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Information Technology and efficiency changes in Indian Banking System

Abstract

In recent years, use of technology and services related to banking are increasing. The advent of new technologies both in terms of computers and communications has transformed completely the way banks conduct their business. This new technology has opened up new vistas and hence it has brought new possibilities and opportunities for banking sector the world over. This paper tries to unfold the linkage between information technology and efficiency of commercial banks in India. The analysis shows that Information Technology has a positive impact on efficiency of banking in India and among the selected banks results show ICICI bank is working at efficient level and this bank followed by Bank of India and State Bank of India in both Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS) models.

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Introduction

Information technology is a capital intensive industry. Investing in e-banking if not done appropriately it can cost very substantial sum of money.Today many banks worldwide offer their services electronically. In an increasingly integrated global economy, an economy will lag behind if it does not take advantage of this new banking system. On the other hand, customers who have the technological understanding are growing in number and these customers prefer a distribution system that is based on information technology. Response to this need of customers with traditional banking systems is relatively expensive. Thus, getting the appropriate technology is essential to remain in the market. Slow response or overlooking this technological innovation will leave space for non-bank companies and organizations to provide banking services and take a larger share of the market.

Participation in electronic banking can remain underdeveloped if customers encounter low level of security, widespread fraud, cultural resistance,poverty and poor operational infrastructure and management. Participation may also have been affected by the skill required for electronic banking technology and the service level provided by the banks. It is known fact that the application of a new technology will depend on how the technology is being perceived and embraced by the customers. Electronic banking as it has demonstrated the velocity of its growth is incredibly fast and efficient. It has allowed individuals including companies to perform their banking businesses from their homes or offices in a very cost-effective way.

In India, computerization started somewhere during the 1950s, when Indian Statistical Institute, Calcutta (ISIC) installed a first generation computer. The use of technology in expanding banking has been a key focus area of the Reserve Bank of India. The RBI has taken several initiatives to popularize usage of technology by banks in India. Periodically, almost once in five years since the early 1980s, the RBI appointed committees and working groups to deliberate on and recommended the appropriate use of technology by banks given the

circumstances and the need.Several initiatives have also been taken by the government as well as the Reserve Bank of India (RBI) to facilitate the development of electronic banking in India. Government of India enacted the IT act 2000 with effect from 17 October 2000 which has provided legal recognition and security for electronic transaction and other means of electronic commerce for the Indian banking system and paved the way for the emergence and growth of e-banking in India. This present research work devoted to look into the facts related to the impactof information technologyon the performance ofthe Indian banking system.

Literature Review

Today because of competitive environment the importance of information technology on the performance of organizations is inevitable fact which each organization faces. Verma, D (2000:69), in his study analyzed the impact of IT on public sector banks and new private sector banks in India and observed that IT is a threat to public sector banks. The strength of new private sector banks lies in their fully computerized branches and services of Internet banking. The study found that ICICI and HDFC Banks are very active on this front and concentrating on Internet banking and e-commerce to offer their clients a whole range of products under one roof.

In Nigeria, Adewoye, J O (2007:70), concluded in his paper that IT investment made a positive contribution to gross marginal output and net marginal output of the banking sector. The findings of the study indicated that, IT investment has increased productivity but have not resulted in supernormal profitability, rather, there was some evidence of small or even negative impact on profitability.

Janki, B (2002:7), analyzed in his research paper that how technology is affecting the employees' productivity in the banking sector. The study shows that there is need to use technology in banking sector particularly in India for improvement in operating efficiency and customer services. The focus on the use of technology has increased never before like today to add value to customer services, develop new products, strengthen risk management etc. The study concluded that technology is the only tool for banks to achieve their goals.

Casolaro and Gobbi (2007:43), have analyzed the effects of investment in information technology (IT) in the financial sector in Italy. The result of the study showed that both cost and profit frontier shifts are strongly correlated with IT capital accumulation. Banks adopting IT capital-intensive technique are more efficient than others.

Osho, S G (2008:15), explained the use of technology in the banking industry and analyses how it has helped banks earn profit. The results indicated that more and more consumers are now turning towards technologies and time saving options for their banking decisions. Furthermore, the results indicated that competition among banks in this attractive industry is a factor of the one offering the most convenient and appealing technological advances.

