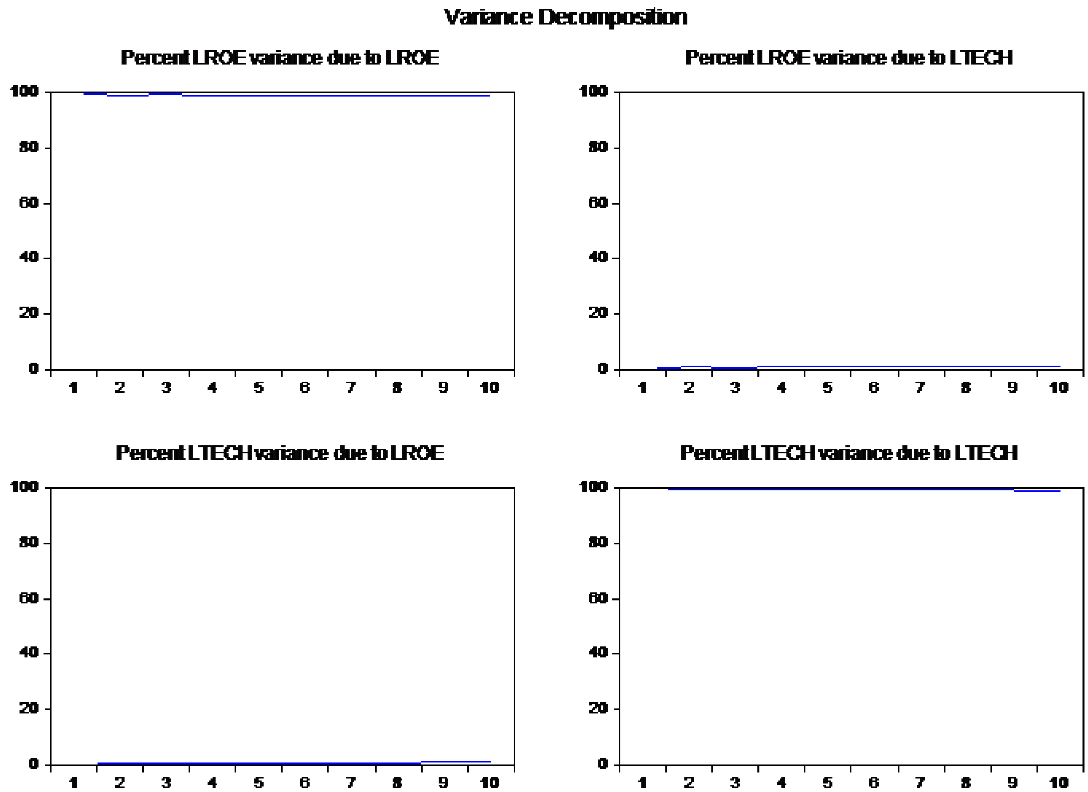

Figure 4.52: Variance Decomposition (Cholesky) - PNB

It is clear from figure 4.52 that the impact is low in the case of LROE variance due to LTECH and more in the case of LTECH variance due to LROE.

4.2.9: Impact of ICT diffusion on ROE – Federal Bank

This section examines the impact of ICT on the ROE of Federal bank. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROE and ICT diffusion in Federal Bank. The ROE of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROE and LTech respectively.

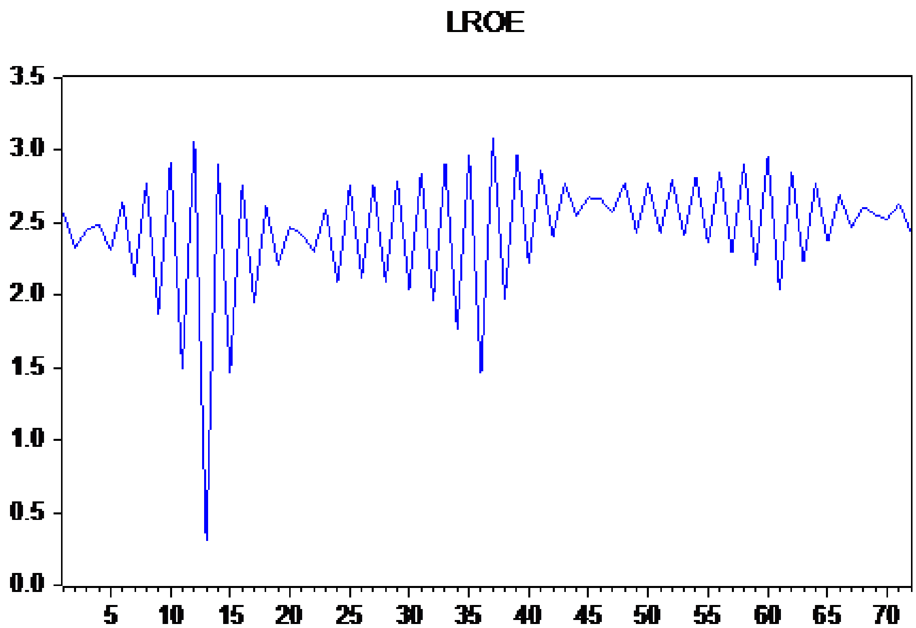

Figure 4.53: ROE Pattern (in Log) – Federal Bank

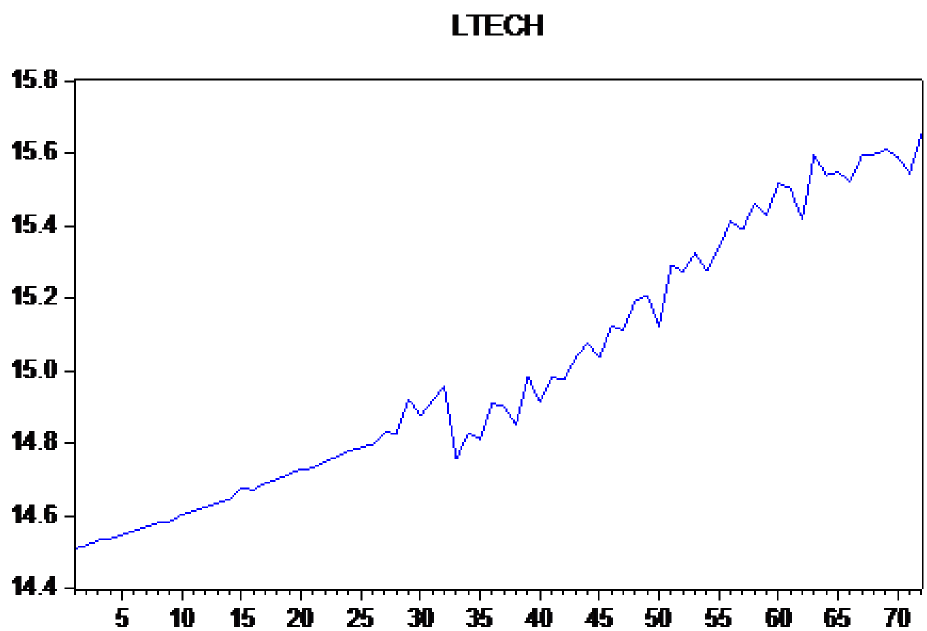

Figure 4.54: Technology Pattern (in Log) – Federal Bank

The result of the unit root analysis made was given in Table 4.50. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.50: Test Result of Unit Root Test for Federal Bank

Variable	Test Statistic	p value
LROE	-3.896229	0.0173
LTech	-1.944006	0.6203
Δ LROE	-11.27131**	0.0000
Δ LTech	-9.470753**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.51 and Table 4.52. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.51: Unrestricted Cointegration Rank Test (Trace) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.344406	34.13769	0.0003
At most 1	0.083601	5.849365	0.2027

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.52: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) – Federal Bank

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.344406	28.28832	0.0004
At most 1	0.083601	5.849365	0.2027

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$\Delta LROE_t = 1.02826\Delta LROE_{t-1} + 0.15924\Delta LROE_{t-2} + 0.05912\Delta LROE_{t-3}$$
$$+ 0.13764\Delta LROE_{t-4} + 0.641674\Delta LTech_{t-1} + 1.353616\Delta LTech_{t-2}$$
$$+ 1.550513\Delta LTech_{t-3} + 0.861529\Delta LTech_{t-4}$$
$$+ 0.27286\ (LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}$$

$$\Delta LTech_t = 0.08403\Delta LROE_{t-1} + 0.0598\Delta LROE_{t-2} + 0.06341\Delta LROE_{t-3}$$
$$+ 0.02967\Delta LROE_{t-4} + 0.74341\Delta LTech_{t-1} + 0.39635\Delta LTech_{t-2}$$
$$+ 0.24749\Delta LTech_{t-3} + 0.26294\Delta LTech_{t-4}$$
$$+ 0.125934\ (LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{2t}$$

In order to know whether there is a two way causation or a one way causation (procedure (iii)), a test was made with the restriction that α_{21}= 0 which implies that LROE adjusts to long run equilibrium whereas LTech does not.

Table 4.53:LR test for binding restrictions α_{21}= 0(rank = 1) – Federal Bank

Chi-square(1)	17.74139
Probability	0.000025

Since the null hypothesis that α_{21}= 0 was rejected, it can be stated that there is a two way causational relation between productivity and technology, that is, technology and ROE are interdependent on each other.

To further explore the nature of interactions between variables we use two techniques in the context of VAR, namely, impulse response functions (procedure (iv)) and error variance decomposition (procedure (v)). We estimate these quantities from the VAR model in LROE and LTech reformulated in first differences in the log of variables.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

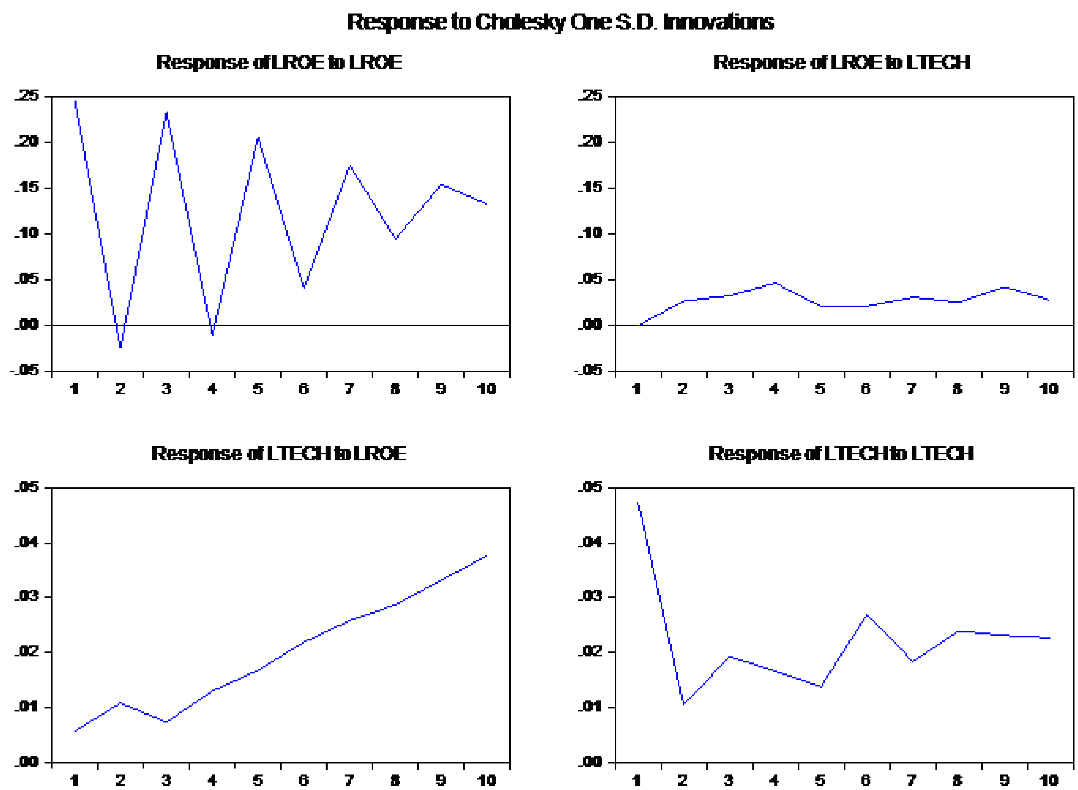

Figure 4.55: Impulse Response (Cholesky dof adjusted) – Federal Bank

Figure 4.35 clearly indicates that the variables concerned are responding to a standard deviation shock. It is clear that the concerned variables have little impact on each other.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.36.

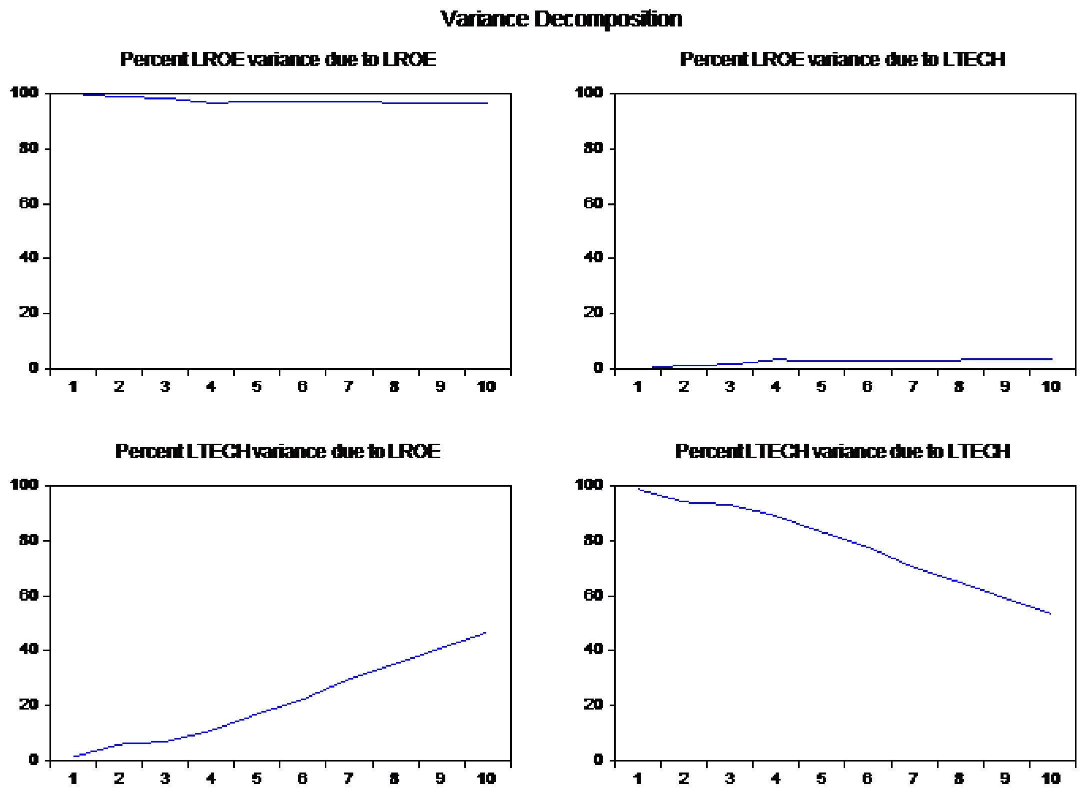

Figure 4.56: Variance Decomposition (Cholesky) – Federal Bank

It is clear from figure 4.36 that the impact is low in the case of LROE variance due to LTECH and in the case of LTECH variance due to LROE.

