Efficiency and Profitability of Commercial Banks in the Pre and Post Crisis Periods: The Case of the Indian Banking Sector

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A thesis submitted for the degree of Doctor of Philosophy

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Full Title of Thesis: **Efficiency and Profitability of Commercial Banks in the Pre and Post Crisis Periods: The Case of the Indian Banking Sector**

Abstract

The financial soundness and economic development of any country is dependent on the effectiveness of the banking system in that country. The research in banking system has been gaining more attention of researchers since the event of global financial crisis of 2008. Most of the research work on banks in the context of a developing economy like India focuses on the measurement of performance of banks based on their profitability with little emphasis being given to their efficiency. At the same, the existing work in the literature based on the evaluation of efficiency and its determinants focuses more on the banks from developed countries and less attention is being given to banks from emerging economies. Furthermore, the research work attributed to the evaluation of efficiency and assessment of how efficiency is related to profitability of banks is limited. The research work attributed to the evaluation of performance and its determinants in India also have some methodological and statistical limitations such as small data samples, short research time – period and so forth. This research thesis attempts to address these limitations and add value to the existing literature.

This research thesis titled 'Efficiency and Profitability of Commercial Banks in the Pre and Post Crisis Periods: The Case of the Indian Banking Sector' is based on the analysis and evaluation of efficiency and profitability of commercial banks of India in the pre and post crisis periods. The time period 2001-2007 has been considered as the pre-crisis period and the 2010-2017 has been considered as the post-crisis period. A comprehensive literature review has been conducted on the concepts of technical efficiency and financial profitability and this has been presented in the literature review chapter. Based on that, a conceptual framework has been drawn and; the technical efficiency and performance of 26 commercial banks of India have been analysed. The technical efficiency scores of banks have been calculated employing the non-parametric frontier method DEA i.e. Data Envelopment Analysis. The inputs and outputs of banking activity used in the DEA method are

determined using the intermediation approach. Loan loss provisions, operating expenses, deposits and borrowings are used as inputs and; investments, advances, net interest income and total other income are considered as outputs of the banking activity.

After this, the relationship of technical efficiency with profitability of banks has been tested in the two periods. Return on equity (ROE) has been taken as a measure of profitability of banks. Lastly, micro and macro determinants of ROE have been tested in the pre and post crisis periods using regression methods. The internal determinants researched in the thesis are capital adequacy, market share, bank size, bank age, liquidity, non-performing assets and net interest margin and; the external variables are GDP, Inflation, exchange rate and real interest rate.

The overall results obtained in the thesis suggest that Indian banking sector is technically efficient in general and the scores of technical efficiency have improved after the event of global financial crisis. Secondly, there is found to be no relationship between technical efficiency and profitability of banks and these are two different dimensions of performance of banks. And lastly, bank liquidity, capital adequacy, non-performing assets and net interest margin have been found to have significant impact on the profitability of commercial banks in India. In addition to this, there is scope to examine other factors which can have impact on the performance of banks.

Declaration

I hereby proclaim that this PhD research thesis titled "Efficiency and Profitability of Commercial Banks in the Pre and Post Crisis Periods: The Case of the Indian Banking Sector" has been accomplished by me for the qualification of PhD i.e. Doctor of Philosophy. The research work produced in this thesis is an outcome of my own analysis and investigation, unless otherwise required and mentioned. Any other sources of information in the form of books, journals, articles etc. used in the thesis have been acknowledged in the form of footnotes, references, bibliography and appendices.

I hereby, also declare that this piece of work has been acknowledged in return of any other qualification and has not been submitted for any other degree at the same time.

I further give permission for my work to be available in the internal libraries and to be issued to the students on loan and for photocopying and the abstract of the thesis to be available to external organisations.

Signed……………………….

Mukta Rani

Date……………………………

Dedication

I dedicate this research thesis to my kids Aryan and Anaya for being my real source of inspiration and making me realize my inner strengths, which I didn't know existed before.

I also dedicate this thesis to my mother for bringing me into this world, constantly encouraging me to do better in life, always believing in me and reminding me of how special I am every day. I also dedicate this thesis to my husband for all the support, patience and understanding me throughout all these years I was working on my research.

I don't doubt the fact that I wouldn't have been able to complete this thesis without continuous encouragement and support from the members of my entire family.

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Last, but not the least, I would like to thank my mother, my husband, my son and other members of my family for their continuous motivation, support and patience shown all the time throughout the duration of this research course.

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List of Abbreviations

CAPAD: Capital Adequacy Ratio	**INF**: Inflation
CCR: Charnes, Cooper and Rhodes	**LB test**: Ljung Box test
CVD: Coefficient Variance Decomposition	**LLRTL**: Loan Loss Reserves to Total Loans.
DEA: Data Envelopment Analysis	**LM test:** Lgrange Multiplier Test
DFA: Distribution Free Approach	**MENA:** Middle East and North Africa
DMU: Decision Making Unit	**MSHARE**: Market Share
EFF: Efficiency	**NIM:** Net Interest Margin
EU: European Union	**NMFIs**: Non-profit Microfinance Institutions
FDH: Free Disposal Hull	**NPA:** Non-Performing Assets
GDP: Gross Domestic Product	**NPL:** Non-performing loans
GUI: Graphical User Interface	**PLS**: Panel Least Squares
ICBs: Indian Commercial Banks	**RATS:** Regression Analysis of Time Series
RBI: Reserve Bank of India	**SCP:** Structure Conduct Performance
RDB: Relational Database	**S.D.:** Standard Deviation
ROA: Return on Assets	**SFA:** Stochastic Frontier Approach
ROAA: Return on Average Assets	**TCTA**: Total Cost to Total Assets
ROE: Return on Equity	**TFA:** Thick Frontier Approach
SBI: State Bank of India	**TSP:** Time Series Processor
SCBs: Scheduled Commercial Banks	**SPSS:** Statistical Package for Social Sciences
VIF: Variance Inflation Factor	**LIQ:** Liquidity
GCC: Gulf Cooperation Council	**CRS:** Constant Returns to Scale
VRS: Variable Returns to Scale	**TFP:** Total Factor Productivity
OTE: Overall Value of Technical Efficiency	**SE:** Scale Efficiency
DRS: Decreasing Returns to Scale	**GLS:** Generalized Least Squares
OLS: Ordinary Least Squares	**RTE:** Relative Technical efficiency
PTE: Pure Technical Efficiency	**GMM:** Generalized Methods of Moments
RMP: Relative Market Power	**LAGE:** Log(Age)
HHI: Herfindahl-Hirschman index	**RIR:** Real Interest Rate
LEXR: Log of Exchange Rate	**INR:** Indian Rupees
CRR: Cash Reserve Ratio	**SLR:** Statutory Liquidity Ratio
ALS: Aigner, Lovell and Schmidt	

List of banks used for data sample

Name of bank	Website link
Allahabad Bank	www.allahabadbank.com
Andhra Bank	www.andhrabank.in
Bank of Baroda	www.bankofbaroda.in
Bank of India	www.bankofindia.co.in
Bank of Maharashtra	www.bankofmaharashtra.in
Canara bank	www.canarabank.com
Central Bank of India	www.centralbankofindia.co.in
Corporation Bank	www.corpbank.com
Dena Bank	www.denabank.com
IDBI Bank ltd.	www.idbibank.In
Indian Bank	www.indianbank.in
Indian Overseas Bank	www.iob.in
Oriental Bank of Commerce	www.obcindia.co.in
Punjab and Sind Bank	www.psbindia.com
Punjab National Bank	www.pnbint.com
Syndicate Bank	www.syndicatebank.in
UCO Bank	www.ucobank.com
Union Bank of India	www.unionbankofindia.co.in
United Bank of India	www.unitedbank.co.in
Vijaya Bank	www.vijayabankonline.in
State Bank of Bikaner and Jaipur	www.sbbjbank.com
State Bank of Hyderabad	www.onlinesbh.com
State Bank of India	www.onlinesbi.com
State Bank of Mysore	www.sbmbank.co.in
State Bank of Patiala	www.bank.sbi.com
State Bank of Travancore	www.statebankoftravancore.com

Chapter 1

The Nature and Significance of the Research

1.1. Background and Context

One of the main constituents of financial systems is banking. The stability of the financial market and the strength of an economy are highly impacted by its banking activities. A banking system acts as a financial mediator which plays the role of bridging fundamental economic units together. It supports the process of wealth creation by forming interconnected economic relations. Therefore, the overall economic conditions of any country are highly impacted by any disturbance in the conventional banks as banks rely primarily on market forced or state governed interest rates. (Ismail, Selamat and Boon, 2004)

In words of MacDonald & Koch (2006), financial institutions play a crucial role in the economic development of any country due to some very significant roles played by them, some of them are: provision of personal borrowings, lending money to government and various other huge projects, financing of various businesses, assessment, initiation and monitoring of economic policies of government and provision of extensive financial services etc. Somoye (2008) depicts banks as viable financial institutions which act as intermediaries by mobilizing financial resources for productive economic activities such as trade, investment and so forth; and thus, contributing towards the overall economic development of a country. The contribution of the banking sector towards the overall financial markets' development in turn supports the promotion of enhancing a country's funds' inflow. According to Akhtar, Ali & Sadaqat (2010), the most important function of banks is to act as intermediators and thus, foster productive economic projects via channelling financial resources from surplus to deficit units.

According to Soyibo & Adekanye (1991), of all the businesses, the banking activities are the most regulated and supervised as any systematic failure in the banking industry can interlude disaster for all the stakeholders. Due to the huge impact of banks on both the micro and macro levels of an economy, it becomes extremely vital to study the performance and efficiency of banks (Athanasoglou, Brissimus & Delish, 2005). The huge significance of the banking sector in the overall prosperity of the economy makes it crucial to study and evaluate the performance of banks so as to enable its further beneficence to the economy development and the introduction of new policies and strategies for the development of banking sector at the same time. According to Tehrani & Rahnama (2006), Efficiency/Performance evaluation of companies provides guidelines for the forthcoming decisions in regards to investments, expansions, most significantly supervision and control.

The main factors responsible for the growing interest in the detailed evaluation of banks' performance constitutes heightened competition, mergers/acquisitions among banks, steady innovation for the provision of innovative financial services to its clients to name a few. Performance evaluation can benefit both managers and bank regulators. It helps managers in the determination of their previous managerial decisions whereas banks' regulators are interested in performance monitoring and identification of banks facing severe problems so as to ensure the soundness of the overall banking system. The failure to monitor and evaluate performance can cause the existing problems to remain unnoticed and thus giving birth to future financial failure which in turn, poses a threat for the whole economy.

The performance of any firm can be further categorized into: financial and nonfinancial. For banks, which mainly focus on financial statements, financial evaluation has remained as one of the most significant as well as the oldest approaches for performance evaluation. The performance evaluation of any firm presents important information related to dividends, correlations, strengths/weaknesses, and financial position in the market, procedures, qualities and so forth. The ideal performance evaluation should recognize a company's past and present situation and provide a direction for future strategic decisions. According to Alharthi (2016), performance of a bank can be determined by analysing its profitability, whereas efficiency measurements are one of the important tools for the determination of non-performance of institutions. Profitability and efficiency are two indicators of a firm's performance and different research studies in the literature have used one or the other indicators of performance in their analysis. Profitability is the estimation of the degree to which a firm earns profit or financial gains from the different production factors and portrays the relationship between incomings (revenue) and outgoings (expenses). On the other hand, efficiency focuses on the extent of the efficacious utilisation of production factors and refers to the use of minimum possible inputs to produce the given outputs or using the given inputs to produce the maximum possible outputs. To get a complete overview of the performance of commercial banks of India, this research study will analyse both their profitability and efficiency.