Floros and Gordian (2008:55), in their paper showed how useful the number of ATMs is for modelling and estimating banking efficiency. To estimate banking efficiency they employed DEA and Free Disposal Hull (FDH) methods. The result of study showed that large banks are more efficient than medium and small sized banks in Greece. Furthermore, banks with a large number of ATMs are more efficient than those with a less number of ATMs. However, provision of e-banking services by banks does not influence their efficiency scores.

Manoj, P K (2010:278), in his paper "Impact of Technology on the Efficiency and Risk Management of Old Private Sector Banks in India: Evidence from Banks Based in Kerala", analyzed the role of IT in improving banking net interest margin (NIM) and noninterest margin (NOM), the most popularly used measures for operational efficiency and risk management. Analysis showed that there is a clear and significant positive relationship between noninterest margin and technological change suggesting that technological advancements can lead to higher non-interest income of banks. But, such technological changes may sometimes affect the net interest income of banks, as is suggested by the reasonably high negative association between net interest margin and technological costs in most cases. The study further reveals that there is a significant and positive correlation of both net interest margin and noninterest margin of old public banks in India with the degree of risk borne by them. However, the result confirmed that the above sort of positive relations are not apparent in respect of the

Kerala-based old public bank (KOPBs). Likewise, the clear negative association of NOM of OPBs with cost of production (COP) is not at all observed in KOPBs.

The study also showed that there is a negative association between technological change (TECH_CHG) and Net Interest Margin (NIM) and this is true in respect of the general case of both OPBs (Old public banks) and NPBs (New private banks) as well and there is a strong, positive and statistically significant (5% LOS) relationship between technological change (TECH_CHG) and Non-Interest Margin (NIM).

Jalal-Karim and Hamdan (2010:1), in their paper entitled "The Impact of Information Technology on Improving Banking Performance Matrix: Jordanian Banks as Case Study", examined the level of use of IT by 15 Jordanian Banks for a period of five years, and then explored the impression on improving the performance of two forms of matrix. The first matrix is of financial performance which comprises Market Value-Added (MVA), Return on Investment (ROI) and Earning per Share (EPR) and the second matrix is of operational performance, which includes the Net Profit Margin (NPM), Operating Return on Assets (ORA) and Profitability of Employee (PE). Utilization of IT by Jordanian banks have been measured by testing the level of investment in Hardware, Software, Internet Banking, Phone banking, number of ATMs, use of Cyber branches and Banking via SMS. The results of the measurements indicated that there is a positive impact on the use of MIS in Jordanian banks in the market value added (MVA), Earnings Per Share (EPS), Return on Assets (ROA), Net Profit Margin (NMP).

Data Envelopment Analysis

Data Envelopment Analysis (DEA), time to time also called frontier analysis, is a performance measurement technique which is used to analyze the relative efficiency of productive units. The multiple inputs and multiple outputs are kept the same. It is a non-parametric analytic technique. This allows us to compare the relative efficiency of the units as a benchmark by measuring the inefficiencies in input combinations in other units relative to the benchmark. One of the earliest studies on DEA is the study of Farrell (1957) who attempted to measure the technical efficiency of production in single input-output case.

The DEA was originally developed by Charnes, Cooper and Rhodes in 1978. With their underlying assumption of constant return to scale (CRS) – they attempted to propose a model that generalizes the single-input to a multiple inputs-outputs setting. Thus, DMU is an entity that uses input to produce output. DEA was elaborated further by Banker, Charnes and Cooper (1984). They include the variable of return to scale (VRS) into the model. The DEA measure, up to that time, was used to evaluate and compare educational departments, health care, agricultural production, banking, armed forces, sports, market research, transportation and some other applications.

DEA is an alternative analytic technique to regression analysis. The regression analysis approach is characterized as a central tendency approach. That is, it evaluates DMUs relative to an average. In contrast, DEA is an extreme point method and compares each DMU with the only best DMU. The main advantage of DEA is that unlike the regression analysis it does not require an assumption of a functional form relating inputs to outputs. Instead, it constructs the best production function solely on the basis of observed data. Hence, statistical tests for significance of the parameters are not necessary (Chansarn, 2008:55).

The Data and Model Specification

This study includes 8 major commercial banks of India, State Bank of India (SBI), Bank of India (BOI), Central Bank of India (CBI), Punjab National Bank (PNB), and Union Bank of India (UBI), ICICI Bank, HDFC Bank and Axis Bank. The annual balance sheet and income statement used were taken from different reports of Reserve Bank of India.