4.2.10: Impact of ICT diffusion on ROE – HDFC Bank

This section examines the impact of ICT on the ROE of all scheduled commercial banks taken together. For this purpose total transaction through NEFT, RTGS, ECS, Mobile, Credit Card (ATMs and POS) and Debit Card (ATMs and POS) was used as a proxy for ICT diffusion. The empirical evaluation of this issue is based on unit root test of stationarity, Johansen cointegration test, and estimation of corresponding error correction mechanism. Also, the strategy of Ribba was used to impose restrictions on adjustment parameters. The object of this analysis is to check whether there exists any long run relationship between ROE and ICT diffusion in banking sector. The ROE of all scheduled commercial banks and ICT diffusion have been subjected to a logarithmic transformation and the series obtained are designated as LROE and LTech respectively.

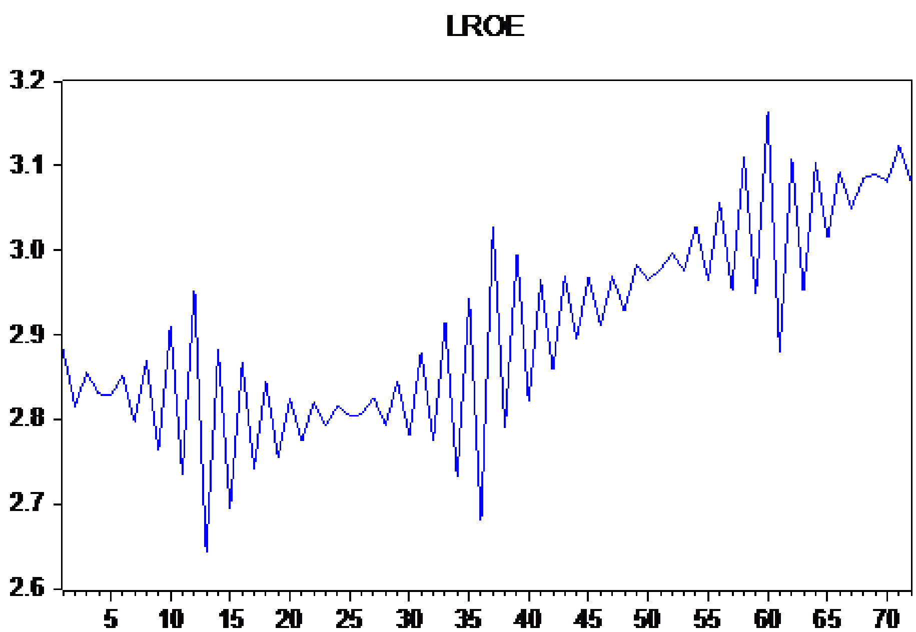

Figure 4.57: ROE Pattern (in Log) – HDFC

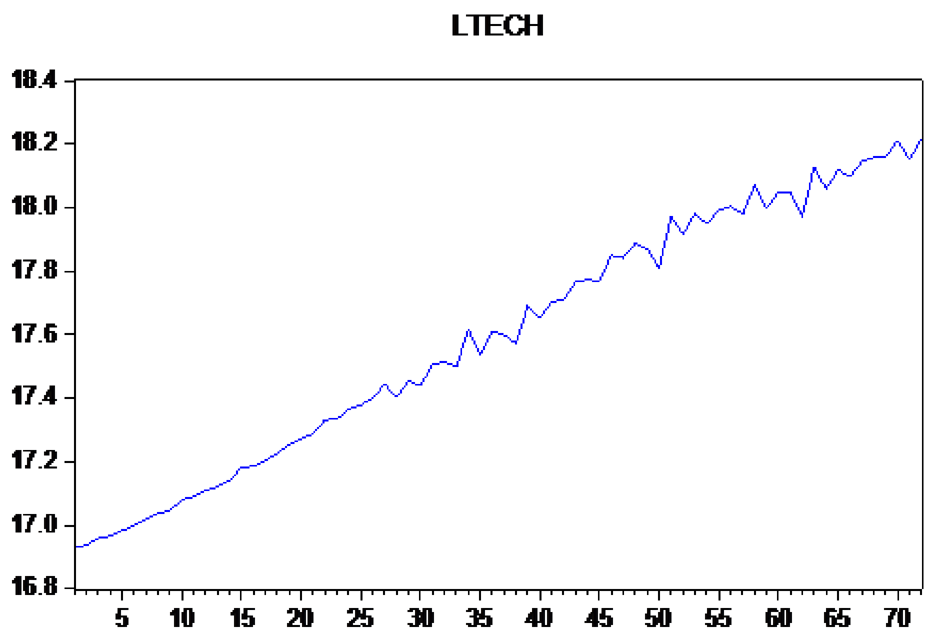

Figure 4.58: Technology Pattern (in Log) – HDFC

The result of the unit root analysis made was given in Table 4.54. The results indicate that the null hypothesis of unit root is rejected at 1% significance level for both the variables in first difference, while it is accepted in levels.

Table 4.54: Test Result of Unit Root Test for HDFC

Variable	Test Statistic	p value
LROE	-2.228279	0.4666
LTech	-0.095944	0.9940
Δ LROE	-12.65450**	0.0001
Δ LTech	-7.080680**	0.0000

** indicates significant at 1% level

Thus the variables are difference stationary and are integrated series of first order. Since both the variables are integrated of same order, these variables can be used for testing for cointegration.

The result of Johansen system test for cointegration was given in Table 4.55 and Table 4.56. The test statistics λ_{trace} and λ_{max} indicate that there is one cointegrating relationship between the variables at 5% level of significance.

Table 4.55: Unrestricted Cointegration Rank Test (Trace) - HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.266608	36.53267	0.0001
At most 1*	0.216082	16.06772	0.0022

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Table 4.56: Unrestricted Cointegration Rank Test (Maximum Eigenvalue) - HDFC

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	p value
None *	0.266608	20.46495	0.0089
At most 1*	0.216082	16.06772	0.0022

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

If the VAR is transformed into a vector error correction model (VECM) and imposes the cointegrating relationships:

$$
\begin{aligned}
\Delta LROE_t = \ & 1.23741\Delta LROE_{t-1} + 0.22582\Delta LROE_{t-2} + 0.22066\Delta LROE_{t-3} \\
& + 0.34\Delta LROE_{t-4} + 0.03812\ \Delta LROE_{t-5} + 0.189502\Delta LTech_{t-1} \\
& + 0.318748\Delta LTech_{t-2} + 0.336452\Delta LTech_{t-3} \\
& + 0.314617\Delta LTech_{t-4} + 0.200767\Delta LTech_{t-5} \\
& + 0.009221\ (LROA_{t-1} - \propto - \beta LTech_{t-1}) + u_{1t}
\end{aligned}
$$

$$
\begin{aligned}
\Delta LTech_t = \ & 0.166814\Delta LROE_{t-1} + 0.238974\Delta LROE_{t-2} + 0.227078\Delta LROE_{t-3} \\
& + 0.255475\Delta LROE_{t-4} + 0.139\,254\Delta LROE_{t-5} + 0.96814\Delta LTech_{t-1} \\
& + 0.5223\,3\Delta LTech_{t-2} + 0.21224\Delta LTech_{t-3} + 0.15961\Delta LTech_{t-4} \\
& + 0.197149\Delta LTech_{t-5} + 0.02742\ (LROA_{t-1} - \propto - \beta LTech_{t-1}) \\
& + u_{2t}
\end{aligned}
$$

Since there are two cointegrating equations, there is no need for testing to know whether there is a two way causation or a one way causation (procedure (iii)), with the restriction that α_{21}= 0 or α_{11}= 0. Here both the equations will hold as a result of two cointegrating equations.

Impulse response function trace out the response of current and future values of both variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The results are illustrated with aid of a graph.

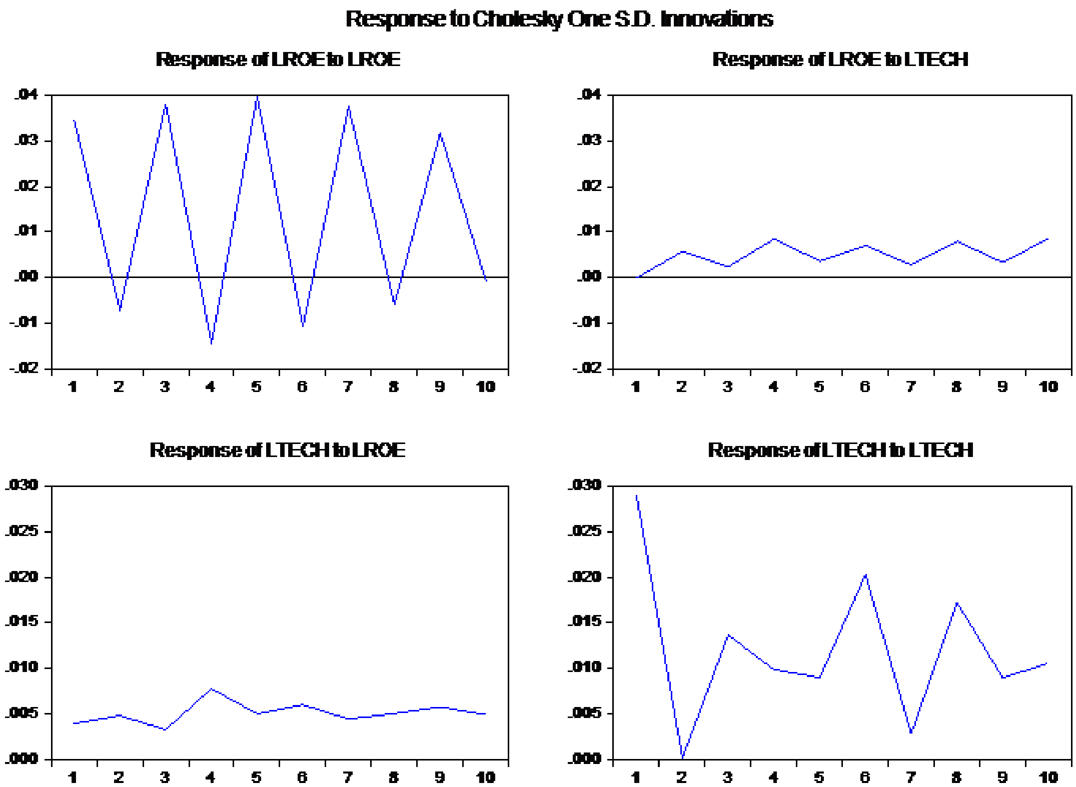

Figure 4.59: Impulse Response (Cholesky dof adjusted) – HDFC

Figure 4.59 clearly indicates that the variables concerned are responding to a standard deviation shock.

Variance decomposition gives an idea about the amount of the predict error variance that can be explained by exogenous shock of other variable. Result is shown using Cholesky Decomposition in Figure 4.60.

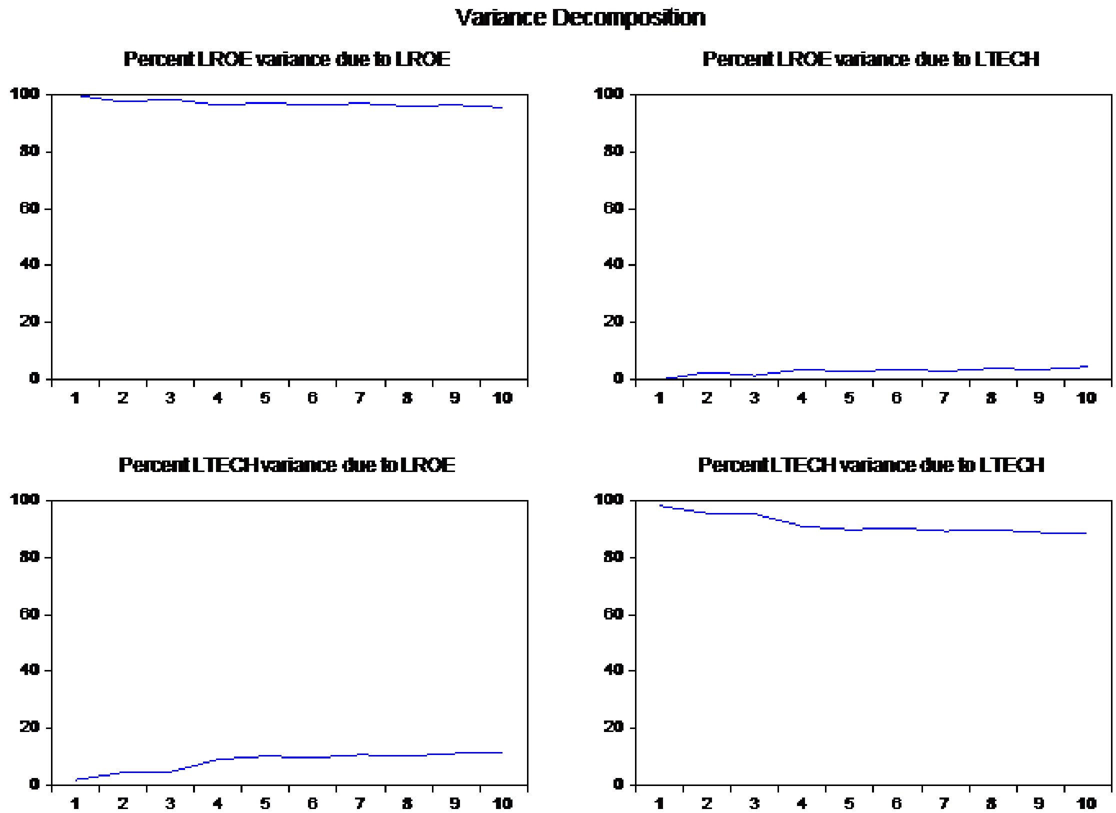

Figure 4.60: Variance Decomposition (Cholesky) – HDFC

It is clear from figure 4.60 that the impact is low in the case of LROE variance due to LTECH and in the case of LTECH variance due to LROE.

4.3. Hypothesis

The study sets the following hypothesis:

"Diffusion of ICT has improved the profitability and productivity of banks"

The hypothesis was tested by forming the null hypotheses as

(1) H_0: There is no association between ICT diffusion and productivity of banks

(2) H_0: There is no association between ICT diffusion and ROA of banks

(3) H_0: There is no association between ICT diffusion and ROE of banks

The results of the study gives clear evidence to reject the null hypotheses and accepting the statement that diffusion of ICT has improved the profitability and productivity of banks.

Concluding observations

The aforesaid discussion on the relationship between ICT and productivity and profitability of Indian banks shows that ICT had a positive impact on productivity and profitability of banks. The analysis made for all SCBs using VAR model clearly indicates that ICT diffusion had made a positive impact on productivity, and ROA and ROE which are taken as measurement of profitability. It was also clear from the analysis that ICT diffusion has both immediate and lagged effects on productivity and profitability. Similar results were obtained for SBI, PNB, HDFC, and Federal Bank. ICT is not a panacea for all the organizations. These results are what may be called indicative; for elaborate policy formulation, an exercise fortified with a larger bank level database is called for.