1.1.1. Efficiency in the banking sector

According to Alber et al., (2019), efficiency in the banking sector can be defined as the ability of the management to minimise their costs to produce a given set of outputs or maximise their outputs for a given set of inputs involved in a banking activity. In recent times, research related to the evaluation and analysis of efficiency in the banking sector has gained importance as most of the banks these days are striving for minimization of their cost associated with their inputs such as expenses and the maximisation of their outputs such as better quality, higher profits etc. Another reason behind the rising importance of efficiency studies is the considerable increase in mergers/acquisitions in the banking sector in recent years. Studies such as Avkiran (1999) suggests an increase in bank efficiency due to mergers and acquisitions due to horizontal integration helping firms to achieve of economies of scale (i.e. productive efficiency), heightened investment in Research and development activities leading to more innovation (i.e. dynamic efficiency) due to increased profit levels from joint operations, improved market power assisting firms to compete in contestable markets (by imposing allocative efficient costs to customers) etc. According to Andries & Capraru (2014), evaluation of efficiency in the banking sector can benefit various stakeholders such as shareholders, bank managers, investors, regulators, policy makers, analysts and so forth. Aikaeli (2006) suggests that effective monetary policies lead to higher efficiency in the banking sector. Efficient banks are capable of producing the maximum outputs by making use of minimum possible inputs, which in turn, can contribute towards making banks more sustainable.

The importance of analysis of efficiency benefits both the sides i.e. the bank customers as well as the bank itself. Efficient banks are capable of the provision of better product quality as well as a better customer service, which is preferred by the clients. To achieve that, banks are required to divulge their measures of efficiency so as to make their customers aware of their quality standards as well as to make them more competitive in the market. Efficiency evaluation can also make banks aware of disadvantages in their operations. Heightened efficiency measures' knowledge also allows bank managers, regulators and policy makers in the reduction of costs and thus, increase in their profits. Recent distressed market conditions such as the global financial crisis of 2007-2009 made banks face many challenges and effected their performance significantly. According to a report published by the World Bank in 2014, only the most efficient banks were able to deal with those challenges.

There is a huge emphasis on studying the determinants of efficiency due to the fact that most of the countries have a financial system based on banking systems. According to Raphael (2013), an efficient banking system is resilient towards different shocks and thus, can contribute towards the overall stability of a country's banking system. A number of research studies in the literature are dedicated to measure, evaluate and analyse the efficiency of firms by making use of the most recent efficiency measurement tools i.e. Frontier methods. Some examples of research papers focused on the efficiency measurement of firms utilising non-parametric frontier methods are: Charnes et al., (1985), Tao (2012), Berger et al., (1993), Lee & Kim (2013), Liang et al., (2013),, Grabowski et al. (1994), Lukorito et al., (2014), Grifell-Tatje & Lovell (1996, 1997), Maudos, Pastor & Perez (2002), Concei & Stosic (2005), Nandkumar & Singh (2014), Prior (2006), Wu, Yang & Liang (2006), Sav (2012) and so forth. This research study will employ the non-paramagnetic method DEA i.e. Data Envelopment Analysis to measure the technical efficiency of sample commercial banks of India.

1.1.2. Profitability in the banking sector

The study and evaluation of bank profitability enables bank managers and policymakers to determine the performance of banks. Walsh (2008) and Beck et al. (2013a) have suggested ROA (Return on Assets) and ROE (Return on Equity) as two of the fundamental measures of profitability. ROA measures how well an organisation is taking advantage of its earning assets, whereas ROE measures how effectively a firm is managing its earning equity/capital. For larger banks, ROE has been recently gaining more popularity as compared to ROA as a measure of their financial profitability due to the fact that ROE is not dependent on the assets of the organisation, due to which the organisation can even compare the performance of its internal product lines or different business departments/units. According to Apergis (2014), banks earn profits by charging fees on their products and services in terms of interest and as a result, higher are the profits earned by banks, more is their efficiency, competitiveness and stability in the market.

The profitability of a bank can get effected by both micro and macro determinants. The analysis of the determinants of bank profitability allows bank managers and policy makers to understand the factors responsible for any profits and losses made by banks, which in turn enables them to make alternative plans in case of low profits and focus on strengthening the factors responsible for higher earnings. A very limited research studies have shown that there are many variables which influence commercial banks' profitability, in particular for studies focusing on developing economies (Raphael, 2013). A good number of studies have used regression analysis of the profitability measures to analyse its different determinants, but focusing much only on internal determinants involving only a few factors. According to Raphael (2013), meaningful research can only be conducted by taking into account both the micro and macro determinants. This research thesis is based on the measurement of performance of sample banks of India using ROE and evaluation of both the internal as well as external determinants of profitability.

To get a complete overview of how the commercial banks in India are performing, this research thesis will evaluate their efficiency as well as profitability. Further to this, the relationship between the two will be tested to establish whether higher efficiency leads to a higher profitability and vice-versa. The fact that most of the research studies in developing economies, particularly in India, have focused more on profitability and performance of banks, emphasising less on their efficiency and effectiveness, justifies this research. Thus, this research thesis will enhance information available on profitability and efficiency evaluation and determinants of banks' profitability and thus, add value to the existing literature.

1.2. Banking system of India

India has a long standing history of banking, both in the public and private sectors. The foundation of the English Agency House in Calcutta and Bombay in the 18th century marks the history of the Indian modern banking system. After the concept of limited liability was introduced in 1860, there was emergence of private and foreign banks in the market. The beginning of the 20th century marks the entry of joint stock banks in the Indian banking sector market. The presidency banks merged together in 1935 to form Imperial Bank of India, which was then renamed to State Bank of India (SBI). The central bank of India i.e. Reserve Bank of India (RBI) started its operations in the same year. After India's independence in 1947, RBI was given authority over the commercial banks. By July 1969, 31 of the scheduled banks were government controlled i.e. controlled by SBI. This was due to the fact that most of the Indian banks had a socialist development strategy and it was felt by the government that people in financial need were not able to borrow enough money from these banks. Thus, all the banks with INR 500 million or more of nationwide deposits were nationalised by end of July, 1969, as a result of which 54 percent of bank branches came under government's control resulting in total nationalised banks' figure to 84 percent. (Joshi & Bhalerao, 2011)

Since mid-1991, a huge range of reforms concerning taxation, banking industry, micro and macro environment, trade in the financial and banking markets have been introduced and two-decades of such reforms have strengthened the Indian economic fundamentals and as a consequence, changed the overall operational environment for banks and financial institutions. One of the largest constituents of Indian financial systems are the commercial banks of India. These commercial banks were predominantly owned by the Indian government until the early 1990s. The banking system of India is comprised of two main parts:

i. Scheduled Commercial Banks (SCBs)

ii. Cooperative Banks

Scheduled Commercial Banks (SCBs) are further categorised into four parts which are:

i. Public sector banks which consist of State Bank of India and its associates; and nationalised banks

ii. Private sector banks which comprise of both new and old private banks

iii. Regional rural banks and finally,

iv. Foreign banks.

After the introduction of the first phase of reform in 1991, India's banking system underwent a metamorphic change. The main motive behind this early first phase reform was to introduce an efficient, productive and profitable industry in the financial services' sector functioning in an environment offering flexibility and financial autonomy. The second phase of reform in the financial sector occurred in 1998, which was focused on nourishing the overall financial system and introducing structural improvements with the aim to align the standards of the Indian banking sector with internationally acknowledged best practices. The main purpose behind the introduction of these reforms was to promote diversity, efficiency and competitiveness in the Indian banking industry. The operational flexibility offered by these reforms strengthened the growth in the balance sheets of banks in India. The reform process created market forces' driven competitive system in the Indian banking sector which is clearly evident from the considerably lowered interest spread and altered business strategy like business based on non-fund, foreign exchange and treasury during the reform time period. Instead of high expenditure on upgrading technology and staff's voluntary retirement, the financial reform lowered down the operating expenses in proportion to total assets due to high emphasis on management of income and expenditure. The main achievement of financial reform is the improvement in the overall financial health of the Indian banking system in terms of boosted asset quality and capital adequacy. (Mohan, 2005)

Before the world financial crisis during 2005-2008, the performance and in general, the business of Indian banks was predicated by secure macro-economic environment and collaborative monetary policies; a robust growth was exhibited by SCBs in the form of accumulated deposits, aggregate bank credit, enhanced asset quality and overall business profitability. The impact of the global crisis on the Indian banking industry was evident during 2009-2010. Although the adoption of countercyclical prudential framework helped the banking industry to withstand this crisis, the complete insulation was still missing. This was clear from the lessened aggregate deposits, net profitability, advances, loans and sharp rise in the amount of provisions and contingencies. (Jayaraman and Sirinivasan, 2014)

Further operationally challenging environment appeared for Indian banks in 2011 in the form of high inflation, heightened interest rates and compact liquidity conditions. As a consequence, deterioration in asset quality and increase in non-performing assets (NPAs) caused a major concern in 2012. The major indicators of performance for Indian SCBs in the current time are listed below in table 1.1.

Table 1.1. Performance indicators of Indian SCBs (Amount in billion Indian Rupees)

Year	2005			2008			2012			2020		
Bank group	**Public**	**Private**	**Foreign**	**Public**	**Private**	**Foreign**	**Public**	**Private**	**Foreign**	**Public**	**Private**	**Foreign**
No. of banks	28	29	31	28	23	28	26	21	43	18	21	46
No. of branches	47320	6143	220	55124	8334	279	69498	13408	324	87892	37794	308
Deposits	14365	3146	864	24539	6750	1912	50020	11746	2774	90484	41590	6843
Advances	8542	2213	753	17974	5184	1611	38738	9664	2301	61581	36252	4281
Investments	6862	1407	429	7998	2786	989	15041	5260	2024	29406	12930	4313
Profit/Loss	154	35	20	266	95	66	495	227	94	(260)	191	162
Net interest income	516	100	51	642	225	138	1562	472	211	2482	1905	379

(Source: Database on Indian Economy, Reserve Bank of India Data Warehouse)

Since 2007, another major cause of concern was banks' high operational costs in India. According to Chakrabarty (2013), one of the ways to increase productivity of Indian banks is the effective use of technology, skills and human resources, which in turn, demands the possession of allocative and operational efficiency. Allocative efficiency refers to the allocation of precious societal resources to the most productive activities, keeping in mind the vulnerable society members' interests. Operational efficiency, on the other hand, refers to safe, secure and fast provision of products and services by banks to their customers, keeping the financial intermediation costs minimum.

1.3. Problem statement

For the development and the smooth running of the overall economy of any country, the efficient working of financial institutions in that country is crucial. The banking industry is very competitive and to achieve a sustainable competitive advantage, it is vital to attain high performance standards at all times. To ensure the efficient working of these financial institutions, it is crucial to monitor and evaluate their performance in a timely manner.

According to Alharthi (2016), different methods have been used by researchers in the literature to determine the performance of banks such as profitability ratios (i.e. ROE, ROA,NIM), efficiency measurements (Technical efficiency, Pure technical efficiency, scale efficiency, allocative efficiency, profit efficiency, cost efficiency), bank stability (z-score, capital ratios) etc. According to Arslan and Ergec (2010), the traditional methods used for performance evaluation and management such as ratio analysis come with flaws. In terms of MacDonald and Koch (2006), the evaluation of economic entities merely on the basis of financial statements is not very wise and is difficult as the probability of the manipulation of those statements by the managers for the disguise of potential problems is quite high. Prior (2006) further adds that the traditional performance evaluations methods can evaluate only one activity of a firm at a time which makes it difficult for the analysers to gain an overall perspective of the performance. According to Daley and Matthews (2009), the ratio analysis can be useful only to calculate the efficiency values, but the identification of the reasons responsible for causing inefficiencies still remains a task.

To overcome these limitations of traditional performance assessment methods, a rising trend can be observed towards the adoption of frontier methods (specifically

DEA) for performance evaluation. The reason for the popularity of these new methods was given by Berger et al. (1993), which stated that the scale and scope economies used in traditional methods account for less that 5 percent of the total cost while on the other hand; efficiency contributes more than 20 percent of the total costs of the banks. The extensive use of DEA for the evaluation and improvement of performance can be seen across various different manufacturing and service industries, such as: schools (Grosskopf and Moutray, 2001); hospitals (Prior, 2006); production companies (Liang et al., 2013); banks (Isik and Hassan, 2002) etc.