In the literature in the field, there is no consensus regarding the inputs and outputs that have to be used in the analysis of the efficiency of the activity of commercial banks (Berger and Humphrey, 1997:180). In the studies in the field, five approaches for defining inputs and outputs in the analysis of the efficiency of a bank were developed, namely: the intermediation approach; the production approach; the asset approach; the user cost; the value added approach. The first three approaches are developed according to the functions that banks do fulfill (Favero and Papi, 1995: 387). The production and the

intermediation approaches are the best known ones and the most used in the quantification of bank efficiency (Sealy and Lindley, 1997: 1255).

In the production-type approach, banks are considered as deposit and loan producers and it is assumed that banks use inputs such as capital and labor to produce a number of deposits and loans. According to the intermediation approach, banks are considered the intermediaries that transfer the financial resources from surplus agents to the agents with deficit. In this approach it is considered that the bank uses as inputs: deposits, other funds, equity and work, which they transform into outputs such as: loans and financial investments. The opportunity for using each method varies depending on circumstances (Tortosa-Ausina, 2002:212).

The intermediation approach is considered relevant for the banking sector, where the largest share of activity consists of transforming the attracted funds into loans or financial investments (Andrie and Cocris, 2010:58).

In our analysis we will use the following set of inputs and outputs to quantify the efficiency of banks in India:

- Outputs: Loans and investments
- Inputs: Fixed assets, deposits, number of employees, number of branches and number of ATMs

This study uses the intermediation approach to define bank inputs and outputs. Under the intermediation approach, banks are treated as financial intermediaries that combine deposits, labour and capital to produce loans and investments.

Data Analysis

In this analysis we estimated efficiency of each bank at a period of time (2003-2011) separately. In order to specify the impact of IT on efficiency of banks we analyzed our model once without e-banking representative (Number of ATMs) in model but in second time we enter number of ATMs in model as an input. As in the latter case it is to estimate efficiency of banks in various years and also to find and compare whether e-banking has any significant impact on efficiency of bank in that period of time or not.

Table 1: Efficiency Analysis of State Bank of India

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.897	1.000	0.897irs	0.925	1.000	0.925 irs
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	0.987	1.000	0.987 irs	1.000	1.000	1.000
2006-07	0.976	1.000	0.976 irs	1.000	1.000	1.000
2007-08	0.982	1.000	0.982 irs	0.987	1.000	0.987 irs
2008-09	1.000	1.000	1.000	1.000	1.000	1.000
2009-10	1.000	1.000	1.000	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 2: Efficiency Analysis of Bank of India

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.934	1.000	0.934 irs	0.947	1.000	0.947 irs
2004-05	0.974	1.000	0.974 irs	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	1.000	1.000	1.000	1.000	1.000	1.000
2007-08	1.000	1.000	1.000	1.000	1.000	1.000
2008-09	1.000	1.000	1.000	1.000	1.000	1.000
2009-10	1.000	1.000	1.000	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 3: Efficiency Analysis of Central Bank of India

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.921	1.000	0.921 irs	1.000	1.000	1.000
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	1.000	1.000	1.000	1.000	1.000	1.000
2007-08	0.877	1.000	0.877 irs	0.976	1.000	0.976 irs
2008-09	0.925	0.925	0.998 irs	0.992	1.000	0.992 irs
2009-10	0.971	1.000	0.971 irs	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 4: Efficiency Analysis of Punjab National Bank

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.976	1.000	0.976 irs	1.000	1.000	1.000
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	0.920	0.964	0.954 irs	1.000	1.000	1.000
2006-07	1.000	1.000	1.000	1.000	1.000	1.000
2007-08	0.967	1.000	0.967 irs	1.000	1.000	1.000
2008-09	0.965	1.000	0.965 irs	0.975 irs	1.000	0.975 irs
2009-10	0.984	0.991	0.992 irs	0.993	1.000	0.993 irs
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 5: Efficiency Analysis of Union Bank of India

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.883	1.000	0.883 irs	0.889	1.000	0.889 irs
2004-05	0.964	1.000	0.964 irs	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	1.000	1.000	1.000	1.000	1.000	1.000
2007-08	0.993	1.000	0.993 irs	0.993	1.000	0.993 irs
2008-09	0.973	0.987	0.983 irs	0.973	0.987	0.983 irs
2009-10	1.000	1.000	1.000	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 6: Efficiency Analysis of ICICI Bank