CHAPTER 5

CHAPTER V

ICT AND QUALITY OF SERVICE: EMPIRICAL EVIDENCES FROM THE CUSTOMER SURVEY

5.1. Introduction

Assessing the service quality satisfaction level of the customers who utilize the services of the commercial banks is important because it will help to identify the service quality gaps and customer perception of the services. This investigation will assist the banking officials to identify problems related to the services provided by the bank and correct it. Ultimately, this will be a great help towards increasing the service levels.

In this chapter, an attempt has been made to measure the satisfaction level of the customers of commercial banks. As mentioned in the introductory chapter, a tool called SERVQUAL developed by A. Parasuraman, Leonard Berry and Valerie A Zeitham in the 1980s was used. SERVQUAL is a multi-item scale developed to assess customer perceptions of service quality in service and retail businesses (Parasuraman, Berry, & Zeihaml, 1988). The scale breaks down the notion of service quality into five dimensions which were derived from five years of qualitative and quantitative customer service quality research (Parasuraman, Berry and Zeitham, 1988 and 1990), namely, tangibility, reliability, responsiveness, assurance and empathy. The SERVQUAL used for the present study consists of 27 statements that are related to seven service quality dimensions, namely, Tangibility, Reliability, Responsiveness, Assurance, Empathy, Efficiency, and Accuracy (see Appendix II). Each of the statements first appears in the form of a question to measure customers' general expectations (E) about the service area being measured and second time appears as a question to measure customers' perceptions (P) about the organization whose service quality is being assessed. In both cases, customer responses are being measured on a five point Likert scale that ranges from "strongly disagree" to "strongly agree".

5.2. Socio-Economic Profile of the respondents

Of the 600 questionnaires used for customer survey, 24 were found to be unusable because the person who completed it indicated that they had not utilized the service. So for practical purposes the sample size used for analysis is 576. The sample population comprised of 66.7% males and 33.3% females indicating that men might use the electronic banking services more than women. This might also be because of the fact that more males in the society have bank accounts than the females. Age-wise distribution of the sampled respondents (Figure 5.1) showed that majority of the respondents (62.85%) are below 45 years which points out the fact that the adoption level of electronic channel is more among the younger population.

Table 5.1: Socio-Economic Profile of the Respondents

		No. of Respondents	Percentage
Gender	Male	384	66.7
	Female	192	33.3
Age	15 - 30	196	34.03
	30 - 45	166	28.82
	45 - 60	152	26.39
	Above 60	62	10.76
Educational Qualification	SSLC & Below	10	1.74
	Plus Two	40	6.94
	Graduate	105	18.23
	Post Graduate	188	32.64
	Professional & Technical	233	40.45
Occupation	Salaried	244	42.36
	Business/ Self Employed	228	39.58
	Student	89	15.45
	Others	15	2.6
Income	Below Rs. 1 lakh	51	8.85
	Rs. 1 - 3 lakhs	109	18.92
	Rs. 3 - 5 lakhs	161	27.95
	Above Rs. 5 lakhs	255	44.27

Of the respondents more than 90% of the respondents have graduation or higher qualifications, which again show that it is the educated category of the population who has widely adopted electronic banking channels. Among the occupational categories, the salaried classification has the highest number among the respondents with 42.36%, followed by the business/self employed category with 39.58%. The largest percentage of the respondents (44.27%) falls in Above Rs 5 lakh per annum income category. The second largest category, that is, 27.95 per cent of respondents belong to Rs 3-5 lakhs income category.

5.3. Gap Score

Gap score is obtained by taking the difference between a customer's perceptions of the service received and the customer's expectations for a service offering. The SERVQUAL customer perception tool requires customers to answer questions about both their expectations and their perceptions. A negative gap score indicates a level of service quality which is below that which is expected by the customer. Conversely, a zero to positive gap score indicates a level of service which is equal to or exceeds customer expectations. This gives an idea about whether ICT in banking sector has risen up to the expectations of the customers with regard to service quality. A gap score was found for each 27 statements given in the questionnaire. For finding out the gap score for dimension, the average of the gap score obtained for the statements related to that dimension was taken.

5.4. Perception Score

Perception score was constructed by taking only customer response to the statement about their perception of the service received. The responses of the customers were averaged to obtain the perception score for the particular statement. A perception score was found for each 27 statements given in the questionnaire. Perception score of the statements were averaged to found perception score for the concerned dimension.

5.5. Level of Satisfaction

The level of satisfaction of the dimensions has been determined by the average perception score values. For the purpose of evaluating customer satisfaction regarding banking services, the perception score of 3.75 out of 5 (75% of the maximum) is the minimum score needed to measure true satisfaction for the combined dimensions as well as each sub category of the dimensions. For instance, a perception score of 3.75 or more in Tangibility would indicate an acceptable level of satisfaction for that category. The same is applicable to each of the sub category of that dimension. On the other hand, a perception score of less than 3.75 is non-acceptable level of satisfaction.

5.6. SERVQUAL Results by Dimension

5.6.1. Tangibility

The Tangibility dimension of the SERVQUAL tool is comprised of the first four questions which assess banking customer perceptions of the tangible appearance aspects. When looking at each of the four factors making up the tangibility dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score

(P-E) for the tangibility dimension of customer satisfaction is -0.824742268. The survey results for the tangibility dimension are summarized in Table 5.2.

Table 5.2: Tangibility Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P - E	Average P Score
Up-to-date equipment & technology	4.608247423	3.907216495	-0.701030928	**3.886597938**
Location of the Bank	4.81443299	4.092783505	-0.721649485	
Sufficient number of ATMs	4.75257732	3.659793814	-1.092783505	
Cash Counting Machines	4.670103093	3.886597938	-0.783505155	
	Average Gap Score		**-0.824742268**	

Average perception score for the tangibility dimension was 3.886597938. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the tangibility aspect of ICT in banking. The same is true for the sub categories of tangibility dimension, except the number of ATMs. In case of the number of ATMs, the score 3.659793814 which is below the threshold level of 3.75 would indicate that the customers are not truly satisfied with it.

5.6.2. Reliability

The Reliability dimension of the SERVQUAL tool is comprised of four questions which assess banking customer perceptions of the reliability aspects. When looking at each of the four factors making up the reliability dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the reliability dimension of customer satisfaction is -0.868556701. The survey results for the reliability dimension are summarized in Table 5.3.

Table 5.3: Reliability Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P – E	Average P Score
Bank Website not freeze after customer put in all the information	4.783505155	3.783505155	-1	**3.845360825**
Information provided on website	4.731958763	3.793814433	-0.93814433	
Up to date content	4.721649485	3.835051546	-0.886597938	
Process of transactions	4.618556701	3.969072165	-0.649484536	
	Average Gap Score		**-0.868556701**	

Average perception score for the reliability dimension was 3.845360825. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the reliability aspect of ICT in banking. The same is true for the all the four sub categories of reliability dimension.

5.6.3. Responsiveness

The Responsiveness dimension of the SERVQUAL tool is comprised of four questions which assess banking customer perceptions of the responsiveness aspects. When looking at each of the four factors making up the responsiveness dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the responsiveness dimension of customer satisfaction is - 0.798969072. The survey results for the responsiveness dimension are summarized in Table 5.4.

Table 5.4: Responsiveness Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P – E	Average P Score
Service representative	4.597938144	3.835051546	-0.762886598	**3.817010309**
Performs the services right for the first time	4.608247423	3.865979381	-0.742268041	
Quick confirmation	4.618556701	3.721649485	-0.896907216	
Requests are handled promptly	4.639175258	3.845360825	-0.793814433	
	Average Gap Score		**-0.798969072**	

Average perception score for the responsiveness dimension was 3.817010309. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the responsiveness aspect of ICT in banking. The same is true for the sub categories of responsiveness dimension, except quick confirmation. In case of quick confirmation, the score 3.721649485 which is below the threshold level of 3.75 would indicate that the customers are not truly satisfied with it.

5.6.4. Assurance

The Assurance dimension of the SERVQUAL tool is comprised of four questions which assess banking customer perceptions of the assurance aspects. When looking at each of the four factors making up the assurance dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the assurance dimension of customer satisfaction is -0.786082474. The survey results for the assurance dimension are summarized in Table 5.5.

Table 5.5: Assurance Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P - E	Average P Score
Employees have knowledge to answer customer questions	4.731958763	4.051546392	-0.680412371	**3.81443299**
Politeness & friendly staff	4.670103093	4	-0.670103093	
Employees are always willing to help you	4.701030928	3.865979381	-0.835051546	
Experienced management team	4.855670103	3.896907216	-0.958762887	
	Average Gap Score		**-0.786082474**	

Average perception score for the assurance dimension was 3.953608247. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the assurance aspect of ICT in banking. The same is true for the all the four sub categories of assurancedimension.

5.6.5. Empathy

The Empathy dimension of the SERVQUAL tool is comprised of four questions which assess banking customer perceptions of the empathy aspects. When looking at each of the four factors making up the empathy dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the empathy dimension of customer satisfaction is -1.023195876. The survey results for the empathy dimension are summarized in Table 5.6.

Table 5.6: Empathy Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P - E	Average P Score
Time bound work of employee	4.75257732	3.731958763	-1.020618557	**3.677835052**
Help desks, call centers of bank	4.75257732	3.484536082	-1.268041237	
Specific needs understood	4.659793814	3.731958763	-0.927835052	
Provisions of financial advices	4.639175258	3.762886598	-0.87628866	
	Average Gap Score		**-1.023195876**	

Average perception score for the empathy dimension was 3.677835052. Since this is below the threshold level of 3.75, it can be concluded that the customers are not truly satisfied with the empathy aspect of ICT in banking. The same is true for the sub categories of empathy dimension, except the case of provisions of financial advices. In case of provisions of financial advices, the score 3.762886598 which is above the threshold level of 3.75 would indicate that the customers are satisfied with it.

5.6.6. Efficiency

The Efficiency dimension of the SERVQUAL tool is comprised of four questions which assess banking customer perceptions of the efficiency aspects. When looking at each of the four factors making up the efficiency dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the efficiency dimension of customer satisfaction is -0.824742268. The survey results for the efficiency dimension are summarized in Table 5.7.

Table 5.7: Efficiency Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P - E	Average P Score
Log in facility	4.81443299	3.855670103	-0.958762887	**3.899484536**
Performance of Plastic cards	4.690721649	4.082474227	-0.608247423	
Transfer of funds	4.690721649	3.81443299	-0.87628866	
Clearing services	4.701030928	3.845360825	-0.855670103	
	Average Gap Score		**-0.824742268**	

Average perception score for the efficiency dimension was 3.899484536. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the efficiency aspect of ICT in banking. The same is true for the all the four sub categories of efficiency dimension.

5.6.7. Accuracy

The Accuracy dimension of the SERVQUAL tool is comprised of three questions which assess banking customer perceptions of the accuracy aspects. When looking at each of the three factors making up the accuracy dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. The average gap score (P-E) for the accuracy dimension of customer satisfaction is -0.886597938. The survey results for the accuracy dimension are summarized in Table 5.8.

Table 5.8: Accuracy Dimension – SERVQUAL Results

Dimension	Expectation E	Perception P	Gap Score P - E	Average P Score
Problem solving through instant information	4.649484536	3.762886598	-0.886597938	**3.81443299**
Bank insists on error-free transaction records	4.75257732	3.886597938	-0.865979381	
Electronic bill payments	4.701030928	3.793814433	-0.907216495	
	Average Gap Score		**-0.886597938**	

Average perception score for the accuracy dimension was 3.81443299. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the accuracy aspect of ICT in banking. The same is true for the all the three sub categories of accuracy dimension.

5.7. Conclusion

This chapter has examined the effect of ICT on the quality of services as perceived by the customers of selected banks. This analysis has been carried out using multiple techniques like Gap score and Perception score. The overall perceived SERVQUAL score for the seven dimensions of customer satisfaction is 3.84307. This indicates a satisfactory level of customer satisfaction in the service quality with respect to ICT in banking. From the analysis it was found that, although gaps scores were negative (that is, expectations greater than perception) for all the seven dimensions and its sub categories, the banking customers were satisfied with the quality of service with respect ICT in banking. The negative gaps that exist in the expected vs. perceived level of service quality indicate that there are areas where efforts to improve should be focused. Dimension wise perception score also indicates that the customers were satisfied with all the dimensions except empathy. A score below the threshold level for the empathy dimension was a clear indication that the banks should work on this aspect very seriously.

CHAPTER 6

CHAPTER VI

SUMMARY OF FINDINGS, SUGGESTIONS, AND CONCLUSION

6.1. Introduction

This chapter presents a brief summary of the study and discusses the findings which are drawn from the data analysis made in this study. The conclusions were drawn according to the research questions. Also suggestions and recommendations based on major findings were presented in this chapter. This is expected to be useful for bankers, policy makers, service designers and stakeholders. Finally, a summary of the general observations made out of this study was presented under the heading conclusion.

6.2. Scope of the Study

The changing face of contemporary World can be explained in terms of ICT. It not only connected the World at one single platform but also helps in bringing traditional and modern societies together. The ICT strategy of a nation is very crucial to put it on a global map. ICT has been widely accepted as an infrastructure which helps to arrest urban-rural divide and imbalance in socio-economic development, especially in India. The first target for these was to attract more people to banks by offering convenient and user friendly methods of banking. In addition, it makes possible broader options of choice for them, adding to the attractiveness of banking.

Significant and important events have taken place in the banking system of India since the financial sectors reforms initiated in 1991, most significant amongst these being the ICT (Information and Communication Technology) Diffusion in Indian banking. The relevant question in this context is not whether ICT is beneficial, but how it is beneficial to the banking community as a whole including consumers and banking administrators and officials. The present study was undertaken in this context which was an attempt to identify the effects of ICT diffusion in Indian banking on productivity, profitability and quality of services.

6.2.1. Objectives of the Study

1. To examine the status of ICT diffusion among the banks operating in India
2. To analyze the impact of ICT on the profitability, and productivity of banks functioning in India, and,
3. To understand the effect of ICT on the quality of banking services.

6.2.2. Methodology and Data

This study examines the case of scheduled commercial banks classified under the public and private sector categories. In this study, we use both primary and secondary data. In order to study the status of ICT diffusion and the impact of ICTs on productivity and profitability among the commercial banks, we have selected one bank each from the State Bank Group, Nationalised Bank Group, old private sector bank and new private sector banks. The banks selected from these categories are: State Bank of India from the State Bank Group, Punjab National Bank from the Nationalized Bank Group, Federal Bank from the old private sector and HDFC from the New Generation private sector banks. These banks were selected on the basis of sound footings. These are the banks which were rated high by the ICT diffusion indices.

Secondary data on the functioning of these banks, ICT diffusion in the areas of operation and customer service collected from different sources constitute the major inputs for the current study. These were collected individually from the concerned banks, from the RBI data base, IBA data base, SLBC and Prowess data base. Since the State level data on ICT diffusion is unavailable, the analysis is carried out on an all-India basis. The empirical investigation is carried out using monthly data from January 2009 to April 2015.