In developing economies such as India, most of the research studies focus on overall performance and profitability of banks and little emphasis is given to efficiency and effectiveness (Raphael (2013). The existing literature on banks' performance and its determinants focuses on banks from developed economies and less attention is being given to banks from emerging economies (Pastor, 2002, Varias & Sofianopoulou, 2012). Also, the studies on performance determinants of banks in India had methodological shortcomings e.g. small sample sizes, short time period data etc. (Debasish & Mishra, 2005). This research thesis addresses these limitations by studying technical efficiency as well as profitability of 26 commercial banks of India to gain a better overview of their performance, over the time period of 17 years (from 2001 to 2017), employing a two-step analysis , where the technical efficiency and ROE and; the relationship between the two performance indicators will be studied in the first step and the determinants of sample banks' performance will be determined in the second step using Regression analysis (Raphael, 2013, Leigh et al., 2005, Wanke, Barros, Macanda, 2015). The research also evaluates the impact of the financial crisis on the efficiency, profitability and the relation profitability has with its determinants.

1.4. Research questions

This research thesis attempts to provide answers to the research questions listed below:

i. What is the state of technical efficiency in Indian commercial banks before and after the crisis?

ii. What is the performance of commercial banks of India, in the pre and post crisis periods?

iii. Are there any links between two concepts of performance i.e. technical efficiency and performance? What are the recommendations for the future?

1.5. Research aim and objectives

The aim of this research is to evaluate technical efficiency and performance of Indian commercial banks before and after the crisis of 2008-2009 and then to examine the relative value of these concepts from the point of view of stakeholders. This research thesis aims to achieve the following research objectives:

i. To extensively review the available literature on evaluation and determinants of banks' technical efficiency and performance in developed and emerging economies.

ii. To measure the technical efficiency of Indian commercial banks and compare and contrast them in the pre and post crisis periods.

iii. To empirically evaluate the performance of Indian commercial banks, and compare and contrast them in the pre and post crisis periods.

iv. To examine the relationship between technical efficiency and performance of Indian commercial banks.

v. To provide recommendations on the basis of empirical findings to bank managers and regulators for improvements in the Indian banking sector.

1.6. Original contribution

As stated in section 1.1 above, the performance of any firm can be divided into financial and non-performance. According to Alharthi (2016), performance of a bank can be determined by analysing its profitability, whereas efficiency measurements are one of the important tools for the determination of non-performance of institutions. Different research studies in the literature have used one or the other indicators of performance in their analysis. The research papers on performance evaluation of firms in India focus more on employing traditional performance evaluation methods such as profitability index (Tandon, Singh and Singh, 2016, Brindadevi, 2013, Thakarshibhai, 2014), Ratio analysis (Tarawneh, 2006, Cyree et al., 2000), Balanced Scorecard (Johnson et al., 2014, Denton and White, 2000).

As discussed in the second chapter of the thesis, these traditional methods are accompanied with many limitations. To overcome these limitations, researchers are now focusing on better and more effective frontier methods to assess performance. The application of frontier methods especially Data Envelopment Analysis (DEA) for performance evaluation is getting popular in many countries across various different industries, but the use of DEA for performance evaluation of firms is still limited in India (Gulati and Kumar, 2011).

In the context of Indian banks, this research will prove to be a pioneering study as it will study and evaluate both the profitability as well as technical efficiency of sample banks. The profitability of banks will be measured using ROE and the technical efficiency will be determined using the non-parametric approach DEA. The uniqueness of the proposed research thesis, at the international context, lies in the fact that both the micro and macro determinants of performance will be studied and the impact of internal (capital adequacy, bank age, bank size, marketshare, liquidity, non-performing assets and net interest margin) and external (GDP, inflation, exchange rate and real interest rate) variables on performance will be researched.

Another contribution of this research is that it will investigate the relationship of profitability with its micro and macro determinants by studying a larger data sample (26 banks), over a longer sample time period (17 years). Further value will be added to the research by evaluating how the relationship of profitability with its determinants differs in the pre and post crisis periods. The robustness of the research lies in the fact that it will also determine the relationship between technical efficiency and profitability of banks to establish whether higher efficiency leads to greater profitability and vice-versa. Most of the research papers in the literature have looked at profitability and efficiency as two different dimensions of performance and very limited studies have established the relationship between the two (Keramidou et al., 2013, Shieh, 2012, Košak & Zajc, 2006, Kosmidou et al., 2008, Afsharian et al., 2011, Sharma, 2018, Palečková, 2015, Pasiouras et al., 2006). Research studies such as Kumar & Gulati (2008), Tan & Floros (2012), Wasiuzzaman & Tramizi (2010), Ranajee (2018) etc. have also used one dimension of performance to explain the other. The research thesis will also evaluate whether the relationship between efficiency and profitability is same or different in the pre and post crisis periods.

1.7. Structure of the rest of the thesis

This chapter is followed by eight more chapters to present the whole thesis.

The next chapter of the research thesis, i.e. Chapter 2 presents the extensive literature related to performance evaluation of firms. The chapter studies the various methods used by researchers to evaluate the performance of firms, the pros and cons of each method, followed by the use of DEA to evaluate the efficiency of organisations in different industries across the world and the different approaches for the selection of input and output variables to be used to calculate the efficiency scores. This chapter further reviews the research papers in the literature based on the evaluation of performance of firms and its different determinants, specifically capital adequacy, age, size, market share, liquidity, non-performing assets, net interest margin, inflation, GDP, exchange rate and interest rate.

The Conceptual Framework of the research thesis is presented in chapter 3. This chapter analyses the detailed procedure for the formation of the method to be used to evaluate the technical efficiency and performance of commercial banks in India, micro and macro determinants of profitability and; the relationship between technical efficiency and profitability of banks.

Chapter 4 i.e. Research Methodology talks about the research aim, objectives, problem statement, research hypothesis, research paradigm, research philosophy, research design, research population, data collection methods, research approach, data diagnostic tests, analytical model for research and the software which will be used for analysis of data.

Chapter 5 presents and discusses the descriptive statistics of DEA input and output variables as well the dependent and independent variables to be used in the regression analysis and the results of different diagnostic tests conducted on the data to ensure its suitability for data analysis, for instance, normality test, data stationarity test and correlation analysis. The chapter also discusses the steps taken to deal with the endogeneity issues associated with data.

Chapter 6 in the thesis is about the analysis of technical efficiency of ICBs. Here, the trends in the technical efficiency scores of the Indian banking sector as well the individual ICBs are discussed along with possible reasons and justifications of the same. The chapter also investigates and interprets the impact of the global financial crisis on the technical efficiency of ICBs.

Chapter 7 is about analysis and discussion of profitability i.e. ROE of ICBs. In this chapter, the trends in the ROE of the Indian banking sector as well the individual ICBs are discussed along with possible reasons and justifications of the same. After this, investigation and interpretation of the impact of the global financial crisis on the ROE of ICBs is presented. Finally, the regression model estimations between ROE and different independent explanatory variables are presented and discussed in detail with reasons behind the resultant models.

The relationship between technical efficiency and ROE is investigated and discussed in chapter 8 of the thesis followed by the impact of the financial crisis on this relationship.

Last, but not the least, chapter 9 outlines the conclusions of the research study, highlights the limitations of the study and provides recommendations for any future research in the same field.

Chapter 2

Literature Review

2.1. Introduction

This chapter is based on reviewing the existing literature on the topic of evaluation and measurement of performance of banks. It depicts the state-of-the-art on performance evaluation of banks and different branches of banks and gives direction for more fruitful future research. This section mainly aims to review the previous research carried out related to performance evaluation of banks and thus encapsulates the main aims, objectives, methodologies used and the conclusions/recommendations given by researchers in literature. The information collected from this review will be used in the empirical study sections, and then the empirical results will be discussed considering the previous research followed by the abstraction of conclusions and recommendations.

There is substantial increase in the competition among different financial institutions caused by some recent developments such as liberalisation of financial markets, globalisation, evolutionary developments in the sector of information technology and so forth. In order to survive in this heightened competition and to achieve competitiveness and good corporate health, it has become mandatory to achieve and retain high levels of performance at all times and a timely performance evaluation is the key to achieve such high performance levels. Therefore, the bankers, bank regulators today are widely attracted and highly attentive towards the topic of performance evaluation of financial firms. There is a considerable amount of increase in the research and published journals dedicated to performance assessment of banks and financial institutions in general.

The research in literature relevant to the banking sector focuses more on evaluating the corporate performance which is derived from efficiency comparisons among different banks. However, it is the management of each individual branch which is responsible for performance improvement in that particular branch. This has given rise to increase in the number of studies relevant to relative branches' efficiencies within a given bank. However, a very limited research can be found on this critical topic of performance evaluation mainly due to the reason that data related to such an assessment is not readily available.

This thesis is based on the performance evaluation of commercial banks of India using efficiency and profitability measures. So the previous studies in the literature based on the evaluation of profitability and efficiency of firms, impact of financial crisis and the relationship between the two measures will be discussed in detail.

2.2. Methods for performance assessment of firms

This section examines the various methodologies of banks' performance evaluation, which have been used so far and discusses their advantages and disadvantages over more modern frontier methods. Before the development of frontier methods, some of the most widely accepted and used methods used to assess performance of banks are:

- Ratio analysis
- Profitability
- Balanced Scorecard approach
- Efficiency measures

These methods along with more recent Frontier Methods are discussed in detail in the following sections.

2.2.1. Ratio analysis

The ratio analysis consists of a series of ratios calculated using a selection of input and output variables. Ratio analysis has been the most widely used methods and the first choice of managers for performance assessment traditionally. Among others, Barros and Leite (1996), Cyree et al. (2000), Milis and Mercken (2004), Lau and Sholihin (2005) and Tarawneh (2006) are the few examples of studies which employed ratio analysis to assess the performance due to the facts that the banks with better and positive values of financial ratios are more successful in attracting more depositors and borrowers. On the other hand, Lau and Sholihin (2005) and Wu et al. (2006) critically state that the ratio analysis result in lagged performance indicators and fail to provide the effective conclusions while dealing with multiple criterion synchronically. Brealey and Mysers (1996) have classified ratio analysis mainly into four different categories of ratios:

- Leverage ratios
- Profitability ratios
- Liquidity ratios
- Market value ratios

Even though ratio analysis is often criticized, but some of the institutions still prefer to assess their performance using ratio analysis. There are many possible reasons responsible for this popularity. Firstly, ratios are easy to calculate and interpret and most of the people in the financial sector are familiar with them. Secondly, some of these measures are demanded by the bank regulators in the financial sector. They use these accounting ratios to screen the banks.

Although ratio analysis has been generally accepted to indicate the performance, but Arslan and Ergec (2010) pointed out the some flaws of these performance measures which are discussed below:

Ratio analysis does not allow a straight forward method to determine performance targets. It requires a benchmark value to compare each ratio to, without considering the remaining input-output sets with the assumption that the benchmark set is suitable for comparison without considering the inputs and outputs for each particular DMU.

During performance evaluation using ratio analysis, each ratio involves only one input and one output and thus it represents only one activity of a DMU. This problem is solved by involving a set of ratios in the analysis of performance for each DMU. However, it gives rise to a large and unmanageable number of performance indicators calculated for each DMU and thus prevents to gain an overall performance perspective. Also the ranking of different DMUs becomes difficult when all the ratios for each DMU don't represent similar performances (Prior, 2006).

The performance summary for each indicated DMU requires the frequent aggregation of different ratios representing different DMU activities. The calculation of ratios is an easy task but their aggregation is comparatively much more complicated and demands experienced judgment and visualization. There are several weighting systems available in the literature for the aggregation of ratios but the resultant measure from aggregation can cause the performance conveyed by each ratio viewed in a biased manner.