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	1.000	1.000	1.000	1.000	1.000	1.000
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	1.000	1.000	1.000	1.000	1.000	1.000
2007-08	1.000	1.000	1.000	1.000	1.000	1.000
2008-09	1.000	1.000	1.000	1.000	1.000	1.000
2009-10	1.000	1.000	1.000	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 7: Efficiency Analysis of HDFC Bank

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.953	1.000	0.953 irs	0.966	1.000	0.966 irs
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	0.990	1.000	0.990 irs	1.000	1.000	1.000
2007-08	1.000	1.000	1.000	1.000	1.000	1.000
2008-09	0.980	1.000	0.980 drs	0.990	1.000	0.990 drs
2009-10	0.986	0.989	0.997 drs	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note:Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 8: Efficiency Analysis of Axis Bank

Year	Without IT effect			With IT effect		
	Crste	Vrste	Scale	Crste	Vrste	Scale
2003-04	0.750	1.000	0.750 irs	0.750	1.000	0.750 irs
2004-05	1.000	1.000	1.000	1.000	1.000	1.000
2005-06	1.000	1.000	1.000	1.000	1.000	1.000
2006-07	0.995	1.000	0.995 irs	0.995	1.000	0.995 irs
2007-08	0.999	1.000	0.999 irs	0.999	1.000	0.999 irs
2008-09	1.000	1.000	1.000	1.000	1.000	1.000
2009-10	1.000	1.000	1.000	1.000	1.000	1.000
2010-11	1.000	1.000	1.000	1.000	1.000	1.000

Note: Crste = technical efficiency from CRS DEA, Vrste = technical efficiency from VRS DEA, Scale = scale efficiency = crste/vrste

Table 1 shows efficiency analysis of the State Bank of India with and without impact of IT. This table shows the multi-stage method of analysis of constant returns to scale (CRS) and variable returns to scale (VRS) models. As can be seen from table's first part, Efficiency of State Bank of India is not at 100 per cent from 2003 to 2007 and its efficiency shows decreasing trend to 2007-08 but again from 2008-09 State bank of India's efficiency increased to efficient level of 1 which shows 100 % efficiency. The second part of the table shows the impact of e-banking services on efficiency of the State Bank of India. As table shows, State Bank of India is working at efficient level and e-banking has had positive contribution on efficiency improvement of State Bank of India.

Table 2 shows efficiency analysis of Bank of India. As can be seen from the table, Bank of India is operating almost on the most efficient frontier in both models. Efficiency of Bank of India increased by IT products as it is clear from the second part of the table.

Table 3 shows efficiency analysis of Central Bank of India. From the table it is understandable that efficiency of Central bank is not at an efficiency level of 1 for some years. It it is because of a decrease in the number of banks' employees from 2007 to 2010 in the bank. As can be seen from table 3, efficiency of Central bank of India reached 100 per cent after entering e-banking variable to model in 2009-10 and also scores of efficiency increased for 2007-08. The result shows e-banking has had a positive impact on efficiency of Central bank of India and increase in number of ATMs substituted to decrease in number of employees.

Table 4 shows efficiency level of Punjab National Bank in different years. From the table it is clear that, without e-banking services Punjab National Bank is a less Efficient Bank. Data of Punjab National Bank shows a decrease in the amount of loans (from 5067283 to 4105532 lakhs) which bank has given in 2005-06. The data also shows a decrease in the number of employees in the same year. Table and data as well show a decrease in level of employees from 2007 to 2010 which decreased efficiency of Punjab National bank. The second part of the table shows e-banking services helped Punjab National Bank to increase its efficiency to an efficient level in almost all years. Equally, it can be interpreted that increase in number of ATMs from 1516 to 3544 in three years had a positive impact on the efficiency of this bank.

Table 5 shows e-banking variable improved efficiency level of Union Bank in 2003-05. While it increased to 100 percent in 2004-05 despite of a decrease in the amount of loans of bank in this year but in other years efficiency of Union Bank remained the same as before. So increase in the number of ATMs did not improve its efficiency.

Table 6 shows efficiency analysis of ICICI bank. ICICI bank is a pioneering bank in case of e-banking in India and as the table shows, ICICI bank is an efficient bank.