Primary data is supplemented to meaningfully analyze the customer satisfaction with the ICT mediated banking service. For this purpose, 600 customers availing services from the selected banks functioning in Kerala were selected at random and administered using a structured interview schedule.

6.2.3. Tools of Analysis

The study has used many statistical and mathematical tools for analysis. In addition to these, a few qualitative tools were also applied wherever necessary. We have constructed an original and comprehensive un-weighted simple index for understanding the status of ICT diffusion among the commercial banks. This index is constructed by taking the transactions through different technology oriented means like NEFT, RTGS, ECS, Mobile, Credit card (ATM & POS), and Debit card (ATM & POS).

The impact of ICT on profitability and productivity of banks were analyzed using the variables like Return on Asset (ROA), Return on Equity (ROE), Total Deposits, Loans and Advances. The study examined both immediate and lagged effect of ICT. For this purpose, a multiple regression model (VAR) using time series data was used.

For analyzing the impact of ICT on quality of service, data were collected from bank customers by using a structured interview schedule on different dimensions of banking service such as: Tangibility, Reliability, Responsiveness, Assurance, Empathy, Efficiency and Accuracy. A tool called SERVQUAL, developed by Parasuraman, Leonard Berry and Valerie A Zeitham in the 1980s was used for this purpose.

6.2.4. Hypothesis

The study sets the following hypothesis:

"Diffusion of ICT has improved the profitability and productivity of banks"

The hypothesis was tested by forming the null hypotheses as

(1) H_0: There is no association between ICT diffusion and productivity of banks

(2) H_0: There is no association between ICT diffusion and ROA of banks

(3) H_0: There is no association between ICT diffusion and ROE of banks

The results of the study gives clear evidence to reject the null hypotheses and accepting the statement that diffusion of ICT has improved the profitability and productivity of banks.

6.3. Summary of Major Findings of the Study

The summary of findings was presented in this section. Major findings of the study were divided into various sections and explained

6.3.1. Status of ICT Diffusion in Indian Banks

An original composite index, namely, ICT Diffusion Index has been developed in this study for analyzing the status of ICT diffusion among Indian banks. Based on this index the following findings were made:

- In case of all scheduled commercial banks taken together, ICT diffusion has more than doubled during the period of study. Moreover it has shown a continuously increasing trend during this period. This implies that banking transactions are more or less moving towards a technology oriented mode.
- The bank-wise analysis shows that in case of State Bank of India, ICT diffusion has almost trebled during the period of study. In case of HDFC Bank and Federal Bank, ICT diffusion has more than trebled during the period of study. Moreover it has shown a continuously increasing trend during this period.
- However, ICT diffusion has declined for Punjab National Bank, during the period of study.

6.3.2. Findings related to Impact of ICT on Productivity of Banks

Following are the important findings related to impact of ICT on productivity of banks:

- Productivity and technology are cointegrated and technology causes an improvement in productivity in case of all SCBs
- Bank wise analysis also gives a similar result for SBI, PNB, HDFC Bank, and Federal Bank that productivity and technology are cointegrated and technology causes an improvement in productivity.

- It was also found that technology had both immediate and lagged effect on productivity for all SCBs and selected banks.

6.3.3. Findings related to Impact of ICT on Return on Assets (ROA) of Banks

Following are the important findings related to impact of ICT on ROA of banks:

- Bank wise analysis also gives a similar result for SBI, PNB, HDFC Bank, and Federal Bank that ROA and technology are cointegrated and technology causes an improvement in ROA.
- It was also found that technology had both immediate and lagged effect on ROA for all SCBs and selected banks.

6.3.4. Findings related to Impact of ICT on Return on Equity (ROE) of Banks

Following are the important findings related to impact of ICT on ROE of banks:

- ROE and technology are cointegrated, and technology causes an improvement in ROE in case of all SCBs

- Bank wise analysis also gives a similar result for SBI, PNB, HDFC Bank, and Federal Bank that ROE and technology are cointegrated and technology causes an improvement in ROE.
- It was also found that technology had both immediate and lagged effect on ROE for all SCBs and selected banks.

6.3.5. Findings related to the Effect of ICT on Service Quality of Banks

Important findings related to service quality can be stated as follows:

- When looking at each of the four factors making up the tangibility dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the tangibility dimension was 3.886597938. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the tangibility aspect of ICT in banking. The same is true for the sub categories of tangibility dimension, except the number of ATMs. In case of the number of ATMs, the score 3.659793814 which is below the threshold level of 3.75 would indicate that the customers are not truly satisfied with it.
- When looking at each of the four factors making up the reliability dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the reliability dimension was 3.845360825. Since this is above the

threshold level of 3.75, it can be concluded that the customers are satisfied with the reliability aspect of ICT in banking. The same is true for the all the four sub categories of reliability dimension.

- When looking at each of the four factors making up the responsiveness dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the responsiveness dimension was 3.817010309. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the responsiveness aspect of ICT in banking. The same is true for the sub categories of responsiveness dimension, except quick confirmation. In case of quick confirmation, the score 3.721649485 which is below the threshold level of 3.75 would indicate that the customers are not truly satisfied with it.
- When looking at each of the four factors making up the assurance dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the assurance dimension was 3.953608247. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the assurance aspect of ICT in banking. The same is true for the all the four sub categories of assurance dimension.
- When looking at each of the four factors making up the empathy dimension of customer satisfaction, the expectations of the customers

exceed their perceptions in all the factors. Average perception score for the empathy dimension was 3.677835052. Since this is below the threshold level of 3.75, it can be concluded that the customers are not truly satisfied with the empathy aspect of ICT in banking. The same is true for the sub categories of empathy dimension, except the case of provisions of financial advices. In case of provisions of financial advices, the score 3.762886598 which is above the threshold level of 3.75 would indicate that the customers are satisfied with it.

- When looking at each of the four factors making up the efficiency dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the efficiency dimension was 3.899484536. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the efficiency aspect of ICT in banking. The same is true for the all the four sub categories of efficiency dimension.
- When looking at each of the three factors making up the accuracy dimension of customer satisfaction, the expectations of the customers exceed their perceptions in all the factors. Average perception score for the accuracy dimension was 3.81443299. Since this is above the threshold level of 3.75, it can be concluded that the customers are satisfied with the accuracy aspect of ICT in banking. The same is true for the all the three sub categories of accuracy dimension.

6.4. Suggestions

Based on the findings of the present study, the following suggestions were made:

- More ATMs may be set up based upon the volume of transactions since this will facilitate banking activities. This suggestion was made on the light of customer dissatisfaction with the number of ATMs.
- Improving the quality of Bank Websites can prove to be a long way forward in the use of different technologies related to banks by the customers. This is relevant in the context of customers' complaints regarding quick confirmation of transactions through such technologies among others.
- Much attention is required from the part of bankers on empathy aspect of banking service. This is clear from the customer dissatisfaction with the empathy dimension. The banking staffs have to be trained to understand the customer's psychology so that they can provide customer service in a satisfied manner. Also banks should focus on providing time bound services to the customers, improving working of help desks, and improving the working of call centers.
- Need based schemes for customers should be introduced since all the customers are not homogenous in their requirements.

- Conducting awareness programmes regarding different ICT devices used in banking and ensuring safety for transactions through these means are the needs of the hour to make it more popular.
- Training programmes on the usage of different technologies of banks should be conducted for rural customers since they are still reluctant to use it.
- In the light of abundant subscriber base of mobile phone users in India, mobile banking has great potential as future technical transaction channel. Therefore banks should undertake serious efforts in promoting mobile banking.

6.5. Conclusion

Wide spread use of technology by banks all over the world has raised many challenges to Indian Banks and it is essential for Indian banks to face these challenges effectively in order to survive in the era of globalization. The "mantra" of success of banks in the present highly competitive environment lies in prompt and efficient customer service, which calls for appropriate customer friendly schemes and procedures. The banks should absorb the technology and upgrade their services constantly in order to be with the competition. At the same time application of technology in a country where there is the predominance of rural, poor and even illiterate people is not an easy affair to be done effectively since they are least concerned with the level of automation and efficiency of services. They are more concerned with ease of services without much complications and safe transactions. Therefore there is a long way to go for the Indian Banks to make these classes aware of these services and to train them in transactions using these techniques, along with ensuring safety. In spite of these challenges, it is expected that banks will do a very effective role in the economic development of the nation in the coming days.

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APPENDIX

Rahul k. “Information and communication technology diffusion in Indian banking : a study with special reference to commercial banks ” Thesis. Department of Economics, University of Calicut, 2015.

APPENDIX I

PROFILE OF COMMERCIAL BANKS IN INDIA

As per the Reserve Bank of India Act 1934, commercial banks are classified into scheduled commercial banks (SCBs) and non-scheduled commercial banks. The scheduled commercial banks are those commercial which are included in the second schedule of the 'RBI Act, 1934'.

The scheduled commercial banks in India are classified into public sector banks, private sector banks, and foreign banks. The public sector banks are subdivided into two categories: State Bank Group and Nationalized Banks. The private sector banks are also subdivided into two categories: old private sector banks and new private sector banks. The structure of scheduled commercial banks in India was shown in Figure 7.1.

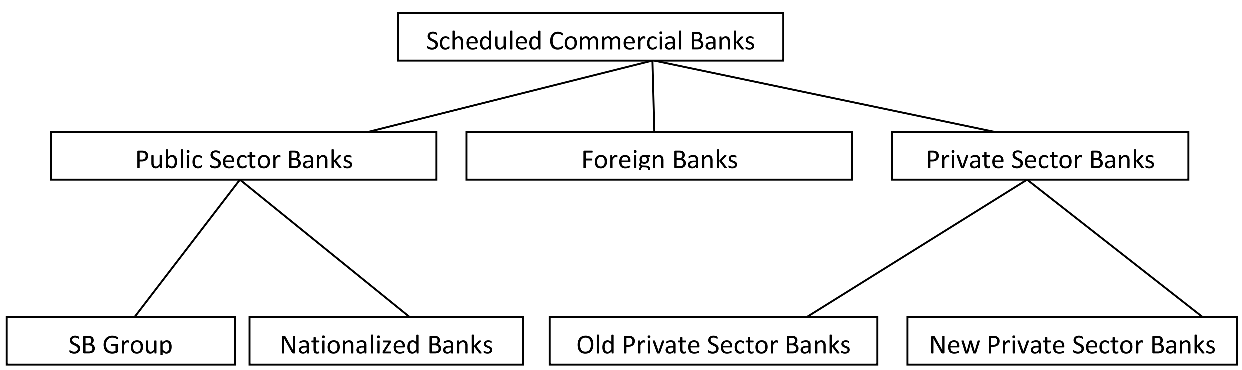

Figure 7.1: Structure of SCBs in India

Table 7.1: Profile of All Scheduled Banks

(Amount in Rs.million)

Items	Bank Group-wise Aggregates				
	2008-09	**2009-10**	**2010-11**	**2011-12**	**2012-13**
No. of banks	80	81	81	87	89
No. of offices	67562	72906	78215	85262	92114
No. of employees	954684	955990	1001096	1048520	1096984
Business per employee	73.98	86.23	99.03	109.95	121.33
Profit per employee	0.55	0.60	0.70	0.78	0.83
Capital and Reserve & Surplus	3679473	4301613	5099192	6085618	7089300
Deposits	40632011	47469196	56158743	64535485	74295324
Investments	14495506	17290059	19236333	22339033	26132752
Advances	29999239	34967200	42974875	50735592	58797025
Interest Income	3884816	4151786	4913407	6552839	7636115
Other income	752204	792676	798501	863437	977866
Interest expended	2632232	2720836	2989248	4303557	5138027
Operating expenses	895814	1000279	1231403	1375720	1565855
Net Interest Margin	2.62	2.54	2.91	2.90	2.79
Cost of Funds (CoF)	5.99	5.10	4.75	5.90	6.12
Return on advances adjusted to COF	4.56	4.19	4.47	4.51	4.21
Wages as % to total expenses	13.60	14.85	17.22	13.73	13.02
Return on Equity	15.44	14.31	14.96	14.60	13.84
Return on Assets	1.13	1.05	1.10	1.08	1.03
CRAR	13.97	14.54	14.19	14.24	13.88
Net NPA ratio	1.05	1.12	0.97	1.28	1.68

Source: RBI database

Table 7.2: Profile of SBI and its Associates

Items	Bank Group-wise Aggregates				
	2008-09	2009-10	2010-11	2011-12	2012-13
No. of banks	7	7	6	6	6
No. of offices	16938	18390	19338	20256	21301
No. of employees	268598	266605	283375	279809	293965
Business per employee	65.02	73.74	79.05	91.38	101.97
Profit per employee	0.44	0.47	0.42	0.55	0.60
Capital and Reserves & Surplus	724216	837256	843942	1072494	1253189
Deposits	10070415	11080856	12458624	14050241	16184449
Investments	3576239	3874734	3856967	4173221	4729979
Advances	7394499	8579368	9941536	11519913	13792240
Interest income	891958	979537	1098281	1435552	1637677
Other income	160727	183937	192400	178231	197442
Interest expended	617704	662285	670179	888609	1065334
Operating expenses	200877	252828	291459	327299	370940
Net Interest Margin	2.39	2.36	2.84	3.25	2.98
Cost of Funds (CoF)	6.00	5.32	4.85	5.66	5.96
Return on advances adjusted to CoF	3.98	3.60	4.11	4.61	3.93
Wages as % to total expenses	15.06	17.10	19.97	17.42	16.20
Return on Equity	17.74	15.92	14.11	16.00	15.29
Return on Assets	1.02	0.91	0.79	0.89	0.88
CRAR	13.96	13.46	12.25	13.70	12.67
Net NPA ratio	1.47	1.50	1.49	1.76	2.04

Source: Ibid

Table 7.3: Profile of Nationalized Banks

Items	Bank Group-wise Aggregates				
	2008-09	2009-10	2010-11	2011-12	2012-13
No. of banks	20	20	20	20	20
No. of offices	41041	43690	46462	50713	54478
No. of employees	462926	473041	471727	494520	507694
Business per employee	78.32	93.59	115.25	127.85	142.23
Profit per employee	0.49	0.57	0.70	0.69	0.65
Capital and Reserves & Surplus	1359202	1572758	2059079	2483255	2832832
Deposits	21057056	25839338	31265862	35969893	41272523
Investments	6550419	8281248	9503797	10899479	12861079
Advances	15197619	18430819	23102793	27253162	30935500
Interest income	1838924	2080289	2563064	3411767	3911088
Other income	263936	304996	287249	325766	370370
Interest expended	1316762	1457115	1641351	2397280	2813956
Operating expenses	354160	407922	538193	574753	647182
Net Interest Margin	2.32	2.26	2.74	2.55	2.39
Cost of Funds (CoF)	6.09	5.37	4.93	6.22	6.39
Return on advances adjusted to CoF	4.09	3.82	4.28	4.10	3.76
Wages as % to total expenses	13.31	13.65	16.41	12.20	11.81
Return on Equity	18.05	18.30	18.19	15.05	12.34
Return on Assets	1.03	1.00	1.03	0.88	0.74
CRAR	13.24	13.18	13.47	13.03	12.26
Net NPA ratio	0.68	0.91	0.92	1.44	2.00