A constant return to scale is implicitly assumed in a ratio analysis. In order to compare the scale size of DMUs, it is assumed that numerator is proportional to denominator while constructing ratios.

Ratio analysis doesn't give explicit explanation about DMUs input-output mix. E.g. to evaluate the operating efficiency of bank branches, the ratio of cost per teller transaction is calculated and assumes the branch with the highest cost per transaction as the least efficient. However, it does not take into account the complexity of transactions. A branch with more complex transactions such as the one which involves account opening and credit selling requires more resources than the branch dealing with less complex transactions such as cash checking and money deposits.

Researchers have tried to overcome the limitations of ratio analysis by employing more modern and efficient performance assessment approaches such as efficiency measurements using Frontier methods. Daley and Matthews (2009) pointed out that although ratio analysis is a useful tool for performance evaluation, but it only results in the efficiency value and doesn't point out the reasons responsible for causing inefficiency and the way to improve efficiency. Elyasiani et al. (1994) and Yeh (1996) utilised different accounting ratios to evaluate performance and discovered that efficiency measurement of firms using DEA is a more effective method to evaluate performance of firms than a general ratio analysis. Smith (1990) also used DEA to evaluate performance using company's financial statements and concluded that DEA can help in the identification of factors effecting a company's efficiency by dissecting the information obtained from traditional method of ratio analysis.

Another research on exploring performance of DMUs based on financial ratios employing DEA was conducted by Fernandez-Casto and Smith in 1994. The limitations of a traditional ratio analysis can be eliminated by the employment of DEA and using ratios as the inputs and the outputs in the method. The relative strengths and weaknesses of ratio analysis and DEA were investigated by Thanassoulis et al., (1996) by conducting a comparison between the two methods.

2.2.2. Profitability

The performance in the corporate sector has often been judged by its long term profitability. Profitability is mostly indicated by calculating the ratios of data presented in company's financial statements. The overall performance of the company is then evaluated by carrying out a comparison between the calculated ratios and a standard benchmark value from the industry. Some of the examples of researches which employed the profitability figures to assess performance are: CheeCheng and Ching-Chow (2002), Cui (2005), Khalfallah et al. (2014), Hoshide (2005), Sam (2013), Adams and Buckle (2003) and so forth.

One of the first pioneer research studies in literature based on the examination of performance of banks and its determinants was Short (1979), which was based on the determination of relationship between profitability and concentration in the banking sector employing a dataset comprising of 12 countries for the time-period 1972 to 1974 and the research concluded a positive relationship between bank concentration and its profitability. After this, another study based on research into firm profitability was Bourke (1989), which was based on establishing the micro and macro determinants of profitability in the Europe, Australia and America for the time period 1972 to 1981 and the study concluded a positive relationship between profitability and market power.

The use of three main indicators i.e. ROA (Return on Assets), ROE (Return on Equity) and NIM (Net Interest Margin) by researchers in the literature to measure profitability of firms can be observed. Apergis (2014) made use of ROA to evaluate performance of banks in the US. ROE was employed by Lee & Kim (2013) to measure the profitability of commercial banks of Korea. Tan & Floros (2012) utilised NIM to study the profitability in China's commercial banking industry. Liang et al. (2013) employed all three measures of profitability i.e. ROA, ROE and NIM to evaluate the performance of banks in the Europe.

Sufian & Habibullah (2010) examined the factors effecting the performance of Malaysian banks for the time-period 1999 to 2007 using ROA and ROE as the performance indicators employing GMM (Generalized Methods of Moments) regression model estimation method. The research concluded ROA as well as ROE to be significantly and positively related to capital adequacy, loan intensity, bank diversification, cost ratio and inflation and negatively related to GDP and credit risk. One of the weaknesses of this research study was that it doesn't include the impact of financial crisis on the performance of banks in Malaysia.

Westman (2011) studied the performance of investment and commercial banks in 37 countries in the Europe using the profitability measures ROA and ROE for the time-period 2003-2006 and discovered the non-traditional banks to be more profitable in comparison to diversified and traditional banks. Further to this, a positive relationship between bank profitability and bank size was established. Finally capital adequacy was found to be positively related to ROA and negatively related to ROE for sample banks in the research study.

Ćurak et al. (2012) evaluated the micro and macro determinants of bank profitability

(indicated by ROA) in the banking sector of Macedonia for the time-period 20052010 employing the regression estimation technique GMM and found a significant negative relationship of ROA with capital ratio, loans/assets ratio (credit risk) and operating expenses. The study further concluded a significant positive relationship of ROA with bank liquidity, GDP growth and bank concentration.

Tan & Floros (2012) studied the factors effecting the profitability (indicated by ROA and NIM) of 101 banks in China for the time-period 2003-2009 using the GMM regression estimation method. The sample banks were found to have a very low average value of ROA (0.7%). The study established ROA to be positively effected by the factors such as efficiency of labour (revenue/number of employees), development in the Chinese banking sector (assets/GDP), development in the stock market (listed firms' market capitalization/GDP) and inflation and; negatively related to credit risk, taxation, capital ratio and bank concentration.

Lee & Kim (2013) studied the performance of 17 banks in Korea for the time-period 2002-2010 using the performance indicators ROA and ROE. The study investigated the effect of independent variables bank size, bank ownership, GDP, mergers & acquisitions and credit risk (loans/deposits) on the profitability of sample Korean banks using the fixed effects regression method of OLS and concluded the bank profitability to be positively effected by bank size, GDP, mergers & acquisitions and; foreign ownership.

Apergis (2014) evaluated the profitability (using ROA as the indicator) determinants of 1725 non-traditional US banks for the time-period 2000 to 2013. The independent variables employed in the research were loans/assets ratio, index of insolvency risk, number of non-traditional operations, capital ratio, NPL (non-performing loans), consumer prices, bank concentration, financial crisis and real per capita income. ROA was found to be positively effected by the factors such as number of non-traditional operations, loans/assets ratio, capital ratio, bank concentration, consumer prices and real per capita income. On the contrary, insolvency risk index, financial crisis and NPLs were found to have a significant negative impact on ROA of sample banks.

Hussain (2014) researched the determinants of NIM for 26 commercial banks in Pakistan for the time-period 2001-2010 using the linear regression estimation method and concluded NIM to be significantly and negatively related to bank size, bank liquidity, bank diversification, operating cost and; significantly and positively related to market share, industry growth and inflation.

Smaoui & Salah (2012) studied the determinants of profitability of Islamic banks in the Gulf Cooperation Council (GCC) region for the time-period 1995 to 2009 using the indicators ROA, ROE and NIM. The research sample comprised of Islamic banks. The study concluded the bank profitability to be positively related to asset quality, capital adequacy, bank size, GDP and inflation.

Wasiuzzaman & Tramizi (2010) investigated the performance of 16 Islamic banks in Malaysia for the time-period 2005 to 2008 using the profitability indicator ROAA (Return on Average Assets) and the OLS regression estimation method. The positive determinants of ROAA were found to be bank liquidity, operational efficiency, inflation and GDP, whereas asset quality and bank capitalization were concluded to be negatively related to ROAA.

For studies based on analysis of bank profitability in India, Ranajee (2018) studied the factors effecting the profitability of 89 commercial banks in India for the time-period 2005-2015 using ROA and ROE as the proxy for indicators of profitability and discovered the significant impact of both micro and macro factors on the profitability of sample banks. The bank profitability was found to have a significant positive relationship with equity capital strength, operational efficiency, deposits/GDP ratio. The factors credit risk, cost of funds, NPA (Non-performing assets), GDP and inflation were found to have a significant negative impact of the profitability of banks. Finally, the study found no influence of priority loans/total loans ratio and bank size on bank profitability. Bhatia et al. (2012) examined the profitability determinants of 23 private banks of India and discovered the bank profitability to be significantly effected by non-interest income, spread ratio, operating expenses, NPAs and profit per employee. Sinha & Sharma (2016) examined the determinants of profitability of 42 banks in India and concluded the bank-specific factors operating efficiency, capital/assets ratio and bank diversification to have significant positive effect on profits, whereas risk to effect the bank profitability negatively.

2.2.2.1. Determinants of bank profitability

After the review of different determinants of profitability used by researchers in the literature, this research thesis has chosen to study the impact of the most beneficial micro and macro variables on the profitability of banks which include capital adequacy, bank age, bank size, market share, liquidity, non-performing assets, net interest margin, inflation, GDP, exchange rate and interest rate. This section of the chapter is based on the review of literature based on the determinants of profitability. The chapter further examines the research done on the impact of financial crisis on the profitability of banks.

2.2.2.1.1. Capital adequacy

Capital adequacy of a firm indicated by its capital ratio is one of the internal factors which portrays the significance of shareholders' equity in the firms. According to Pasiouras & Kosmidou (2007), banks with adequate capital are self-sufficient and experience lower requirement for outside funding and thus, benefit from higher profits.

Examples of research studies which have demonstrated a positive relationship between capital adequacy and performance of banks are Yildrim & Philippatos (2007), Pasiouras (2008), Tochkov & Nenousky (2009), Ani, Ugwunta & Imo (2012), Adeusi, Kolapo & Aluko (2014), Grigorian & Manole (2002), Naceur et al. (2009), Das & Ghosh (2009), Sufian and Noor (2009), Chortareas, Garza-Garcia & Girardone (2009), Yildrim & Philippatos (2002), Wapmuk (2016), Barth et al. (2013b), Pessarossi& Weill (2014), Pasiouras (2008), Shrieves & Dahl (1992), Jacques & Nigro (1997), Aggarwal & Jacques (2001), Rime (2001), Jeitschko & Jeung (2005), Kaparakis et al. (1990), Elyasani et al. (1994), Girardone et al. (2004), Berger (1995), Alexiou & Sofoklis (2009), Haron (2004), Kosmidou (2008), Demirguc-Kunt & Huizinga (1999), Goddard et al. (2004), Sufian & Chong (2008), Pasiouras & Kosmidou (2007), Alunbas et al. (2007), Hafez (2018) and so forth. These research studies state that well capitalised banks have lower risks of bankruptcy and thus, have high credit worthiness, which in turn reduces their cost of funding and ultimately, enhances their profitability and efficiency.

In contrary to the findings of the research papers mentioned above, studies such as Guru et al. (2002), Ali et al. (2011), Chronopoulos et al. (2012), Goddard, Molyneux & Wilson (2004), Ayaydin & Karakaya (2014), Oladeji, Ikpefan & Olokoyo (2015) and; Ugwuanyi & Ewah (2015) have reported a negative relationship between bank performance and it's capital adequacy position by stating that higher capital reduces a bank's position of financial leverage which in turn, effects the risk and thus have an adverse effect on its overall profitability. Goddard et al. (2004) state that a bank's higher capital adequacy ratio reveals its over-cautious operative nature and ignorance of potential higher profitable business opportunities resulting in lesser profits for the bank. This in turn, implies an inverse relationship between its capital adequacy and profitability. No significant relationship between bank performance and capital adequacy has been reported by Gupta, Doshit & Chinubhai (2008) and Casu & Molyneux (2003).

2.2.2.1.2. Bank age

Based on the research of Mester (1996) on the research on efficiency of 214 banks, newer or younger banks were found to be less efficient as compared to older banks. Similar to this, Alber (2015) discovered the older banks to be more efficient as compared to newer banks. According to Abul Alkheil et al. (2012), the reason behind better performance of older banks as compared to newer banks is the benefit older banks get from their experience in running their banking operations and the quality of service they can provide to their clients. Similar results of positive relationship between age and performance of banks were reported by studies such as Satub et al., (2010), Chiou (2009) etc.

In contrary to this, Isik & Hassan (2003) and; Lee & Chih (2013) observed a negative relationship between age of a bank and its efficiency. According to Hasan & Marton (2003), age is not significant and doesn't play any important role in the performance of banks in Hungry for the time period 1993 to 1998.