As can be seen from table 7, e-banking has had a positive impact on the efficiency of HDFC bank. Efficiency scores of HDFC bank

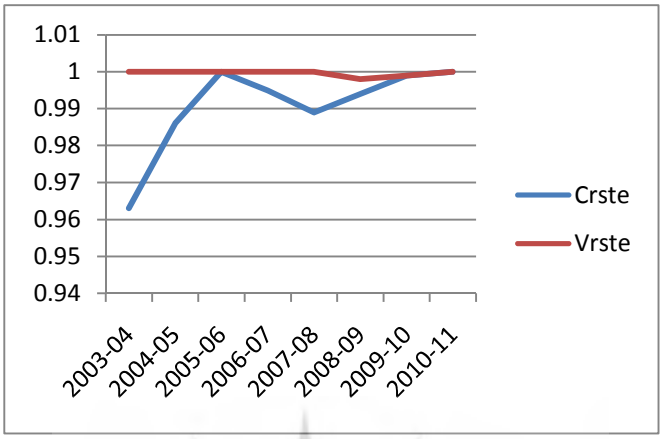
increased to an efficient level in 2006-07. In spite of a decrease in investment level and number of employees of bank in 2008- 09 and 2009-10 Banks' efficiency increased to a higher level from 0.980 to 0.990 in 2008-09 and to efficient level at 2009- 10 which mean that increase in number of ATMs from 3295 to 4235 affected positively efficiency of this bank. Table exhibits that HDFC bank operated on decreasing return to scale (drs) for some years which implies this bank increased all resources (labor, capital and other inputs) by a given proportion and output increased by less than this proportion.

Table 8 shows efficiency scores of Axis bank in various years. The efficiency score of this bank increased from 0.750 in 2003-04 to 1 in 2004-05 and 2005-06 but the efficiency level of this bank started to decrease to 0.995 and 0.999 in 2006 to 2007. The table also indicates that e-banking did not have any impact on the efficiency level of Axis bank.

From above tables it can be seen that among the banks ICICI bank is working at efficient level and this bank followed by Bank of India and State Bank of India in both models. Union Bank ranked as the least efficient in both models with the lowest overall efficiency scores. Mean value of overall efficiency scores increased while e-banking entered in the model except for Union bank which its score decreased slightly for a year and Axis Bank that its scores remained same as before.

Figure 1: Average Efficiency of Banks without IT Impact

Figure 2: Average Efficiency of Banks with IT Impact



Figures (1 and 2) show, average level of overall technical efficiency of both models. The highest scores are observed for both models employing the VRS. A comparison of both figures confirms that overall technical efficiency with employing e-banking services (ATMs) increased to a higher level. Figure 2 proved that e-banking services and increase in number of ATMs has positive impact on overall efficiency of banks in India.

Tables indicate almost all banks suffered inefficiency since 2007 and it is outcome of financial crisis at global level which has affected Indian banks also. Global economy, after a sustained period of expansion entered into a phase of downturn due to global financial crisis. Global financial turmoil was accentuated significantly during 2008 and it severely has impaired confidence in global financial institution and market ever since.

Indian economy experienced a slowdown trend in 2007-08. Financial performance of Schedule Commercial Banks (SCBs) was dented by hardening of lending rates and deposit rates. The net interest income of banks in relation to total asset declined somewhat and also Indian banks witnessed a declined in return to equity (ROE) in this year.

Conclusion

This paper undertook a quantitative analysis of the development of IT and efficiency of the banking system in India. An empirical analysis was undertaken to answer the following question: What is the main opportunity for banks to adopt and implement information technology? This analysis shows that efficiency of banks and development of information technology services are co-integrated. From above tables it can be seen that among the banks ICICI bank is working at efficient level and this bank followed by Bank of India and State Bank of India in both models. Union Bank ranked as the least efficient in both models with the lowest overall efficiency scores. Mean value of overall efficiency scores increased while information technology variable entered in the model except for Union bank which its score decreased slightly for a year and also for Axis Bank its scores remained same as before. As it is clear from all above tables, Information Technology (IT) has had a positive impact on efficiency of the banking system in India. Tables show as the number of ATMs is increasing the efficiency of banks also will be increased. Therefore, it confirms that information technology has a positive impact on efficiency of banks in India.

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