Source: Ibid

Table 7.4: Profile of Old Private Sector Banks

Items	Bank Group-wise Aggregates				
	2008-09	**2009-10**	**2010-11**	**2011-12**	**2012-13**
No. of banks	15	15	14	13	13
No. of offices	4952	5273	5090	5673	6283
No. of employees	51341	55052	55380	62589	66208
Business per employee	63.84	69.75	81.04	87.23	97.24
Profit per employee	0.47	0.42	0.56	0.63	0.75
Capital and Reserves & Surplus	174765	201706	237982	278963	330127
Deposits	1992735	2298969	2641571	3158914	3738964
Investments	723926	834993	926545	1093333	1344993
Advances	1285039	1540853	1846473	2300795	2699373
Interest income	187898	204975	232989	325802	399275
Other income	27821	31518	30286	33948	41452
Interest expended	128340	140760	147681	225057	278598
Operating expenses	39392	47153	56000	65404	77459
Net Interest Margin	2.79	2.56	2.95	2.95	2.94
Cost of Funds (CoF)	6.67	6.13	5.66	7.10	7.27
Return on advances adjusted to CoF	5.15	4.82	5.02	4.88	4.88
Wages as % to total expenses	13.26	14.57	16.75	13.00	12.28
Return on Equity	14.69	12.29	14.11	15.18	16.22
Return on Assets	1.15	0.95	1.12	1.20	1.26
CRAR	14.74	14.85	14.55	14.12	13.73
Net NPA ratio	0.90	0.82	0.53	0.58	0.77

Source: Ibid

Table 7.5: Profile of New Private Sector Banks

Items	Bank Group-wise Aggregates				
	2008-09	2009-10	2010-11	2011-12	2012-13
No. of banks	7	7	7	7	7
No. of offices	4336	5243	7007	8297	9718
No. of employees	142237	133280	162573	185695	203733
Business per employee	69.18	80.38	83.13	85.89	93.03
Profit per employee	0.59	0.81	0.90	1.01	1.18
Capital and Reserves & Surplus	821921	998133	1147682	1313989	1599334
Deposits	5371041	5929038	7386018	8586960	10219391
Investments	2341385	2706176	3294031	4166489	4916070
Advances	4468237	4783556	6128967	7363235	8733113
Interest income	662816	623090	734142	1019752	1265589
Other income	150781	172713	178447	216532	256475
Interest expended	441234	371296	423810	642787	792733
Operating expenses	178401	181357	220064	274898	327392
Net Interest Margin	2.88	3.00	3.15	3.13	3.30
Cost of Funds (CoF)	6.15	4.42	4.27	5.45	5.77
Return on advances adjusted to CoF	5.36	5.14	5.14	5.32	5.57
Wages as % to total expenses	10.17	12.10	13.83	11.97	11.40
Return on Equity	10.69	11.87	13.62	15.27	16.51
Return on Assets	1.12	1.38	1.51	1.63	1.74
CRAR	15.33	18.03	16.87	16.66	17.52
Net NPA ratio	1.40	1.09	0.56	0.42	0.45

Source: Ibid

Table 7.6: Profile of Foreign Banks

Items	Bank Group-wise Aggregates				
	2008-09	2009-10	2010-11	2011-12	2012-13
No. of banks	31	32	34	41	43
No. of offices	295	310	318	323	334
No. of employees	29582	28012	28041	25907	25384
Business per employee	128.27	141.14	155.55	195.62	217.33
Profit per employee	2.54	1.69	2.75	3.64	4.56
Capital and Reserves & Surplus	599368	691760	810507	936917	1073817
Deposits	2140764	2320995	2406668	2769477	2879997
Investments	1303537	1592909	1654993	2006511	2280631
Advances	1653846	1632604	1955106	2298488	2636799
Interest income	303220	263897	284931	359966	422486
Other income	148940	99513	110118	108959	112127
Interest expended	128191	89379	106227	149824	187406
Operating expenses	122984	111019	125686	133367	142882
Net Interest Margin	4.33	3.96	3.86	3.89	3.89
Cost of Funds (CoF)	4.46	2.83	3.11	3.88	4.05
Return on advances adjusted to CoF	8.15	7.16	5.64	5.72	5.50
Wages as % to total expenses	19.44	23.48	23.30	20.35	18.22
Return on Equity	13.75	7.34	10.28	10.79	11.52
Return on Assets	1.99	1.26	1.75	1.76	1.94
CRAR	14.19	17.26	16.97	16.75	17.88
Net NPA ratio	1.81	1.82	0.67	0.61	1.01

Source: Ibid

LIST OF BANKS

State Bank Group

State Bank of India
State Bank of Bikaner and Jaipur
State Bank of Hyderabad
State Bank of Mysore
State Bank of Patiala
State Bank of Travancore

Nationalized Banks

Allahabad Bank
Andhra Bank
Bank of Baroda
Bank of India
Bank of Maharashtra
Canara Bank
Central Bank of India
Corporation Bank
Dena Bank
IDBI Bank
Indian Bank
Indian Overseas Bank
Oriental Bank of Commerce
Punjab National Bank
Punjab and Sind Bank
Syndicate Bank
UCO Bank
Union Bank of India
United Bank of India
Vijaya Bank

Old Private Sector Banks

Catholic Syrian Bank Ltd.
City Union Bank Ltd.
Dhanalakshmi Bank Ltd.

Federal Bank Ltd.

ING Vysya Bank

Jammu and Kashmir Bank Ltd.

Karnataka Bank Ltd.

Karur Vysya Bank Ltd.

Lakshmi Vilas Bank Ltd.

Nainital Bank Ltd.

Ratnakar Bank Ltd.

South Indian Bank Ltd.

Tamilnad Mercantile Bank Ltd.

New Private Sector Banks

Axis Bank Ltd.

Development Credit Bank Ltd.

HDFC Bank Ltd.

ICICI Bank Ltd.

IndusInd Bank Ltd.

Kotak Mahindra Ltd.

Yes Bank Ltd.

Foreign Banks

AB Bank Ltd.

Abu Dhabi Commercial Bank Ltd.

American Express Banking Corp.

Antwerp Diamond Bank NV

Australia and New Zealand Banking Group Ltd.

BNP Paribas

Bank International Indonesia

Bank of America National Association

Bank of Bahrain & Kuwait B.S.C.

Bank of Ceylon

Bank of Nova Scotia

Barclays Bank PLC

Chinatrust Commercial Bank

Citibank N.A.

Commomwealth Bank of Australia

Credit Agricole Corporate and Investment
Credit Suisse AG
DBS Bank Ltd.
Deutsche Bank (Asia)
First Rand Bank
HSBC Ltd.
Industrial and Commercial Bank of China
JPMorgan Chase Bank National Association
JSC VTB Bank
Krung Thai Bank Public Co. Ltd.
Mashreqbank PSC
Mizuho Corporate Bank Ltd.
National Australia Bank
Oman International Bank S.A.O.G.
Rabobank International
Sber Bank
Shinhan Bank
Societe Generale
Sonali Bank
Standard Chartered Bank
State Bank of Mauritius Ltd.
Sumitomo Mitsui Banking Corporation
The Bank of Tokyo-Mitsubishi UFJ,Ltd.
The Royal Bank of Scotland N V
UBS AG
United Overseas Bank Ltd.
WestPac Banking Corporation
Woori Bank

Profile of Selected Banks

The study had been made by taking particular cases of State Bank of India, Punjab National Bank, Federal Bank and HDFC, each representing SB Group, Nationalized Bank Group, Old Private Sector Banks, and New Private Sector Banks respectively. The profiles of these banks were given in Table 7.7, Table 7.8, Table 7.9 and Table 7.10.

Table 7.7: Profile of State Bank of India

Items	2008-09	2009-10	2010-11	2011-12	2012-13
No. of offices	12070	13252	14350	14902	15564
No. of employees	205896	200299	222933	215481	228296
Business per employee	55.60	63.60	70.47	79.84	94.39
Profit per employee	0.47	0.45	0.39	0.53	0.65
Capital and Reserves & Surplus	579477	659492	649860	839512	988837
Deposits	7420731	8041162	9339328	10436474	12027396
Investments	2759540	2957852	2956006	3121976	3509273
Advances	5425032	6319142	7567194	8675789	10456166
Interest income	637884	709939	813944	1065215	1196571
Other income	126908	149682	158246	143514	160348
Interest expended	429153	473225	488680	632304	753258
Operating expenses	156487	203187	230154	260690	292844
Net Interest Margin	2.48	2.35	2.86	3.38	3.06
Cost of Funds (CoF)	5.72	5.14	4.67	5.35	5.63
Return on advances adjusted to CoF	3.95	3.48	3.97	4.63	3.83
Wages as % to total expenses	16.64	18.86	21.16	19.01	17.57
Return on Equity	17.05	14.80	12.62	15.72	15.43
Return on Assets	1.04	0.88	0.71	0.88	0.91
CRAR	14.25	13.39	11.98	13.86	12.92
Net NPA ratio	1.79	1.72	1.63	1.82	2.10

Source: RBI Database

Table 7.8: Profile of Punjab National Bank

Items	2008-09	2009-10	2010-11	2011-12	2012-13
No. of offices	4536	5056	5256	5777	5977
No. of employees	54780	57103	53114	62127	63292
Business per employee	65.49	80.80	101.78	113.20	116.51
Profit per employee	0.56	0.73	0.84	0.84	0.81
Capital and Reserves & Surplus	146536	177229	215086	278154	326769
Deposits	2097605	2493298	3128987	3795885	3915601
Investments	633852	777245	951623	1227030	1298962
Advances	1547030	1866012	2421067	2937748	3087252
Interest income	191272	214221	269865	364761	418933
Other income	30647	36101	36126	42026	42159
Interest expended	122953	129440	151791	230617	270368
Operating expenses	42062	47619	63642	70028	81651
Net Interest Margin	3.06	3.12	3.50	3.21	3.17
Cost of Funds (CoF)	5.93	4.90	4.58	5.73	6.11
Return on advances adjusted to CoF	4.71	4.87	5.26	4.88	4.46
Wages as % to total expenses	17.72	17.63	20.71	15.71	16.12
Return on Equity	22.92	24.12	22.60	19.80	15.70
Return on Assets	1.39	1.44	1.34	1.19	1.00
CRAR	14.03	14.16	12.42	12.63	12.72
Net NPA ratio	0.17	0.53	0.85	1.52	2.35

Source: Ibid

Table 7.9: Profile of Federal Bank

Items	2008-09	2009-10	2010-11	2011-12	2012-13
No. of offices	639	700	771	978	1128
No. of employees	7570	7896	8270	8745	10059
Business per employee	75.00	81.30	92.30	101.10	107.50
Profit per employee	0.69	0.60	0.70	0.90	0.90
Capital and Reserves & Surplus	43259	46904	51087	57063	63647
Deposits	321982	360580	430148	489371	576149
Investments	121190	130546	145377	174025	211546
Advances	223919	269501	319532	377560	440967
Interest income	33154	36732	40520	55584	61676
Other income	5158	5309	5168	5323	6644
Interest expended	19999	22624	23054	36050	41929
Operating expenses	5715	6769	8361	9793	11795
Net Interest Margin	3.69	3.42	3.67	3.49	3.00
Cost of Funds (CoF)	6.32	6.11	5.26	6.89	6.75
Return on advances adjusted to CoF	6.10	5.44	5.49	5.13	4.57
Wages as % to total expenses	12.35	12.45	15.29	11.86	11.66
Return on Equity	12.13	10.30	11.98	14.37	13.89
Return on Assets	1.48	1.15	1.34	1.41	1.35
CRAR	20.22	18.36	16.79	16.64	14.73
Net NPA ratio	0.30	0.48	0.60	0.53	0.98

Source: Ibid

Table 7.10: Profile of HDFC Bank

Items	2008-09	2009-10	2010-11	2011-12	2012-13
No. of offices	1422	1736	1999	2553	3046
No. of employees	52687	51888	55752	66076	69401
Business per employee	44.6	59	65.3	65.4	75
Profit per employee	0.42	0.6	0.74	0.8	1
Capital and Reserves & Surplus	146518	215225	253793	299247	362141
Deposits	142811	167404	208586	246706	296247
Investments	588175	586076	709294	974829	111613
Advances	988830	1258306	1599827	1954200	2397206
Interest income	163323	161727	199282	278742	350649
Other income	32906	39831	43352	57836	68526
Interest expended	89111	77863	93851	149896	192538
Operating expenses	55328	59398	71529	92776	112361
Net Interest Margin	4.69	4.13	4.22	4.19	4.28
Cost of Funds (CoF)	6.92	4.66	4.64	6.06	6.41
Return on advances adjusted to CoF	8.04	6.11	5.91	5.83	5.92
Wages as % to total expenses	15.5	16.68	17.15	14.01	13.01
Return on Equity	17.17	16.3	16.74	18.69	20.34
Return on Assets	1.28	1.53	1.58	1.77	1.9
CRAR	15.69	17.44	16.22	16.52	16.8
Net NPA ratio	0.63	0.31	0.19	0.18	0.2