2.2.2.1.3. Bank size

Most of the studies in the literature based on the determinants of profitability of banks have examined bank size (log of total assets) as an important indicator of bank profitability. Petria et al. (2015) studied the performance of banks in 27 countries in the Europe for the time-period 2004 to 2011 and demonstrated a significant positive relationship between a bank's profitability and its size, which in turn implies that banks with higher number of totals assets are able to earn higher profits and the reason for this was given as the economies of scale benefitted by the banks from their higher size. Other examples of studies in the literature which have proposed the positive effect of bank size on its profitability are Lee & Kim (2013), Flamini et al. (2009), Shehzad et al. (2013), Houston et al. (2010), Chronopoulos et al. (2015) and so forth. In contrary to this, Altunbas & Marques (2008), Lin & Zhang (2009), Barry et al. (2011), Haan & Poghosyan (2012) found a negative relationship between a bank's profitability and its size. Some studies such as Ghosh (2015), Ćurak et al. (2012), Tan & Floros (2012), Delis et al. (2012) and Althanasoglou et al. (2008) found no relationship between profitability and size of a bank and suggested that a bank's size is not important to its profitability.

2.2.2.1.4. Market share

According to Genchev (2012) and Laverty (2011), the research on the topic of effect of market share on profitability of a firm is one of the most researched topics in the area of development of a business policy. Two theories have been proposed to explain the relationship between market share and performance of firms, which are: The Structure-Conduct Performance Hypothesis and The Efficient Structure Theory. The first published study to research the relationship between a firm's market share and profitability is Gale (1972) and a positive relationship between the two was reported in the same. According to Buzzell (2004), a linear positive impact of market share on the performance of firms has been found and demonstrated by most of the research papers in the literature.

Aeteaga (2001) studied the performance of banking sector of Mexico for the time period 1995 to 1999 and found a positive relationship between a bank's profitability and its market share. Genchev (2012) studied the determinants of profitability of banks in Bulgaria for the time-period 2006-2010 and found that market share impacts the profitability of banks significantly and positively. In contrary to this, Bahtti & Hussain (2010) studied the performance determinants of commercial banks in Pakistan and showed a negative relationship between a firm's market share and its profitability. Samad (2008) and Athanasoglou et al. (2008) established that there is no effect of market share of a bank on its profitability.

2.2.2.1.5. Liquidity

According to Lukorito et al. (2014), Sufian (2012), Dang (2011) and Ibe (2013), bank liquidity is one of the significant determinants of its profitability. As per Lukorito et al. (2014), banks with higher levels of liquidity are able to settle their short-term liabilities as well as operational expenses smoothly, which in turn, facilitates better service delivery to their customers and thus, results in better performance. A weak positive relationship between bank liquidity and its profitability has been discovered by Lartey et al. (2013) for Ghanian Banks for the time period 2005-2010 and; Munteanu (2013) for commercial banks in Eastern and central Europe for the time-period 2003-2010. On the other hand, Nimer et al. (2013) has discovered a significant negative impact of liquidity on the profitability of Jordanian banks for the time-period 2005-2011. Accoridng to Nimer et al. (2013), banks with high liquidity suffer from the loss occurred due to holding too many liquid assets rather than earning benefits from investing them in profitable ventures. Some studies such as Ongore & Kusa (2013) and; Mohanty & Mehrotra (2018) have demonstrated that bank's position in terms of its liquidity doesn't have to do anything with the profits earned by it and thus, is insignificant to its profitability.

2.2.2.1.6. Net interest Margin

Many studies have studied the impact of net interest margin on profitability of banks and have reported a significant positive relationship between the two. Examples include Silaban (2017) for Indonesian banks for the time-period 2012-2016, Almilia & Herdiningtyas (2005), Wasiuzzaman & Gunasegavan (2013) for banks in Malaysia for the time-period 2005-2009, Doliente (2003), Wasiuzzaman & Tarmizi (2010), Gul et.al (2011) for commercial banks of Pakistan for the time-period

20052009, Park & Weber (2006) for Korean Banks for the time-period 1992-2002 etc.

According to Almilia & Herdiningtyas (2005), greater is the value of NIM, higher is the value of interest income on the earning assets of the bank, which in turn, depicts a better performance. Wasiuzzaman & Tarmizi (2010) state that wise investment decisions made by the banks reduce the credit risk, which in turn, improves the revenues earned by lending operations and thus, contributes positively towards the overall profitability of banks.

2.2.2.1.7. Non-Performing Assets (NPAs)

According to research studies such as Pastor (1992), Sufian & Habibullah (2009), Sufian (2009), Manthos (2009), Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017), Mehta & Malhotra (2014), Ibrahim & Thangavelu (2014), Alam, Haq & Kader (2015), Alagarsamy & Ganapathy (2017) and; Sengupta & Vardhan (2017), non-performing assets of banks are as one of the main determinants of their performance.

Most of the studies in the literature have established a significant negative impact of non-performing assets of a bank on its profitability. Examples include Pastor (1992) for Mexican banks, Sufian & Habibullah (2009) and Sufian (2009) for banks in Singapore, Manthos (2009) for Greek banks, Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017) and; Mehta & Malhotra (2014) for banks in India. According to Daru (2016), high NPAs demotivate investors, creditors and depositors. It effects the funds recycling negatively, which in turn effects the credit deployment negatively. When loans become non-recoverable, it not only has negative impact on credit availability in the future, but also has bad effect on banks' financial soundness. As per Mittal & Suneja (2017), NPAs negatively impact the performance of banks due to their undermining and negative influence on liquidity position, future funding, risk, productivity etc.

2.2.2.1.8. Inflation

Many studies in the literature have studied the impact of inflation on the performance of banks. A lot of research papers have found out that banks tend to perform better in countries with higher inflation rates in comparison to countries with comparatively lower inflation rates. Examples of research studies which have reported a positive and significant relationship between inflation and profitability of banks include Bertay et al. (2013), Tan & Floras (2012), Sufian & Habibullah (2010), Delis et al. (2012), Kutan et al. (2012), Flamini et al. (2009), Pasiouras & Kosmidou (2007) etc.

In contrary to this, studies such as Lee & Kim (2013), Shehzad et al. (2013), Houston et al. (2010), Kanas et al. (2012) etc. have found out that higher inflation in a country causes banks to earn lower profits and thus, a negative relationship between inflation and bank profitability was established. According to Liang et al. (2013), high inflation deters an individual's power to purchase and thus, reduce the flow of cash. This in turn, reduces deposits of banks and loans and thus, reduces its profits. Though inflation plays a significant role in the development of an economy, no significant role of inflation in the profitability of of firms was found by Petria et al. (2015), Mirzaei et al. (2013), Althanasoglou et al. (2008) etc.

2.2.2.1.9. GDP

Most of the banks in general focus their operations in developed countries in order to gain economics of scale as well as scope. A positive relationship between a country's GDP growth and the profitability (ROA/ROE) of banks in that country have been underlined by many studies in the literature such as Chronopoulos et al. (2015), Houston et al. (2010), Flamini et al. (2009), Pasiouras & Kosmidou (2007), Dietrich & Wanzenried (2011), Kutan et al. (2012), Lee & Kim (2013), Chitan (2012) and so forth. In contrary to this, a negative impact of GDP on profitability of banks has been reported by studies such as shehzad et al. (2013), Delis et al. (2012), Sufian & Habibullah (2010), Boubakri et al. (2005) etc.

2.2.2.1.10. Interest rate

Interest rate denotes the interest sum which is due each period as a percentage of the sum lent, loaned or invested. The total interest amount is dependent upon the principal sum that is loaned or lent, the duration, rate of interest. Interest is one of the one sources of income for banks and interest rate plays a significant role in their performance. (Alsharif, 2021)

Rashid & Khalid (2017) investigated how the operations and stability of banks in Pakistan were impacted by rising prices and real interest rate volatility. The study made use of data for the time period 2008-2015 for 25 banks and regression models were estimated using the Generalized Least Square (GLS) estimation method. The results of the study demonstrated an insignificant impact of both inflation as well as interest rates on the profitability of both the conventional as well as Islamic banks in Pakistan.

Suhadek and Suciany (2020) studied the impact of inflation, exchange rate and interest rate on composite stock price index and a significant negative impact of interest rate was established on the same.

Qing and Kusairi (2019) studies the impact of interest spread on the stock market performance suing monthly data from 1997-2018 and findings demonstrated a significant long term impact and a short term negative effect of interest spread on the performance of stock market.

2.2.2.1.11. Exchange rate

Exchange rate is among the significant macroeconomic variables, which can have direct or indirect influence on the profitability of banks (Kiganda, 2014).

Nguyen & Do (2020) investigated the impact of imports, real exchange rate volatility, and inbound international investment on Vietnam's trade flows. The findings showed that while a rising import volume provides modest long-term growth, it greatly enhances export efficiency range. Increases in declared overseas investment level will mostly result in a decline in export growth over the short and long terms. Nations all across the globe have traditionally been more prone to assess their currencies to boost trade balance. The study found that while exchange rate changes have no immediate impact on short-term international trade, it does so over the long term.

Another research study to investigate the impact of fluctuations in exchange rate on performance of banks is Keshtgar et al., (2020) which studied the performance of 14 banks in Iran for the time-period 2007-2017 using two performance indicators which are: profitability and liquidity. In recent times, the economy of Iran has experienced significant changes in their exchange rates which in turn affected the performance of banks in Iran. Econometric models were estimated using panel data and the results indicate a detrimental and significant impact of fluctuations in exchange rate on the capital return ratio of sample Iranian banks.

Chauque & Rayappan (2018) also studied the relationship between exchange rate and performance for the Malaysian market employing casual and multiple regression tests making use of monthly data for the time-period 2007-2016 and discovered a negative relationship between the two variables.

Manyok (2016) used quasi data to examine the impact of exchange rate volatility on the economic condition of South Sudan's banking sector for the time-period 2006-2015. The research found a tenuous negative correlation among exchange rate volatility and financial performance.

Mbithi (2009) studies the impact of fluctuations in exchange rate on the financial performance of Nairobi Exchange listed 46 firms between the time-period 2002 and 2012 employing descriptive statistics and multiple regression estimations and found out that exchange rate volatility significantly affects the performance of firms negatively.

Khan et al., (2018) studies the impact of exchange rate, inflation and interest rate on share returns of 15 firms listed on Pakistan Stock Exchange using monthly data for the time period 2008-2012 employing multiple regression analysis and found out there the share returns have an inverse relationship with interest and exchange rates.

2.2.2.2. Limitations of performance evaluation using profitability measures

Though the performance measure using profitability is highly relevant and popular, but the organisations today are very complex comprising of multiple dimensions. In such a complex scenario, evaluating performance merely on the basis of profitability is not realistic and will result in partial and less perfect results. Also the profitability evaluation does not take into account the concept of efficiency (taking the maximum advantage of available resources) in business activities. A company can be more profitable due to its favourable conditions, for instance its location. The profitability figure of a firm does not reflect its efficiency.

Bottazzi et al. (2008) studied the comparative analysis of two important performance evaluation dimensions i.e. profitability and productivity and found a weak behavioural connection between profitability and efficiency. In contrary to this, Ahmad (2010) investigated the performance of Islamic banks on the basis of eight performance indicator items and discovered profitability to be one of the most important indicators. Tsikriktsis (2007) also tested the relationship between performance and profitability for US airlines industry and observed a link between performance and profitability for focused airlines, but not for full service airlines.

Another limitation of the profitability based evaluation is that it is short term in nature. It takes into account the performance in the present term and ignores the significance of strategic decisions and investments which will affect the future performance. For example, a company which has decided to lower its cost by limiting the promotions and marketing activities will look profitable now on the basis of favourable financial ratios, but all this will adversely affect its future performance.

2.2.3. Balanced scorecard approach (BSC)

In order to develop a link between a company's short term tactics to its future strategy, Kaplan & Norton (1992) introduced the concept of Balanced Scorecard and addressed the weaknesses of traditional performance assessment methods.