Source: Ibid

APPENDIX II

MONTHLY DATA ON BANKING TRANSACTIONS USING TECHNOLOGY ORIENTED MEANS

Table 8.1: Transactions through NEFT & RTGS – All SCBs

		NEFT		RTGS				NEFT		RTGS	
Year	**Month**	**Outward**	**Inward**	**Inward**	**Outward**	**Year**	**Month**	**Outward**	**Inward**	**Inward**	**Outward**
2009	Jan.	3198764	3198746	1436951	1436951	2012	Mar.	27113193	27113208	6339614	6339614
2009	Feb.	3300290	3300248	1498555	1498555	2012	Apr.	23765181	23765181	4928530	4928530
2009	Mar.	4030747	4030612	1941215	1941215	2012	May	27226080	27226080	5562933	5562933
2009	Apr.	3920380	3920380	1813195	1813195	2012	June	27193036	27193052	5502721	5502721
2009	May	4200633	4200635	2021752	2021752	2012	July	29254732	29254732	5475349	5475349
2009	June	4480887	4480890	2230310	2230310	2012	Aug.	29279962	29279962	5125939	5125939
2009	July	5068311	5068311	2346972	2346972	2012	Sept.	29430373	29430373	5097981	5097981
2009	Aug.	5198659	5198659	2322862	2322862	2012	Oct.	34843661	34843661	5833365	5833365
2009	Sept.	4928763	4928763	2433615	2433615	2012	Nov.	33709717	33709717	5549751	5549751
2009	Oct.	5924831	5924831	2925034	2925034	2012	Dec.	35537622	35537622	6032600	6032600
2009	Nov.	6050856	6050856	2939294	2939294	2013	Jan.	38364041	38364041	6284692	6284692
2009	Dec.	6050856	6050856	3275146	3275146	2013	Feb.	38293445	38293445	5821396	5821396
2010	Jan.	6176882	6176882	3006279	3006279	2013	Mar.	47089584	47089584	7294396	7294396
2010	Feb.	6403232	6403232	3356307	3356307	2013	Apr.	40659106	40659106	6463274	6463274
2010	Mar.	8277084	8277084	4364447	4364447	2013	May	45055749	45055749	6693509	6693509
2010	Apr.	7469898	7469898	3733791	3733791	2013	June	43190649	43190650	6143437	6143437
2010	May	7742375	7742375	3929808	3929808	2013	July	50418407	50418407	6579571	6579571
2010	June	8420321	8420321	4085623	4085623	2013	Aug.	47616669	47616668	6206023	6206023
2010	July	9463029	9463029	4153918	4153918	2013	Sept.	51245981	51246019	6256432	6256432
2010	Aug.	9803815	9803815	4194349	4194349	2013	Oct.	56912269	56912269	6952413	6952413
2010	Sept.	9831194	9831194	4103393	4103393	2013	Nov.	52651429	52651429	6376494	6376494
2010	Oct.	11626795	11626795	4713577	4713577	2013	Dec.	60358140	60358140	7017796	7017796
2010	Nov.	11751241	11751241	4012463	4012463	2014	Jan.	65911714	65911714	7124050	7124050
2010	Dec.	13457326	13457326	3899349	3899349	2014	Feb.	64154201	64154201	6650225	6650225
2011	Jan.	12960745	12960745	3832583	3832583	2014	Mar.	82831068	82831069	8635504	8635504
2011	Feb.	13434456	13434456	3805814	3805814	2014	Apr.	70615096	70615096	7267031	7267031
2011	Mar.	16358800	16358800	4795260	4795260	2014	May	69106748	69106748	7796914	7796914
2011	Apr.	14865824	148658274	3295927	3295927	2014	June	67857492	67857492	7473492	7473492
2011	May	15766053	15766053	4275250	4275250	2014	July	71673336	71673336	7545986	7545986
2011	June	15944780	15944780	4251614	4251614	2014	Aug.	71673336	71673336	7545986	7545986
2011	July	16631990	16631990	4125403	4125403	2014	Sept.	87995192	87995192	7718709	7718709
2011	Aug.	17334570	17334570	4130165	4130165	2014	Oct.	73293967	73293967	7206852	7206852
2011	Sept.	17559721	17559721	4340623	4340623	2014	Nov.	69123465	69123465	7325796	7325796
2011	Oct.	19251388	19251388	4461522	4461522	2014	Dec.	83485916	83485916	8185900	8185900
2011	Nov.	18785329	18785329	4698557	4698557	2015	Jan.	80224999	80224999	7889908	7889908
2011	Dec.	20613975	20613975	5097667	5097667	2015	Feb.	81185268	81185268	7687796	7687796
2012	Jan.	20630753	20630753	4996935	4996935	2015	Mar.	106001351	106001351	9672739	9672739
2012	Feb.	21629978	21629978	5020473	5020473	2015	Apr.	138403021	138403021	7897752	7897752

Source: RBI Database

Table 8.2: Transaction through ECS & Mobile – All SCBs

Year	Month	ECS		Mobile	Year	Month	ECS		Mobile
		CREDIT	DEBIT				CREDIT	DEBIT	
2009	January	5293238	13700671	46283	2012	March	8732751	14790024	3123105
2009	February	7548240	12904769	47583	2012	April	7643301	14377842	3178405
2009	March	4592950	13558084	48835	2012	May	5999841	14549221	3346743
2009	April	3820242	12217451	50038	2012	June	9814253	14428566	3437074
2009	May	3263572	12126872	52538	2012	July	13341581	14697088	3705690
2009	June	6072190	12746062	61677	2012	August	13636248	14695901	3968226
2009	July	11545089	12622254	63759	2012	September	14730884	14365541	3897614
2009	August	11894776	11763755	91565	2012	October	14071845	15070846	4437205
2009	September	11419602	11613165	99169	2012	November	8866243	14682062	4720871
2009	October	13433665	13097571	111623	2012	December	6887980	14998111	5221007
2009	November	7588750	12218505	125853	2013	January	7484302	14878490	5554327
2009	December	5826752	12651782	156593	2013	February	8702583	14990149	5441624
2010	January	6513661	12567901	196380	2013	March	11147316	15386563	6400973
2010	February	7807765	11189524	195067	2013	April	9993665	15567269	6326709
2010	March	7091208	14466285	271920	2013	May	9419441	15250219	6866932
2010	April	7865953	12739425	289214	2013	June	12516039	15357994	6632153
2010	May	6572089	12622121	351977	2013	July	15049067	15875190	7031635
2010	June	8920032	12824060	371639	2013	August	18907901	15415071	6762969
2010	July	12239763	12958967	472978	2013	September	15347925	16126966	7169429
2010	August	13392595	12639207	528589	2013	October	18258918	15850152	7789460
2010	September	10791982	12666370	499039	2013	November	10315674	17411266	8128644
2010	October	16704932	13276572	556003	2013	December	10208447	16150771	8892790
2010	November	9126513	13179660	622480	2014	January	10914010	16552126	9519166
2010	December	7716786	13494849	681037	2014	February	11078712	16576010	8861159
2011	January	6731870	13307880	724682	2014	March	10608209	17742245	10739917
2011	February	10370924	13201762	707496	2014	April	10882126	17857611	10171527
2011	March	6835082	13859565	1047251	2014	May	11516561	17877513	10890474
2011	April	7729864	13242212	1081921	2014	June	10096080	17212842	10728715
2011	May	6694453	13541793	1277643	2014	July	8040831	18286648	11537359
2011	June	10415024	13464902	1408396	2014	August	8040831	18286648	11537359
2011	July	11528760	12759948	1744691	2014	September	11054237	18446221	13109391
2011	August	15398989	3489160	1981924	2014	October	10002609	19384291	14780452
2011	September	12706020	13305275	2055003	2014	November	8544949	18617540	15276042
2011	October	17195644	14085553	2245138	2014	December	10100650	19352526	16783505
2011	November	7552267	13665404	2319145	2015	January	9646433	19487138	18071922
2011	December	7077334	14273119	2670488	2015	February	8293368	19105289	17910105
2012	January	6250409	14182360	2844938	2015	March	8568200	20273076	19757203
2012	February	10218905	13954057	2799554	2015	April	4831187	18841245	19775045

Source: Ibid

Table 8.3: Transactions through Credit & Debit Cards – All SCBs

		Credit Card		Debit Card				Credit Card		Debit Card	
Year	**Month**	**ATM**	**POS**	**ATM**	**POS**	**Year**	**Month**	**ATM**	**POS**	**ATM**	**POS**
2009	Jan.	126190	14523558	358167747	14766201	2012	Mar.	202106	28744710	471031623	30668922
2009	Feb.	127636	14792395	359985776	14829706	2012	Apr.	191696	29483446	452614082	31041360
2009	Mar.	129103	15069316	361813809	14916240	2012	May	195616	30166356	460263881	32101263
2009	Apr.	130590	15354321	363651846	15025804	2012	June	194256	29513853	437110100	33055758
2009	May	132098	15647410	365499887	15158395	2012	July	205250	33372045	433449531	36895944
2009	June	133627	15948583	367357933	15314016	2012	Aug.	209236	32524725	424658556	37999996
2009	July	135177	16257840	369225982	15492665	2012	Sept.	198862	30427400	420141864	36709046
2009	Aug.	136748	16575181	371104036	15694343	2012	Oct.	261213	35583728	446049609	39662970
2009	Sept.	138340	16900606	372992094	15919050	2012	Nov.	205079	33996899	427533189	46894237
2009	Oct.	139953	17234115	374890156	16166786	2012	Dec.	215268	36104486	448551210	43129684
2009	Nov.	141586	17575708	376798222	16437550	2013	Jan.	211402	37005455	451309699	43310477
2009	Dec.	143240	17925385	378716292	16731343	2013	Feb.	199523	32921958	427800442	40685594
2010	Jan.	144915	18283147	380644367	17048165	2013	Mar.	225770	35616482	482004645	45376619
2010	Feb.	146611	18648992	382582446	17388016	2013	Apr.	228604	37739514	473418167	45286896
2010	Mar.	148328	19022922	384530529	17750895	2013	May	228909	40281121	477855168	47493284
2010	Apr.	150066	19404935	386488616	18136803	2013	June	214911	36803376	468144788	47640990
2010	May	151825	19795033	388456707	18545740	2013	July	234708	44192634	487148560	52163965
2010	June	153604	20193214	390434803	18977705	2013	Aug.	239695	43151823	496932651	55198729
2010	July	155405	20599480	392422902	19432700	2013	Sept.	229116	41812425	493858796	53147269
2010	Aug.	157226	21013830	394421006	19910723	2013	Oct.	247420	45127761	538649053	54516803
2010	Sept.	159068	21436263	396429114	20411775	2013	Nov.	235633	41838607	510246036	51623636
2010	Oct.	160931	21866781	398447226	20935855	2013	Dec.	273653	45636971	530351893	52295128
2010	Nov.	162814	22305383	400475342	21482965	2014	Jan.	274156	45578598	538387754	53832983
2010	Dec.	164719	22752069	402513463	22053103	2014	Feb.	254956	40808266	501526642	48898775
2011	Jan.	166645	23206839	404561588	22646270	2014	Mar.	296548	46105415	571497661	56981333
2011	Feb.	168591	23669693	406619716	23262465	2014	Apr.	295478	46324573	554034275	56266452
2011	Mar.	170558	24140631	408687849	23901689	2014	May	305724	47240362	568127694	59220836
2011	Apr.	171978	23227778	399553342	22461539	2014	June	306826	48262074	555809580	59562768
2011	May	177189	25341607	403465526	24387011	2014	July	319766	50915719	583123745	64662917
2011	June	172625	24182946	391737317	23891416	2014	Aug.	324137	50541670	587304093	67658774
2011	July	172970	25608258	414648767	26603990	2014	Sept.	337585	50174185	592422384	64791285
2011	Aug.	180047	27688863	414472319	27752834	2014	Oct.	349484	54575789	601243824	73637777
2011	Sept.	178119	25586421	409673081	26049559	2014	Nov.	396812	48262297	565472961	70075548
2011	Oct.	185542	28641501	449866388	30500708	2014	Dec.	438032	56091791	591056613	73618740
2011	Nov.	176818	24683380	417004503	27064448	2015	Jan.	410590	56171747	602575841	74464782
2011	Dec.	184298	28145943	444161114	29406351	2015	Feb.	367535	49548431	570389206	67901867
2012	Jan.	188208	29812268	434051835	30673852	2015	Mar.	437278	56906942	624205135	76105726
2012	Feb.	200762	26565890	432250953	28073471	2015	Apr.	430487	57304068	615527057	80124846

Source: Ibid

Table 8.4: Transactions through NEFT, RTGS & Mobile – SBI

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	January	221865	522426	248702	220283	1021515
2009	February	210208	558848	258576	229291	888153
2009	March	270085	665388	323234	293564	765107
2009	April	262347	682439	317320	276757	652378
2009	May	278701	706953	346938	305596	549965
2009	June	295055	731467	376556	334435	457869
2009	July	346109	797115	384617	349741	376089
2009	August	315940	798235	372562	338434	304625
2009	September	366173	807584	390652	352737	243478
2009	October	439649	943438	480989	432049	192648
2009	November	444564	963885	490390	428529	152133
2009	December	456798	985673	535856	463809	121935
2010	January	466323	1008093	520245	472330	102054
2010	February	522827	1070325	532838	493424	92488
2010	March	653670	1328914	663414	617706	93240
2010	April	664987	1275282	595712	539543	104307
2010	May	713014	1288835	624841	564104	125691
2010	June	860153	1364766	651148	581414	157392
2010	July	1083449	1523930	654432	583172	199408
2010	August	1200598	1607315	652094	581208	251742
2010	September	1172762	1619510	628053	586961	314391
2010	October	1400197	1951492	743341	671652	387357
2010	November	1538084	1934798	662590	574125	470640
2010	December	1880630	2223367	656823	543155	564238
2011	January	1517911	2216596	644274	532330	668153
2011	February	1737623	2284660	625913	535444	782385
2011	March	1990652	2851929	757735	663820	906933
2011	April	1822246	2648381	553356	463054	860528
2011	May	2078824	2752579	719401	607935	1042026
2011	June	1990049	2776818	702554	604798	1104480
2011	July	2057195	2927362	678976	576662	1378627
2011	August	2240273	3059316	662361	565806	1561484
2011	September	2324632	3026978	697550	595701	1656942
2011	October	2869186	3351963	730210	616564	1794299
2011	November	2525491	3291804	779120	652581	1849214
2011	December	2908181	3589923	833811	712893	2122445
2012	January	2847691	3635665	815942	699207	2363800
2012	February	3066994	3833233	816241	693847	2343199

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2012	March	3763484	4799881	989501	871585	2560751
2012	April	3294868	4402510	812659	681371	2584132
2012	May	3741165	5049207	912606	775548	2585419
2012	June	3809410	4956810	891888	746341	2577383
2012	July	3896087	5378394	875883	720541	2762262
2012	August	3624593	5488165	803598	657711	2748885
2012	September	3773826	5556782	792664	656068	2751449
2012	October	4402051	6663622	930127	745416	3001041
2012	November	4532154	6339876	897661	709849	3087845
2012	December	4685380	6680186	965446	778551	3424352
2013	January	5178117	7193062	996491	806353	3635332
2013	February	6165283	7094926	911999	742116	3504108
2013	March	8172219	8551362	1118202	926569	4033349
2013	April	5864021	7660408	1030743	822635	3962923
2013	May	7343998	8252389	1064269	868982	4174636
2013	June	7562854	7642991	978449	793901	3981695
2013	July	8444126	9230643	1030238	824375	4285666
2013	August	7945465	8741674	963697	772134	3777747
2013	September	9749358	9227842	973570	773109	3971968
2013	October	10511583	10398138	1090280	849865	4312195
2013	November	9708653	9878485	1027178	799648	4473928
2013	December	12282685	10826161	1104967	867704	5026462
2014	January	12916063	12155655	1114559	860816	5155643
2014	February	13448122	11858942	1029513	796400	4547862
2014	March	19102401	15056797	1286207	1035828	5388126
2014	April	16295385	12768611	1131852	869794	4917285
2014	May	12200280	13545098	1202920	943439	5265159
2014	June	12543820	13012710	1145356	899432	5227782
2014	July	12764329	13417715	1143600	888875	5697602
2014	August	11166442	13006930	1044044	817135	5939298
2014	September	17367491	16578805	1137915	894734	6007930
2014	October	13019457	13831946	1077853	828965	6518779
2014	November	12489808	12782377	1109448	843659	6688245
2014	December	17137149	15202192	1208046	934165	7429003
2015	January	16342282	14613937	1173973	889032	8007069
2015	February	19244474	14346069	1138559	865068	7383483
2015	March	26906303	17867393	1359588	1072737	8044577
2015	April	29567688	16786586	1186765	895710	7848471

Source: Ibid

Table 8.5: Transactions through Credit & Debit Cards – SBI

		Credit Card		Debit Card				Credit Card		Debit Card	
Year	**Month**	ATM	POS	ATM	POS	**Year**	**Month**	ATM	POS	ATM	POS
2009	Jan.	1379	1285447	111074913	1399661	2012	Mar.	29110	3517581	173401000	6287000
2009	Feb.	2063	1317345	112222460	1434141	2012	Apr.	27387	3584436	169098000	5743000
2009	Mar.	2747	1351204	113384938	1474660	2012	May	28159	3752198	170184000	6123000
2009	Apr.	3431	1387022	114562346	1521219	2012	June	27308	3750132	166292000	6567000
2009	May	4116	1424801	115754684	1573818	2012	July	28560	4249580	173025000	7591000
2009	June	4802	1464539	116961953	1632456	2012	Aug.	30457	4265857	167812000	7881000
2009	July	5488	1506237	118184153	1697133	2012	Sept.	29755	3943216	165265000	8037000
2009	Aug.	6175	1549895	119421282	1767850	2012	Oct.	31544	4679460	178282000	8112000
2009	Sept.	6862	1595513	120673342	1844607	2012	Nov.	29789	4566200	170901000	8130000
2009	Oct.	7550	1643091	121940333	1927403	2012	Dec.	30836	4768659	175302000	8687000
2009	Nov.	8238	1692629	123222254	2016239	2013	Jan.	30753	4949078	177053000	9109000
2009	Dec.	8927	1744127	124519105	2111114	2013	Feb.	31381	4397023	166975000	9023000
2010	Jan.	9616	1797585	125830887	2212029	2013	Mar.	34924	4713204	190639000	10025000
2010	Feb.	10306	1853003	127157599	2318983	2013	Apr.	33560	5039611	193041000	9941000
2010	Mar.	10997	1910381	128499242	2431976	2013	May	32674	5145442	193282000	10015000
2010	Apr.	11688	1969718	129855815	2551010	2013	June	33114	4896324	183651000	10167000
2010	May	12379	2031016	131227318	2676082	2013	July	37931	5547689	194009000	11955000
2010	June	13071	2094273	132613752	2807195	2013	Aug.	39043	5495472	194442000	12991000
2010	July	13764	2159491	134015116	2944346	2013	Sept.	36709	5271901	193398000	12598000
2010	Aug.	14457	2226668	135431411	3087538	2013	Oct.	41017	5774647	213221000	11627000
2010	Sept.	15151	2295805	136862636	3236768	2013	Nov.	42082	5439913	203335000	11071000
2010	Oct.	15846	2366903	138308791	3392039	2013	Dec.	49103	5762489	216277000	11958000
2010	Nov.	16540	2439960	139769877	3553349	2014	Jan.	46101	5745208	224013823	12303532
2010	Dec.	17236	2514977	141245894	3720698	2014	Feb.	43254	5114554	207785904	11149285
2011	Jan.	17932	2591954	142736840	3894087	2014	Mar.	52102	5725442	233020443	12655842
2011	Feb.	18628	2670891	144242717	4073515	2014	Apr.	49527	5831334	229977715	12460514
2011	Mar.	19326	2751788	145763525	4258983	2014	May	49976	6046100	233427456	12955489
2011	Apr.	21508	2737188	144809000	4219000	2014	June	50226	6150831	227243913	13062587
2011	May	21343	2957662	144580000	4613000	2014	July	53392	6374279	241814460	14754039
2011	June	20134	2828490	141650000	4753000	2014	Aug.	56238	6525979	239592769	15231114
2011	July	21316	2960077	151958000	4885000	2014	Sept.	58593	6472031	246078098	14522570
2011	Aug.	22483	3233804	151138000	5185000	2014	Oct.	59223	7202826	249769303	16087715
2011	Sept.	22008	2980112	147711000	5029000	2014	Nov.	102269	5044316	234842234	15380216
2011	Oct.	22766	3422634	165870000	5522000	2014	Dec.	103721	5995692	248969377	16240872
2011	Nov.	21969	3111008	150942000	5076000	2015	Jan.	64780	7422408	252938382	15917946
2011	Dec.	22426	3327385	162978000	5643000	2015	Feb.	60610	6621420	239025108	14813419
2012	Jan.	25194	3531876	162381000	5997000	2015	Mar.	75158	7621279	258184051	16509423
2012	Feb.	43404	3219979	158268000	5713000	2015	Apr.	70474	7835632	258068793	19063649

Source: Ibid

Table 8.6: Transactions through NEFT, RTGS & Mobile – PNB

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	January	19708	464	56857	80853	0
2009	February	22330	392	59564	88263	0
2009	March	25305	542	82098	112634	0
2009	April	24476	744	71712	112677	0
2009	May	27858	959	78620	123891	0
2009	June	31239	1174	85527	135104	0
2009	July	35590	636	89807	138356	0
2009	August	37938	1554	86093	136520	0
2009	September	43999	1300	92614	139335	0
2009	October	52474	1432	112174	174720	0
2009	November	53678	1388	112939	174824	0
2009	December	54728	1444	127739	195224	0
2010	January	56402	1224	125298	185520	0
2010	February	66241	1582	127573	194267	0
2010	March	78286	1801	172584	242253	0
2010	April	76836	2172	138236	211777	0
2010	May	91359	2160	143698	227574	0
2010	June	93643	1849	145498	229770	0
2010	July	106552	2130	149049	228827	0
2010	August	116053	1953	150475	226669	0
2010	September	112174	2397	149580	217725	0
2010	October	119464	2341	176569	255584	2
2010	November	162899	2001	153829	218980	5
2010	December	197710	2590	149648	207088	10
2011	January	203692	2550	147527	202316	16
2011	February	199535	2611	147665	198625	23
2011	March	242532	3263	195888	245248	36
2011	April	220829	4050	127447	181085	42
2011	May	262650	3007	166697	231460	93
2011	June	257200	3721	160215	217450	101
2011	July	281301	3018	155935	211495	101
2011	August	274712	3464	154057	204048	79
2011	September	307113	3848	166886	217588	116
2011	October	301155	3957	176237	232502	257
2011	November	320303	4386	189007	244939	271
2011	December	366939	4524	200953	260524	330
2012	January	345889	47678	201422	254874	339
2012	February	351697	46449	202846	251923	329
2012	March	458213	77534	273633	320586	532

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2012	April	414782	55728	197365	254190	387
2012	May	475310	65692	225604	265346	548
2012	June	479956	7012	212951	269287	613
2012	July	499805	6329	218358	269661	568
2012	August	509261	6650	202650	246938	663
2012	September	521822	8166	202126	245277	927
2012	October	657463	9435	232926	290038	983
2012	November	636802	81649	222763	274246	1589
2012	December	654787	98507	238634	295761	1419
2013	January	749689	100837	250175	310313	1898
2013	February	700775	92619	229988	279750	2650
2013	March	862229	164103	302183	354635	2859
2013	April	881489	113380	250582	321565	2484
2013	May	1017191	137981	267146	330847	2641
2013	June	967643	116489	234340	302553	3100
2013	July	1051905	137660	256198	319436	19999
2013	August	1113827	116160	237771	293533	19857
2013	September	1130507	126790	245914	301863	27637
2013	October	1285590	144227	273137	349517	5004
2013	November	1208289	124151	252192	328129	7016
2013	December	1358495	144347	269306	343325	10609
2014	January	1614284	155195	274587	340831	13245
2014	February	1457529	145077	256524	317973	14561
2014	March	1806973	227408	350019	412913	19706
2014	April	1672679	178376	269527	340752	20812
2014	May	1440563	155678	296910	365670	23619
2014	June	1507877	167968	272750	342665	29231
2014	July	1565702	169144	278808	343397	23005
2014	August	1511415	173831	260810	301213	20904
2014	September	2290209	198480	287030	340130	25215
2014	October	2837315	174986	272227	331129	27061
2014	November	1926544	180661	287112	346312	100503
2014	December	2519037	221504	312866	377229	32049
2015	January	2326526	212830	301262	364493	34159
2015	February	2358678	204830	290310	354065	29439
2015	March	3671714	301502	381364	445318	31942
2015	April	3786613	291423	293615	364481	32573

Source: Ibid

Table 8.7: Transactions through Credit & Debit Cards – PNB

Year	Month	Credit Card		Debit Card		Year	Month	Credit Card		Debit Card	
		ATM	POS	ATM	POS			ATM	POS	ATM	POS
2009	Jan.	1975	66584	37237681	269701	2012	Mar.	2428	114472	40732553	1279923
2009	Feb.	1986	67485	37411212	275149	2012	Apr.	2204	118126	39138879	1241621
2009	Mar.	1997	68408	37572059	281720	2012	May	2043	119546	39161917	1074022
2009	Apr.	2008	69353	37720222	289413	2012	June	2169	121783	37924633	1226310
2009	May	2019	70320	37855701	298228	2012	July	2301	135105	15694805	1210434
2009	June	2030	71309	37978496	308164	2012	Aug.	2176	135009	15571854	1287946
2009	July	2041	72320	38088607	319223	2012	Sept.	2067	122457	16387588	1302307
2009	Aug.	2052	73352	38186035	331404	2012	Oct.	2230	145429	17304910	1366578
2009	Sept.	2064	74407	38270778	344707	2012	Nov.	1962	142973	16566143	1421784
2009	Oct.	2075	75483	38342837	359132	2012	Dec.	2202	145108	16901873	1522102
2009	Nov.	2086	76581	38402212	374679	2013	Jan.	2151	153209	16777583	1567144
2009	Dec.	2098	77701	38448904	391348	2013	Feb.	1918	135830	15820228	1476950
2010	Jan.	2109	78843	38482911	409139	2013	Mar.	2270	147780	18555300	1586456
2010	Feb.	2121	80007	38504234	428052	2013	Apr.	2245	155564	18495638	1544045
2010	Mar.	2132	81193	38512874	448087	2013	May	2215	156509	18555119	1726114
2010	Apr.	2144	82400	38508829	469245	2013	June	2140	152079	17352206	1639368
2010	May	2155	83630	38492101	491524	2013	July	2408	173097	18326792	1684706
2010	June	2167	84881	38462688	514925	2013	Aug.	2344	171089	18494391	1766853
2010	July	2179	86154	38420592	539448	2013	Sept.	2178	160141	19279083	1744353
2010	Aug.	2190	87449	38365811	565094	2013	Oct.	2290	178138	20674934	1760323
2010	Sept.	2202	88766	38298347	591861	2013	Nov.	1996	161256	19020339	1668957
2010	Oct.	2214	90105	38218198	619751	2013	Dec.	2171	173572	19797749	1705825
2010	Nov.	2226	91465	38125366	648762	2014	Jan.	2022	169333	19863731	1790176
2010	Dec.	2238	92848	38019850	678896	2014	Feb.	2076	149487	17625101	1613137
2011	Jan.	2250	94252	37901650	710151	2014	Mar.	2430	165919	20040903	1912191
2011	Feb.	2262	95678	37770765	742529	2014	Apr.	2518	167306	20176590	1926005
2011	Mar.	2274	97126	37627197	776029	2014	May	2437	164781	20472458	1984947
2011	Apr.	2277	84560	36192527	647495	2014	June	2143	170065	19626358	2124724
2011	May	2275	94158	36299864	694574	2014	July	2377	172220	17809230	2395667
2011	June	2227	92940	35217573	720258	2014	Aug.	2346	172104	20355166	2441565
2011	July	2281	100355	36780528	885752	2014	Sept.	2740	166422	21191433	2316406
2011	Aug.	2452	110673	36556152	964647	2014	Oct.	2966	184532	21056241	2441567
2011	Sept.	2325	102509	37298382	969845	2014	Nov.	2705	165839	20064832	2566208
2011	Oct.	2378	119531	39132584	1074386	2014	Dec.	2841	186859	20689640	2522552
2011	Nov.	2232	105156	36467607	1057795	2015	Jan.	2847	181147	19919295	2580869
2011	Dec.	2404	112590	38598006	1164436	2015	Feb.	2775	160069	19031332	2260452
2012	Jan.	2152	121186	37635882	1276996	2015	Mar.	3175	172062	21160658	2563190
2012	Feb.	2140	10998	37349091	1196369	2015	Apr.	3075	162295	20792137	2519313

Source: Ibid

Table 8.8: Transactions through NEFT, RTGS & Mobile – HDFC Bank

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	January	541415	464568	183532	156479	9381
2009	February	555784	445195	195482	164076	9349
2009	March	655853	544674	254516	209814	9340
2009	April	658079	514724	251792	185725	9352
2009	May	695326	559732	286629	211696	9387
2009	June	732572	604740	321466	237666	9444
2009	July	854971	665448	342961	254026	9524
2009	August	824307	798347	348495	251856	9626
2009	September	859474	642260	369443	261916	9749
2009	October	1181671	756191	451470	307165	9896
2009	November	1028786	774321	452232	313889	10064
2009	December	1058965	795467	508887	359080	10255
2010	January	1049059	811171	508409	345789	10468
2010	February	1066174	839743	531574	347649	10703
2010	March	1331411	1086883	660787	457422	10961
2010	April	1293381	923287	592713	383548	11240
2010	May	1258914	1001889	639945	404643	11543
2010	June	1273306	1113794	666023	425576	11867
2010	July	1508910	1200856	673244	441944	12213
2010	August	1479374	1220106	678355	450783	12582
2010	September	1516671	1218083	665523	447920	12973
2010	October	2058513	1372277	758132	519046	13387
2010	November	1717786	1444813	634782	450528	13822
2010	December	1985564	1707021	599430	446419	14280
2011	January	1938818	1623342	575746	430077	14760
2011	February	1996335	1664213	580448	425916	15263
2011	March	2441678	1964339	692992	554564	15788
2011	April	2258736	1712846	499481	363390	15001
2011	May	2213749	1904750	655057	483342	13266
2011	June	2334401	1940228	655221	488848	16867
2011	July	2413498	1984379	634886	478993	17749
2011	August	2450885	2074110	636876	498666	17916
2011	September	2418127	2145047	665962	516260	17887
2011	October	2758298	2273302	693356	521679	21915
2011	November	2677202	2281381	730056	557629	26080
2011	December	2909338	2474325	781192	605181	14711
2012	January	3010677	2435650	749761	593366	13149
2012	February	3129043	2518821	765378	604947	17071

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2012	March	3813080	3017909	933501	759178	30021
2012	April	3476880	2583387	749320	573191	41893
2012	May	3861479	2947779	854821	662670	50586
2012	June	3878067	3006474	859507	662165	58333
2012	July	4339417	3097627	848703	678175	52667
2012	August	4366988	3099182	793760	655028	49870
2012	September	4454336	3066182	784488	648096	52319
2012	October	5281548	3578469	903381	751563	60748
2012	November	4907928	3470822	857616	730391	61077
2012	December	5254984	3659782	936787	781277	61056
2013	January	5618944	3826838	963632	794320	61938
2013	February	5333748	3671763	890539	743377	140084
2013	March	6479061	4368799	1073862	919708	151245
2013	April	5796996	4133818	990753	797892	156545
2013	May	6235342	4536746	1028526	846065	185338
2013	June	5864452	4360782	956105	775561	194172
2013	July	6662376	4743003	1009737	823140	204753
2013	August	6572794	4607034	961989	779376	189215
2013	September	6594309	4700226	953355	789916	213530
2013	October	7497853	5166590	1059862	878246	250723
2013	November	6758325	4781297	989946	798838	1862
2013	December	7474246	5273936	1077533	885438	272237
2014	January	7705205	5354542	1080211	877976	290605
2014	February	7198011	4949041	1016180	834370	272549
2014	March	9026051	5956175	1274416	1090887	317180
2014	April	7708516	5337535	1105893	895713	295470
2014	May	8336108	5642416	1194307	1005303	358737
2014	June	8048794	5593074	1162930	959990	351883
2014	July	8912063	6014571	1166829	983926	387206
2014	August	8545669	5688397	1082215	909054	425581
2014	September	9776321	6384594	1202365	1028810	1041164
2014	October	9095121	6077008	1136483	944357	1103128
2014	November	8957315	6064599	1156973	984732	1115060
2014	December	10334779	6914104	1283902	1095102	1252189
2015	January	9731688	6649810	1227204	1034738	1491924
2015	February	9432184	6556661	1188313	1015936	1547909
2015	March	11290337	7834788	1456929	1295276	1720761
2015	April	12260526	7954978	1241214	1038546	1746757