According to Bach et al. (2001), the concept of Balanced Scorecard modified traditional methods of performance evaluations by introducing the criterion of performance measurement from three different perspectives which are:

- Customers
- Internal business processes
- Innovation and learning

Johnson et al. (2014) states that by employing a balanced scorecard approach, companies can keep a record of their financial results and at the same time, track their progress in terms of preparing for their future growth by acquiring intangible assets and developing competitive advantage. Denton & White (2000), Green et al. (2007), Ahn (2001), Kaplan & Norton (1996), Phusavat (2007) etc. are few examples of studies which have made use of BSC in their respective researches.

Although, the balanced scorecard approach is a significant compliment for accounting based ratio analysis, but it still has failed to achieve widespread acceptance. Kranji & Moura (2001) argue that BSC is a top-down approach which does not allow sufficient interactions between the top management and the workforce. Lohman et al. (2004) discovered that BSC is not very efficient in terms of its failure for the provision of opportunities for the development, communication and implementation of strategies in a corporate environment. Fletcher & Smith (2004) further adds that BSC lacks formal methodology which forces the management to focus on short-term financial strategies and at the same time, it lacks focused accountability.

2.2.4. Efficiency measures using Frontier Methods

Before the late 1980s, performance evaluation of banks was primarily based on ratio analysis and at times on econometric techniques like multi-variative regression analysis. These methods used average standards of performance and were based on implicit efficiency assumptions using the idea of scale and scope measurements (Greene, 2005).

The innovative and pioneering work on performance assessment of banks began in 1985 with the introduction of frontier methods (Sherman and Gold, 1985). This study adopted an operational perspective by evaluating the efficiencies of sample banks using frontier methods.

The later research conducted by Berger et al. in 1993 discovered that even less than 5 percent of costs were dependent on much famous scale and scope economies used in past methods of performance evaluation while on the other hand, efficiency contributed more than 20 percent towards banks' total costs. This gives the answer to the widespread popularity and attraction towards frontier methods in the 90s.

There are two different categories of frontier methods: parametric and non-parametric which can be used to evaluate the efficiency of banks. These two categories of frontier methods further comprise five different types:

- Thick Frontier Approach (TFA)
- Distribution Free Approach (DFA)
- Stochastic Frontier Approach (SFA)
- Free Disposal Hull (FDH) and last, but not the least
- Data Envelopment Analysis (DEA)

The difference between these five methods lies in the amount of shape imposed by them on the frontier and their distributional assumptions employed to remove random errors from the efficiency differences.

The concept of SFA was originated in two papers simultaneously: Meeusen and Van den Broeck (MB) and Aigner, Lovell and Schmdt (ALS) in 1977 with a time difference of merely a month. The further methodological advancements and empirical application for SFA were designed by Kumbhakar and Lovell (2003). According to Jaw-Yang Day (2003), SFA was developed to capture the effects of statistical and estimate the mean inefficiency of a sample's technical inefficiency.

The problem with this method is that it does not allow the decomposition of individual residuals into its components which makes the observational estimation of technical inefficiency difficult (ALS, 1997). Jun-Yen (2005) states that SFA introduces explicit restrictions on technology's functional form and if a misspecification of the functional form occurs, it results in specification error in identified inefficiencies. Additionally, it also requires explicit distribution of inefficiencies. Some of the studies which made use of SFA for performance evaluation are: Filippini et al. (2008) (Slovenian water system), Haider (2011) (Bangladeshi agricultural farms), Vishwakarma et al. (2012) (waste management system in India) etc.

The Distribution-Free Approach i.e. DFA as specified by its name is free of any inefficiencies' distribution requirements, but it works on the assumption of efficiency level not changing over time while random errors are changing over time and needs the panel data. So the unit efficiency is estimated by calculating the mean of total measured efficiency over the given time period of all years. DFA can be utilised in case of availability of time-series data (Noulas, 2001). Examples of the studies which made use of DFA for performance assessment are: Baur et al. (1993), Berger and Humphrey (1992) and Berger (1993) etc.

TFA has the least requirements regarding the frontier form and inefficiencies' distribution, but it cannot provide efficiency estimations for individual DMUs. On the basis of average cost, TFA divides the sample into quartiles. It is based on the assumption that deviations from the estimated costs which lie within the smallest cost quartile constitute random errors whereas inefficiency is represented by the variations in estimated costs which lie within highest and lowest cost quartiles (Noulas, 2001). Examples of the studies which have brought TFA into use are: Baur et al. (1993), Berger and Humphrey (1992), Berger (1993); and Berger and Humphrey (1991) etc.

All these three parametric methods i.e. SFA, DFA and TFA cannot estimate allocative efficiency and are unable to deal with multiple inputs-outputs at one time. The non-parametric methods DEA and FDH impose less structural requirements on the frontier but they do not allow random data variations. If random variations occur due to luck or errors in measurements, efficiency gets compounded with the random deviations from the frontier.

DEA was first introduced in the literature by Charnes et al. (1978) and its methodological advancements, empirical applications and issues of implementation were introduced by Cooper et al. (2007) and; Cook & Zhu (2008). Narasimhan and Graham (2005), Wang (2006) and Serrano-Cinca et al. (2005) define DEA as a non-parametric approach to calculate efficiencies based on a certain set of inputs and outputs. It follows the principle of linear programming and the inefficiency is estimated from the variations from the predicted frontier.

Emrouznejad et al. (2008) has presented the fact that the use of DEA for performance evaluation has been supported by over 4000 research papers in different industries. Concei and Stosic (2005) employed DEA and FDH to calculate Brazilian municipalities' technical efficiencies and to eliminate highly leveraged municipalities. Eilat et al. (2006) have demonstrated application of DEA for portfolio selection of research and development projects. El-Mashaleh et al. (2005, 2007) have applied DEA to the evaluation of firm-level performance of construction contractors. Prior (2006) investigated the efficiencies and quality management system in Spanish hospitals using DEA. Few more examples of the research studies which have utilised DEA in their research are: Ching-Kuo (2006) (Taiwanese hospitals), Tao (2012) (evaluation of workforce performance), Liang et al., (2013) (supply chain management), Sanei and Banihashem (2014) (Portfolio performance and asset selection), Moffat and Valadkhani (2011) (financial institutions of Botswana), Avkiran (1999), Rangan et al. (1988), Resti (1997), Ketkar (1996), Grabowski et al. (1994), Elyasiani and Mehdian (1995), Faviero and Papi (1995), Aly et al. (1990) and so forth.

There is an opinion difference among different researchers about the preferred frontier method as both types of methods possess their own advantages and disadvantages (Pakistan Research Repository), so the topic lacks mutual agreement. If it is possible to accurately estimate the frontier's functional form and distribution of inefficiencies, then it is feasible to obtain strong results with strong assumptions, but if the required information is unavailable, it is preferred to have minimal assumptions. There is no theory or statistical tests available which allow the parametric methods (i.e. SFA, DFA and TFA) to specify the functional form of frontier or distribution of efficiencies. On the other hand, the assumptions estimated by DEA on functional form of frontier are very flexible. Additionally, DEA can handle multiple inputs and outputs at the same time and it also allows the decomposition of estimated efficiency into allocative, technical and scale efficiencies for individuals DMUs in a straight forward manner (Rickards, 2003).

There is no consensus in the literature yet for the determination of best practice frontier for the benchmarking of financial institutions' relative efficiencies. Out of above mentioned five different frontier methods, DEA and SFA have been the most widely used tools for efficiency assessment of firms. The combined use of DEA and SFA can be seen in a number of research studies in the literature, e.g. Sharma et al. (1997) (investigation of Hawaiian Swine firms' operating efficiencies), Reinhard et al. (1999) (dairy firms of Denmark), Wadud and White (2000) (Farms of Bangladesh), Jacobs (2001) (UK hospitals), Tingley et al. (2005) (Fisheries in the English Channel), McMillan and Chan (2006) (Canadian universities), Theodoridis and Psychoudakis (2008) (Greek dairy farms), Bhandari and Maiti (2011) (leather firms in India) etc. to name a few.

Jacobs (2001) conducted a comparison between DEA and SFA by measuring the efficiencies in the sector of hospitals and concluded that each method has their own particular strengths and weaknesses and they measure different aspects of efficiencies. Jaw-Yang Day (2003) studied the link between cost inefficiency and diversification levels employing different frontier methods and obtained similar efficiency results with all the methods. Jun-Yen (2005) employed SFA and DEA for the measurement and comparison of efficiencies of 79 different forest and paper firms and concluded that though there existed a slight difference in efficiency scores calculated by these two methods but the relative efficiencies' ranking remained the same. Similar results were obtained by Kiadaliri et al. (2013) in efficiencies' calculation of Iranian hospitals using both DEA and SFA and no difference was observed in the efficiency scores calculated by the two methods. On the contrary, Sav (2012) found out that the efficiencies of public colleges of US calculated by DEA and SFA had a big gap of 11.3 %.

Franco and Bourne (2003), Wu et al. (200) and; Lin et al. (2008) argue that there is no usage of a performance evaluation system unless it reports managerial implications and actions. Braam & Nijssen (2004) supports the superiority of DEA in lines of this argument with the fact that DEA evaluates the overall performance and at the same time provides benchmarks for other companies. According to Mostafa (2007), DEA can efficiently determine the most efficient and the most inefficient firms. Cooper et al. (2006) presents additional advantage of using a DEA model that it helps to underline the sources of inefficiency in addition to the value of inefficiency for a given input and output for a particular DMU. In contrast, Serrano-Cinca et al. (2005) could not evolve any redundant information using DEA. According to Chang and Lo (2005), DEA can deal better with the aggregate information as compared to a detailed one.

Easton, Murphy and Pearson (2002) state that the major drawback of DEA is that it is difficult to obtain and rely on the data which is to be used in the analysis. Additionally, Smith and Goddard (2002) argue that DEA is very sensitive to the possible data errors and extreme points of data. Alp et al. (2012) further state that DEA can only measure relative efficiencies and it cannot provide a ranking of DMUs by comparing their relative efficiencies with a given theoretical efficiency value. Even if a DMU appears on the efficient frontier, chances are there that it might not perform well in the real life. Since DEA is superior only to evaluate relative efficiencies of a given observation set of DMUs, so Alp et al. (2012) advised to keep a large number of DMUs in the analysis set to get rid of this obstacle.

This thesis is for the performance evaluation of selected commercial banks of India, so the data in the empirical part of the study opted to be very detailed. As DEA does not limit the random errors in the data and imposes least assumptions on the production frontier shape, so this method is the most suitable for the empirical part in this research thesis. Thus the evaluation of technical efficiency of selected banks will be carried out employing the DEA approach.

2.2.4.1. Methodological Issues in Frontier Methods

Some of the methodological issues which need to be considered and addressed before choosing a frontier method for the evaluation of efficiency are discussed in the following sections.

2.2.4.1.1. The inputs and outputs involved in a banking activity

This section tends to describe the particular approaches exercised in the empirical section of this keeping in mind the conceptual matters associated with the definition of inputs and outputs of banking activity.

A considerable growth can be observed in the number of researches addressing the efficiencies of banking industry. One of the major difficulties involved in the analysis of banking activity is to characterise the production process. The banks provide services to its customers rather than any physical products which can be identified readily. There is no extensive consensus in the literature for the identification of relevant inputs and outputs for the banking activity. This topic has remained as a perturbed controversy in the literature and as a result and it has given birth to various different approaches in order to define the banking activity (Milima and Hjalmarsson, 2002).

In words of Humphrey (1985), the main function of banks is to intermediate equity, capital and liabilities (the customers' deposits and the funds purchased from the inter-bank financial markets) into assets (securities, loans and other investment funds). Banks generate revenues as the interest payments paid for the loans given to customers and the commissions received for the provision of various other services such as investments, insurances etc. At the same time, banks pay interests to the depositors as a compensation for using their funds. In addition to the monetary interests, depositors are also provided non-monetary services like safekeeping, accounting, liquidity services and so forth. The execution of this process demands real time resources such as labour, raw materials, machinery, plant, finance, information systems etc.