Source: Ibid

Table 8.9: Transactions through Credit & Debit Cards – HDFC Bank

		Credit Card		Debit Card				Credit Card		Debit Card	
Year	**Month**	ATM	POS	ATM	POS	**Year**	**Month**	ATM	POS	ATM	POS
2009	January	29489	2644209	15138814	3296199	2012	March	68877	7443931	26397135	5725396
2009	February	29873	2705893	15213099	3348252	2012	April	69360	7616056	25450308	5768433
2009	March	30295	2771914	15300092	3401570	2012	May	69202	7694073	26683750	5954437
2009	April	30755	2842272	15399793	3456151	2012	June	71951	7728750	26737013	6140501
2009	May	31254	2916967	15512203	3511997	2012	July	75071	8807388	27392214	6661628
2009	June	31791	2995999	15637320	3569106	2012	August	77691	8696648	27750467	6812214
2009	July	32366	3079369	15775146	3627479	2012	September	72580	8241125	28055076	6696787
2009	August	32979	3167075	15925680	3687117	2012	October	81109	9485878	29385970	6934395
2009	September	33630	3259119	16088922	3748018	2012	November	73954	9105057	29643759	7223385
2009	October	34320	3355500	16264872	3810183	2012	December	77124	9883168	30429476	7566251
2009	November	35047	3456218	16453531	3873613	2013	January	78076	10100812	28789331	7411651
2009	December	35813	3561273	16654897	3938306	2013	February	69915	9160742	27289943	6972023
2010	January	36617	3670666	16868972	4004263	2013	March	80587	10014020	32680814	7994779
2010	February	37460	3784395	17095755	4071485	2013	April	82730	10374501	30450447	7539002
2010	March	38340	3902462	17335246	4139970	2013	May	82371	12497356	31019823	7954381
2010	April	39259	4024865	17587445	4209719	2013	June	74540	12123119	29926032	8064170
2010	May	40216	4151606	17852353	4280733	2013	July	77671	13668380	29604822	8263067
2010	June	41211	4282684	18129968	4353010	2013	August	78473	13673238	30188775	8820651
2010	July	42244	4418100	18420292	4426551	2013	September	74207	13254814	29634445	8112916
2010	August	43315	4557852	18723324	4501357	2013	October	74692	14143046	32551612	8870976
2010	September	44425	4701941	19039064	4577426	2013	November	69096	13197140	30426316	8425986
2010	October	45573	4850368	19367512	4654759	2013	December	81197	14433225	31775652	7694636
2010	November	46759	5003132	19708668	4733356	2014	January	83387	14463694	30873218	8024823
2010	December	47983	5160233	20062533	4813218	2014	February	78625	13022434	28941299	7517528
2011	January	49245	5321671	20429106	4894343	2014	March	89997	14879965	33109642	8762349
2011	February	50546	5487446	20808386	4976732	2014	April	91509	14643830	31117311	8440338
2011	March	51885	5657559	21200375	5060385	2014	May	94159	15218157	32847342	9215078
2011	April	50701	5344558	21263901	4606216	2014	June	95973	15438842	31696097	9058238
2011	May	53220	5873844	21851725	4972650	2014	July	97404	16341415	32461106	9563648
2011	June	52384	5700902	21387996	4877210	2014	August	100584	16332988	33470815	10388413
2011	July	53651	6230129	22550312	5629294	2014	September	107524	15866931	31982274	9590095
2011	August	59710	6697422	22452495	5523811	2014	October	111324	17332004	34257055	11077977
2011	September	56990	6248345	22415249	5270180	2014	November	108816	15930826	31301968	10693666
2011	October	62491	7159652	25082453	6254422	2014	December	124415	18009719	31614787	11019007
2011	November	60670	6398578	22853025	5691266	2015	January	126109	17947247	31439384	11151245
2011	December	64080	7163111	24876045	5510860	2015	February	110929	15602279	29431449	10288412
2012	January	65392	7589316	24071217	5488282	2015	March	134345	17970090	32621787	11582587
2012	February	64665	6711082	23767676	5158212	2015	April	133613	18188579	32041281	12044987

Source: Ibid

Table 8.10: Transactions through NEFT, RTGS & Mobile – Federal Bank

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2009	January	4805	29042	8915	13595	15
2009	February	5276	31934	9052	13660	10
2009	March	6863	41357	12339	18038	14
2009	April	6849	36707	11097	16961	12
2009	May	8591	40854	12289	18532	27
2009	June	10333	45001	13481	20104	42
2009	July	15528	49865	14326	18423	74
2009	August	15261	54119	15161	23170	40
2009	September	18055	46109	14960	21726	77
2009	October	23395	56909	18636	27701	492
2009	November	25667	58810	19430	27796	397
2009	December	28765	59987	21997	32369	313
2010	January	32149	60253	22160	32778	238
2010	February	41187	61864	22587	32285	174
2010	March	54091	77301	31597	42432	119
2010	April	50091	67922	24600	35946	123
2010	May	61938	75728	27123	39632	178
2010	June	63490	79057	27965	40088	243
2010	July	69353	86361	29161	42094	318
2010	August	74862	90545	30002	43251	404
2010	September	69642	86091	29550	41337	499
2010	October	75099	95304	32291	45569	604
2010	November	94256	102014	28218	40662	719
2010	December	109382	112004	27452	38020	844
2011	January	113628	107174	27979	38636	980
2011	February	114693	107972	27515	38028	1125
2011	March	137271	136284	35723	46641	1280
2011	April	122048	112290	23068	32444	1024
2011	May	143537	127553	30097	42738	1145
2011	June	143180	130226	29998	41896	1320
2011	July	144177	131073	29162	41349	1532
2011	August	179004	144402	31282	43388	2117
2011	September	164496	139245	31854	44292	2102
2011	October	184507	150560	31339	45104	2331
2011	November	188753	155385	32076	46149	2717
2011	December	212824	171143	36834	51418	3359
2012	January	193021	164681	34537	48918	3441
2012	February	182498	167041	34526	47950	3388

Year	Month	NEFT		RTGS		MOBILE
		Outward	Inward	Inward	Outward	
2012	March	237176	203273	44859	60252	4426
2012	April	204289	170294	32637	47753	4077
2012	May	244380	196120	35884	52486	4143
2012	June	238684	199173	37156	55683	4368
2012	July	271046	218359	37281	56365	18888
2012	August	299812	231340	36097	52085	51498
2012	September	289238	215882	36231	55445	8680
2012	October	341552	254834	40318	60395	5699
2012	November	342329	248416	38375	60070	6289
2012	December	390290	264594	41802	63498	6566
2013	January	428636	279406	43489	67768	10132
2013	February	397054	261858	40295	61413	8944
2013	March	528929	316526	52214	74652	13495
2013	April	485437	290805	48037	69352	13509
2013	May	584670	320544	50463	71436	15743
2013	June	557739	314676	46614	66369	16470
2013	July	569810	348230	49558	74008	18129
2013	August	603572	360549	50194	73699	20858
2013	September	604465	412173	51198	73502	35315
2013	October	664156	431892	53210	77383	29043
2013	November	614148	454276	49028	72743	28648
2013	December	678549	535726	55375	78718	32912
2014	January	709782	470429	57952	81540	32427
2014	February	644566	427180	53660	72927	29659
2014	March	812852	611502	70845	95025	44376
2014	April	690968	700909	57389	79554	44018
2014	May	765666	424237	62020	85491	47940
2014	June	758306	449684	60157	83270	47589
2014	July	845191	492821	62351	86688	50930
2014	August	781338	492567	61081	84499	53582
2014	September	844726	589404	63248	87571	54622
2014	October	758977	494205	59075	82266	57122
2014	November	700867	466662	58734	80634	58078
2014	December	820346	750246	67800	91689	61826
2015	January	732702	523252	64680	88663	61654
2015	February	738241	573507	62287	84679	58497
2015	March	1005376	728624	80905	104276	71094
2015	April	998765	708746	61414	83529	67890

Source: Ibid

Table 8.11: Transactions through Credit & Debit Cards – Federal Bank

		Credit Card		Debit Card				Credit Card		Debit Card	
Year	Month	ATM	POS	ATM	POS	Year	Month	ATM	POS	ATM	POS
2009	January	0	0	1922699	24903	2012	March	0	0	2493068	178429
2009	February	0	0	1935359	24588	2012	April	0	0	2351681	186371
2009	March	0	0	1948146	24562	2012	May	0	0	2484101	193358
2009	April	0	0	1961060	24823	2012	June	0	0	2460057	197367
2009	May	0	0	1974102	25371	2012	July	0	0	2560880	222051
2009	June	0	0	1987272	26208	2012	August	0	0	2590586	267827
2009	July	0	0	2000569	27333	2012	September	0	0	2561472	219588
2009	August	0	0	2013993	28745	2012	October	0	0	2753750	238618
2009	September	0	0	2027545	30445	2012	November	0	0	2713736	247556
2009	October	0	0	2041225	32432	2012	December	0	0	2918755	281161
2009	November	0	0	2055032	34708	2013	January	0	0	2916188	281768
2009	December	0	0	2068967	37271	2013	February	0	0	2669635	253275
2010	January	0	0	2083029	40122	2013	March	0	0	3086186	300519
2010	February	0	0	2097219	43261	2013	April	0	0	3079968	310756
2010	March	0	0	2111536	46688	2013	May	0	0	3153914	325139
2010	April	0	0	2125980	50402	2013	June	0	0	2970906	324860
2010	May	0	0	2140553	54404	2013	July	0	0	3165668	367939
2010	June	0	0	2155252	58694	2013	August	0	0	3386567	434607
2010	July	0	0	2170080	63272	2013	September	0	0	3249120	396395
2010	August	0	0	2185035	68138	2013	October	0	0	3532472	406355
2010	September	0	0	2200117	73291	2013	November	0	0	3417073	384173
2010	October	0	0	2215327	78732	2013	December	0	0	3698057	402853
2010	November	0	0	2230664	84461	2014	January	0	0	3647869	406432
2010	December	0	0	2246129	90478	2014	February	0	0	3356318	373425
2011	January	0	0	2261721	96782	2014	March	0	0	3851272	433733
2011	February	0	0	2277441	103374	2014	April	0	0	3596396	435396
2011	March	0	0	2293289	110254	2014	May	0	0	3787336	477334
2011	April	0	0	2349889	110523	2014	June	0	0	3643063	468506
2011	May	0	0	2557268	123478	2014	July	0	0	3843054	532837
2011	June	0	0	2425581	116641	2014	August	0	0	3881786	574550
2011	July	0	0	2525115	134543	2014	September	0	0	3831312	549134
2011	August	0	0	2581955	153151	2014	October	0	0	3847314	593578
2011	September	0	0	2041455	140681	2014	November	0	0	3713087	560784
2011	October	0	0	2189295	148756	2014	December	0	0	3876289	605855
2011	November	0	0	2142661	143102	2015	January	0	0	3910130	620225
2011	December	0	0	2341449	173962	2015	February	0	0	3685120	552563
2012	January	0	0	2340653	176297	2015	March	0	0	4210491	642011
2012	February	0	0	2222796	158997	2015	April	0	0	3901792	639602

Source: Ibid

APPENDIX III

Interview Schedule for Customers

This schedule is intended to collect information regarding customer views on different banking services. The survey is conducted by Rahul K. (Research Scholar, Dept. of Economics, University of Calicut, Dr. John Mathai Centre) under the guidance of Dr. C. Krishnan (Associate Professor& Guide, Govt. College, Kodenchery). Please be assured that your responses will be strictly confidential.

Personal Data

1. Name of the customer:
2. Gender: (a) Male ☐ (b) Female ☐
3. Age:
4. Education: (a) Illiterate☐ (b) School ☐ (c) Degree/PG ☐
   (d) Professional/Technical ☐
   (e) Others (please specify)________________
5. Profession
   (a) Govt Employee ☐ (b) Private Employee☐ (c) Self Employee ☐
   (d) Student ☐ (e) House Wife ☐ (f) Others (please specify) _______
6. Monthly Income ☐

Data related to Bank

7. Name of the bank and branch:
8. Reason for selecting this bank: (Tick all that are applicable)
   (a) Quality of Service☐
   (b)Technology used ☐
   (c) Trust ☐
   (d) Location ☐
   (e) Type of the bank ☐

9. Are you using the new techniques in Banking? Yes ☐ No ☐

10. If yes, which factor prompts you to use the new techniques in banking? (Tick all that are applicable)
    (a) Reduced time of transactions ☐
    (b) Cost effectiveness ☐
    (c) Ease of use ☐
    (d)Technology savvy ☐

11. Techniques you are using (Tick all that are applicable)
    (a) Internet banking ☐
    (b) Mobile banking ☐
    (c) ATM/Debit card service ☐
    (d) Credit card service ☐
    (e) Other services (Please specify) ☐

Satisfaction levels regarding the various service quality dimensions

(For questions from 12 to 38, please give 5 for extremely satisfied, 4 for moderately satisfied, 3 for satisfied, 2 for dissatisfied and 1 for extremely dissatisfied for both expectations and perceptions separately)

	Expectation	Perception
A. Tangibility		
12. Bank has up - to - date equipment & technology		
13. Location of the Bank		
14. Sufficient number of ATM machines		
15. Cash counting machines		
B. Reliability		
16. The bank website does not freeze after customer put in all the information		
17. Information provided on website		
18. Up to date content		
19. Process of transactions		
C. Responsiveness		
20. Customer service representative		
21. Bank performs the services right the first time		

22. Quick confirmation
23. Our requests are handled promptly

D. Assurance

24. Employees of bank have the knowledge to answer customer questions
25. Politeness and friendly staff
26. Employees are always willing to help you
27. Experienced management team.

E. Empathy

28. Time bound work of employee
29. Help desks, call centers of bank
30. Specific needs understood
31. Provisions of financial advices

F. Efficiency

32. Log in facility
33. Performance of Plastic cards (ATM, Debit/Credit)
34. Transfer of Funds (NEFT, RTGS)
35. Clearing Services (ECS-Credit/Debit)

G. Accuracy

36. Problem solving through instant information
37. Bank insists on error-free transaction records
38. Electronic Bills payments

Suggestions to improve service quality

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