For the evaluation of inputs and outputs of a banking activity, various different approaches can be found in the literature. Berger and Humphery (1992) introduced five different approaches for the identification of inputs and outputs keeping in mind the characteristics of the banking business. These are: production approach, intermediation approach, asset approach, user-cost approach and the value added approach. All these approaches can be utilised to assess efficiency of a bank or the relative efficiencies of different branches within a particular bank.

2.2.4.1.1.1. Production Approach

The production approach was introduced by Benston in 1965. This approach, emphasizing on banks' operational activity, views banks as services' providers to its customers. According to this approach, operational activities' workload measures outputs whereas operating costs related to physical variables such as labour, IT, plant, machinery, raw materials etc. contribute towards inputs (Berger et al., 1991, Parson et al., 1993).

Tasks such as processing financial documents, transactions and customer service require physical inputs such as labour, finance, raw materials etc. Thus, only the physical inputs and their associated costs should be involved in the input set. As interest is involved in the operational process, so the production approach does not include the interest costs in the input set.

In words of Benson et al. (1982, p9), although interest is one of the most significant expenditures for the bank, but there are many other alternatives driven by the market forces presented to depositors. So, for purposes of efficiency measurements of banks, interest is not considered as an operating expense.

The production approach defines outputs as the services provided to the customers. It can be measured by the number and type of transactions carried out or the number of financial documents processed over a given period of time. For the better interpretation of resultant efficiencies, it is advised that the processed transactions are grouped together according to their complexity level, the purpose involved in carrying out a particular transaction and the quantity of resources consumed. However, it is not easy to obtain the data in such a deep detail and so the deposit and loan accounts' data is generally used as a proxy for the level of services provided. In case of studies, which are based on efficiency measurement of different branches within a bank, it can be problematic to incorporate such proxy variables specially in those cases where an account is opened in one branch and the transactions happen in another branch for the same account. Unless such adjustments are introduced in the model related to interbank transactions, the model does not allow a proper evaluation of workload in a branch (Isik and Hassan, 2003).

Additionally, the definition of an output as the number and/or value of accounts lacks mutual consensus by researchers. According to Lozano-Vivas (2009), although the value of accounts may affect the operational cost to some extent, but it is mainly the number of accounts processed which primarily determine the operational cost. The consideration of number of accounts as the output has a major drawback as the banks can have numerous 'dead accounts' where no deposits are made and thus, are not in use anymore. This situation arises in cases, where deposits happen using accounts with two or more different banks.

The use of value of bank accounts as the output has also faced many arguments. One of those arguments put forward by Isik and Hassan (2003) states that different banks compete in the market on the basis of increments in their market share in terms of monetary deposits instead of number of accounts held. As large accounts tend to be more active as compared to small ones, so they can prove to be more costly for the bank.

The use of production approach for the efficiency measurement of bank branches is very popular; however, Livanis (2004) states that it has been used scarcely at the bank level. It is mainly due to the reason that it is very difficult to collate the data required in this model. The data demanded by regulators and published by banks generally tend to be financial in nature and the input/output data is rarely disclosed in most of the countries.

Campbell (2001), Isik and Hassan (2003), Livanis (2004), Lozano-Vivas (2009), Dand-Thanh (2011), Konstandina (2007) are few examples of studies which have made use of production approach to identify the inputs/outputs involved in the banking activity.

2.2.4.1.1.2. Intermediation approach

The intermediation approach views banks as the intermediator of funds between investors and depositors. According to Daley and Matthews (2009), the banks manufacture intermediating services by collecting deposits, liabilities etc. and utilising them to produce interest generating assets such as loans, securities and other investments funds.

Under the intermediation approach, the interest/non-interest costs count towards inputs whereas the cash flow generated by the intermediation services is considered as the output. As the intermediation cash flow data is not readily available, it is generally assumed that the cash flow is equally proportional to the funds held in the accounts published in the balance sheet of the banks (Gardener et al., 2011)

The use of deposits, whether as an input or output, has always remained as a controversial topic for a very long time. The arguments put forward to support the use of deposits in the input set is that they create additional cost for the banks in terms of interest paid to the depositor and until they are not intermediated into investment funds and loans, they rarely generate any revenue for the institution. These deposits play the role of raw materials to produce investment funds and in turn, it is the use of these investment funds that ultimately produce large sums of direct revenue for the company. (Fukuyama & Matousek, 2010)

Some of the recent studies categorise deposits as outputs. These deposits are seen as the additional products over which banks compete in the market. They consume resources and cause a significant cost to banks. Banks also need to provide non-monetary service to depositors as a compensation for the use of their cash. Some of the studies have included deposits both in input and the output set. The interest paid for the deposits is considered as an input, whereas the monetary value of those deposits has been termed as an output (Fukuyama & Matousek, 2010).

Attempts have been made to refine the input-output definition by making distinctions between various deposit types. For instance Rangan et al. (1988) defined purchase funds as outputs as they do not really consume much resources and the savings, demands and term deposits have been considered as inputs.

Oztorul (2011) has defined outputs as the revenues earned by the banks from the process of intermediation. It is difficult to estimate the revenue generation from value of accounts held by them as a result of banks' intermediating activities. So relating outputs to revenues is similar to analysing banks' economic viability. The use of interest revenues as outputs in the model defines two aspects of the banking activity at the same time; the amount of money lent and the interest charged by the banks for those loans. However, revenues are more effected by conditions in the market and the external environment than the internal issues of management and the value of accounts takes this into consideration to a larger extent.

Favero and Papi (1995) argue that the intermediation approach has numerous shortcomings and one of the main weaknesses is the fact that most of the banks' services not represented by the balance sheet magnitudes are very rarely considered.

It is highly relevant to point out this exclusion here especially when the heightened competition these days has lowered the intermediation margins for the banks. These lowered margin levels have pushed banks to consider other commission based services (such as selling insurance covers, investment funds, brokerage services etc.) offered by them to their clients.

Saunders (1993) found out that the monetary value of off-balance sheet activities of major banks of US is four to five times the monetary value of their on-balance sheet activities. Despite all these arguments, the intermediation model is one of the most widely used approaches employed by the studies focusing on efficiency evaluations of banks.

Examples of studies which have followed the intermediation approach for the selection of inputs-outputs are: Gardener et al. (2011), Casu et al. (2004), Esho (2001), Mester (1996), Llyod- Williams (1996), Molyneux et al. (1996), Altunbas (2001), Evans et al. (2001) etc.

2.2.4.1.1.3. Asset approach

The asset approach, first introduced by Sealey and Lindley (1977), is a modified form of the intermediation approach of modelling of banking activity, which exclusively focuses on banks as the intermediators between the depositors and the lenders. Unlike the intermediation approach (where a flexibility is allowed to choose inputs and outputs), the asset approach rigorously defines the inputs and the outputs. The variables in the input set are: deposits, liabilities and the resources such as labour, capital etc., whereas the banks’ assets are considered as the outputs.

The liabilities of the banks provide raw materials for investment funds, so they are considered as inputs. Similarly, assets are a direct source of bulk revenue for banks, so they are termed as outputs.

The definition of output variables given by the asset approach is strongly valid for banks which buy their funds from other banks (for interest) and then convert those funds into loans lent to their customers. However, in most cases, in addition to the interest paid to their customers, banks also offer additional services to depositors for their deposits which are not taken into consideration by this approach. It is mandatory for the banks to attract the customers’ deposits these days as the major portion of the operational costs is restrained by the maintenance and attraction costs of such deposits.

Another major drawback of the asset approach is that the output variables are concluded solely on the basis of the data presented in the balance sheet and despite the growing significance of commission based services such as securities, investment funds etc., they are not implicated in the output set.

2.2.4.1.1.4. User Cost Approach

The user cost approach was first applied to the banking industry by Hancock in 1985. The user cost approach differentiates between different financial products as inputs or outputs in terms of their percentage share in the total revenue of the bank. Outputs are the assets where the financial returns exceed or the financial liabilities deseed their respective opportunity costs. If the assets fail to do so, then they fall in the category of inputs.

There are some pitfalls in this model. Firstly, it is difficult to collect the accurate data and the subsidisation practice does not allow the available data to rely much on costs and profit figures. Keeping the crucial issues such as credit risk, liquidity and maturity into consideration, it is hard to determine the opportunity costs for assets and liabilities. (Berger and Humphrey, 1992)

2.2.4.1.1.5. Value added approach

The value added approach defines outputs as the assets or liabilities in the balance sheet which are associated with value added business activities i.e. businesses which consume real time resources. According to this approach, the output set comprises of the major deposit categories achieved (such as term, savings and demand deposits) and loans (such as commercial loans and mortgages) as they account for the major share of the value added. The input set consists of resources like workforce, capital, purchased funds etc. The off-balance sheet activities do not contribute much towards the value added, so they are not involved in the output set. (Berger and Humphrey, 1992)

All the above discussed approaches for the identification of inputs and outputs are well established. However, the selection of inputs and outputs for the studies based on the measurement of efficiencies of banks are highly influenced by how the analyst views the banking activity, the issues involved in the analysis and the extent to which the data is available for the analysis.

According to Berger and Humphrey (1992), the three approaches value-added, asset and the user-cost approach, all use the financial data and are based on the intermediation role of banks. So they are only viewed as different variations of the intermediation approach only.

2.2.4.1.1.6. Comparison between different methods for the determination of inputs and outputs

Out of all these five different approaches, Gardener et al. (2011) considers intermediation approach and the production approach as the most commonly employed approaches for the efficiency evaluations of banks. The financial institutions serve two main roles in general- i. processing of transactions and financial documents ii. Play the role of intermediation between depositors and investors, transferring funds between the two for a profit. Berger and Humphrey (1997) state that although these two approaches have gained a wide acceptance in the literature, but none of them completely incorporates both these dual roles of banks. Thus, the use of these approaches is recommended only in cases of availability of sufficient data for the given design. Nevertheless, every approach possesses a certain scope and thus, can provide valuable outcomes and conclusions which can prove to be proficient for specific purposes.

Ferrier and Lovell (1990) and Berger et al. (1987) argue that as the intermediation approach takes into account the expenses resulted from operations and interests, so it suits better to evaluate the whole financial institution and their economic viability. Berger and Humphrey (1997) states that none of the approaches is perfect but Yue (1992) found the intermediation approach to be surpassing to evaluate and compare efficiencies of different branches within a bank as it includes interest expenses (1/2 to 2/3 of the total cost comprises of interest expenses only) whereas interest expenses are not included in the production approach. Molyneux and Casu (2003) also prefer the intermediation approach as the maximisation of total profits demand the decrease in total costs rather than just the operational costs.

Berger and Humphrey (1991, 1997) argue that the production approach should be utilised only to evaluate the banking activity's operational costs and abandon the interest costs (which account of 50-70 percent share of banks' total costs). However, the production approach can be utilised for the assessment of efficiencies of branches within a given bank. This is due to the reason that the branches are generally involved mainly in the processing of documents for their customers and have very little involvement in the decisions concerning fund raising and investments. Also, in order to favour other important strategic decisions, the sacrifice of the given branch's economic viability won't make much difference.

Table 2.1 presented below provides a summary of different input and output variables used in different studies in India based on efficiency measurements.

Table 2.1. Research papers in India based on efficiency measurements

Author (Year)	Approach used	Input variables	Output variables
Mukherjee et al. (2002)	Intermediation approach	Operating expenses, workforce number, No. of branches, Borrowings, Net worth of the business	Advances , Net profit, deposits, Non-interest income, interest spread
Reddy (2004)	Intermediation approach	Fixed assets, interest expense, staff salaries	Total Income, Advances, Liquid assets
Das et al. (2005)	Intermediation approach	Borrowings, Number of employees, No-current assets, Equity	Investments, Non-interest income, Performing loan assets
Kumbhakar & Sarkar (2005)	Value added approach	Labour, Capital	Deposits, investments, number of business branches, loans, advances
Kumar & Gulati (2008a, 2008b, 2009b)	Intermediation approach	Physical capital, Labour, Deposits, Borrowings	Net interest income
Ray (2007)	Intermediation approach	Borrowings, Labour, Physical capital	Investments, Other income, Payables
Gupta et al. (2008)	Intermediation approach	Interest expense, Operating expense	Interest income, Other income, Income from investments
Das & Ghosh (2009)	Intermediation approach	Deposits, Labour, Capital, Equity	Loans, Advances, Investments, Other income
Bhattacharyya et al., (1997b)	Value added approach	Interest expense, Operating expense	Advances, Investments, Deposits
Sathye (2003)	Intermediation approach	Deposits, Staff number	Loans, Non-interest income

(Source: Compilation by the author)

2.2.4.2. **Topics related to efficiency measurements using frontier methods**

The following sub-sections discuss and address the issues related to the measurement of efficiency using the frontier methods.

2.2.4.2.1. The orientation preference for the assessment (input/output)

Coelli et al., (2005) points out that there are two orientations available to choose from for the performance assessment of banks i.e. input orientation and output orientation.

In an input-oriented approach, emphasis is given to reduce the quantity of inputs used in the production of the same number of outputs. On the other hand, in an output oriented approach, emphasis is given on maximising the number of outputs for the same given number of inputs. Till now, most of the studies have adopted an input oriented approach in efficiency evaluation studies, e.g. Guedes (2012), Salerian and Chan (2005), Wey (2013), Mariappan and Sreeaarthi (2013), Lea and Choi (2010), Singh and Bajpai (2013) etc. to name a few. Coelli et al. (2005) further states that the reason behind the popularity of input orientation over the output orientation is that managers have better control over inputs (such as labour, expenses, raw materials etc.) as compared to outputs (amount of products/services demanded by the customers).

However, examples of studies can also be found which have adopted an output oriented approach, e.g. Ataullah and Lee (2006), Ataulaah et al. (2004) etc. Few studies have also utilised both input and output orientations such as Beccalli et al. (2006), Casu and Molyneux (2003) etc. It can be found in the working paper series of university of Bath that for CRS, both input and output orientations provide the same results whereas variable results are obtained by the two orientations in case of VRS. However, Coelli et al. (2005) mention that as the econometric approaches are based on linear programming, so the selection of a particular orientation does not make any difference. Furthermore, Coelli and Parelman (1996) state that the orientation selection makes a minor impact on efficiency scores in many instances.

2.2.4.2.2. Efficiency measures

Most of the research studies in the literature based on efficiency measurements have evaluated technical efficiency of firms. Examples include Drake et al. (2006), Daley & Mathews (2009), Assaf et al. (2011), Pasiouras (2008) and so forth. However, it is also possible to evaluate a firm's cost as well as profit efficiencies in instances where the data relevant to inputs'/outputs' prices can be easily obtained. Mathematically,

$$CostEfficiency = technicalefficiency \times allocativeefficiency$$

Allocative efficiency can be defined as a bank's ability in the utilisation of its inputs (available with their respective prices) to their optimum level. Constituently, cost efficiency represents a bank's ability in terms of the provision of services at a minimum wastage resulted from technical and allocative efficiencies. Studies which have measured cost efficiency are: Isik and Hassan (2002, 2003), Tortosa-Ausina (2002) etc.

Cost inefficiency has been further decomposed into two components: i. composition inefficiency ii. intra-specialisation inefficiency; by Pastor and Serrano (2006) where composition inefficiency represents the inefficiency resulted from the composition of banks into different banking sectors according to their specialisations and the intra-specialisation inefficiency represents the inefficiency resulted from the resources' inefficient use within each of the specialised sectors. The deviation from above studies has occurred in the research conducted by Prior (2003) on Spanish banks where he has calculated capacity and cost inefficiency (both short and longterm). For short-term cost inefficiency, it is assumed that the inputs are fixed and can't be modified. In case of long-term inefficiency measurements, it is assumed that the inputs used are variable and are under management's control. Sahoo and Tone (2008) applied the similar concept to the banking sector in India.

Coelli et al. (2005) measured revenue efficiency in their research studies and state that the research based on the estimation of profit efficiency employing the nonparametric method DEA is limited. This is due to the reason that it is not possible to further decompose profit efficiency into allocative efficiency and technical efficiency in a straightforward manner. Secondly, the access of a clear and reliable data related to the prices of outputs is relatively hard. This problem was addressed by Fare et al. (2004) by the employment of linear-programme DEA to estimate profit (profit maximising DEA) and technical efficiency (function of directional distance, where inputs and outputs can be possibly simultaneoulsly adjusted). Another estimation of profit efficiency was given by Kirkwood and Nahm (2006) by considering only the input prices. Similar to profit efficiency, Berger & Mester (1997) estimated efficiency of alternative profits employing SFA. Estimations of both alternative profit as well as standard efficiency were given by studies such as Maudos & Pastor (2003) , Ariff & Can (2008) etc.

Lastly, Sathye (2002) and Casu et al. (2004) measured total factor productivity (i.e. TFP). TFP can be further categorized into: technological changes and technical changes' efficiency. Technical efficiency has been disaggregated into two further types by a lot of research papers, which are: Pure technical efficiency and; Scale efficiency

2.2.4.2.3. Returns to Scale

The implementation of DEA for efficiency measurements can be done with two assumptions i.e. Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). Charnes et al. (1978) estimated overall value of technical efficiency (OTE) assuming an input orientation and CRS. Banker et al. (1984) made use of VRS for the decomposition of OTE into PTE and SE. PTE denotes managers' ability in terms of optimal use of the organizational resources while SE denotes the ability to exploit the scale economies with the operation at production frontier which exhibits CRS.

Coelli et al., (2005) states that most of the recent studies have employed DEA for efficiency evaluations assuming a VRS case. This is due to the reason that the use of CRS suits for efficiency related studies only when the firms are performing optimally, but it is not possible due to various factors such as regulation/supervision by the government, competitive forces in the market and so forth. There are other studies which favour CRS over VRS. For instance, according to Noulas (1997), the comparison between small and large firms becomes possible with a CRS assumption. Berger et al. (1991) point out that in a sample of presence of large banks in a VRS framework, large banks appear to be efficienct due to the presumption that in the true sense, no bank is fully efficient. According to Avkiran (1999), a VRS framework allows comparisons between units of same sizes only. So VRS suits more the large samples. Zenios (1999) mentions that extra caution is needed in case of a VRS assumption as it requires the orientation of the model (input Vs output). Allen (1997) mentions that it might become problematic to assume a VRS framework due to its weight restrictions. Studies like Casu and Molyneux (2003), Canhoto and Dermine (2003) etc. have carried out the assessments assuming both CRS and VRS frameworks.

2.2.4.2.4. The effect of specification of the frontier on the estimations of efficiency

In order to measure efficiency of banks, both types of frontier methods: parametric and nonparametric have been utilised extensively. However, it is not possible to find wide acceptance on the issue of selecting the best frontier method in order to explore and evaluate the efficiency of financial institutions at the corporate level. The nonparametric methods have been used more amply as compared as parametric methods for the evaluation of efficiencies of different branches within a given bank. This might emulate the wider consent of the non-parametric methods being more appropriate for the efficiency evaluations of branches among the researchers. The extensive use of non-parametric methods at the branch level can be due to more clean proprietary data used in this method than the published chaotic financial data required for analysis at the corporate level.

After the comparisons conducted between the resultant efficiencies measured using parametric and non-parametric methods, Berger & Humphrey (1997), discovered that there was a similarity between the central tendencies (approximately 80%). Further to this, the efficiency estimates resulted from non-parametric methods were lower with greater dispersions as compared to the results obtained from parametric methods.

Very limited information can be found in the literature relevant to the comparisons between different measurements resulted from different methods regarding the efficiency rankings of different DMUs. A very few studies such as, Drake & Weyman-Jones (1996), Ferrier and Lovell (1990), Sheldon (1994), Sheldon and Haegler (1993) etc. applied both types of frontier methods and then compared the efficiency estimations resulted from those different methods. According to the research conducted by Weyman-Jones (1996), the efficiency rankings obtained by two approaches were pretty much identical despite the fact that the resultant efficiencies differed significantly in terms of quantity. Ferrier and Lovell (1990) observed all together contrasting results in their studies. According to them, the resultant average efficiency values were similar; however, the efficiency rankings from the two types of methods had a difference of more than zero. According to Resti (1997), there was not a dramatic difference between the efficiency results, although there was a huge positive correlation between the efficiency rankings of different DMUs. The studies conducted by Sheldon (1994) and; Sheldon and Haegler (1993) directed the comparisons only between the efficiency values and showed a significant difference between the results obtained from different methods.

From the above discussion, it is evident that there is a scope for further research on the topic of capability of different methods for the efficiency measurements and the efficiency rankings. In order to convincingly address the issues related to the management, policy making decisions and research areas, it is advised to apply more than one frontier method to the same data set. If the different competing methods provide the complying results, it would heighten the confidence level of the audience in the resultant outcomes.

2.2.4.2.5. Identification of a banking activity's inputs and outputs and; the extent to which the efficiency outcomes are sensitive to the variable perceptions

The research related to the inputs' and outputs' definition and identification in the banking industry is vast and is still ongoing. Bergendahl (1998) states that the number of studies on assumptions of a banking activity's inputs and outputs is almost same as the number of researches conducted on the topic of DEA.

As discussed above, there are five different approaches available for the identification of inputs and outputs, but as per Berger & Humphrey (1997), out of those five different approaches, the intermediation and the production approaches have been the most important and the most widely used ones. Based on the production approach, workforce and monetary resources are used as inputs by banks to produce loans and; deposits and the number of processed transactions or financial documents measure outputs. The intermediation approach considers banks as the intermediaries between depositors and investors. Berger and Humphrey (1997) does not consider any of these approaches as perfect as the dual nature of banks (i.e. processor of financial transactions and documents; and the role of intermediary) is not fully justified by any of these approaches. It further points out that the production approach is ideal for the performance assessment of branches, whereas the intermediation approach is more suitable for the performance evaluation of the whole financial firm. It is difficult to obtain the whole data demanded by the production approach, so intermediation approach is favoured more by the researchers.

Berger as Humphrey (1997) states that the classification of deposits has always remained as a controversy. In lines with Sealey and Lindley (1977), earning assets are the only outputs to be considered in the assessment, but recently, deposits are also considered in the output set.

Sathey (2002) and Weill (2004) have classified the interest expense on the deposits (without the actual value of deposits) as inputs. On the other hand, Maudos et al. (2002), Chen et al. (2005), Saha & Ravisankar (2000) have classified deposits in the output set while the interest paid on those deposits as the input. Furthermore, Gilbert & Wilson (1998), Sathye (2001), Bauer et al. (1998) define demand deposits as outputs, whereas time and saving deposits as inputs. Finally, Tortosa and Ausina (2002) have constituted deposits both in the input and the output sets.

More recently, Drake et al. (2006) have adopted profit orientation of the intermediation approach which defines the components of revenue such as interest/non-interest income as outputs whereas the constituents of cost such as labour, interest based expenses etc. as the inputs. It further explains that this profit oriented intermediation approach better suits the range of strategic decisions taken by financial institutions in response to the inevitable and constant changes in the external environment. Luo (2003) introduces another concept of 'marketability efficiency' to measure a company's market stock value. Under this approach, revenues or profits are seen as inputs and the outputs are the market value of the company, earnings/share, and stock price.

Although, a general agreement can be seen about the categorisation of inputs and outputs with deposits as the exception, but there still lies an inconsistency. For example: Casu and Girardone (2004), Maudos and Pastor (2003), Isik and Hassan (2002) consider labour, deposits and fixed assets as inputs. On the other hand, in addition to these input elements, studies like Chen (2001) included branches, Drake et al. (2006) and Drake (2001) add provisions of loan loss, Mukherjee et al. (2001), Pasiouras (2008) and; Sturm & Williams (2004), have added equity to the list. Chen (2001) has classified deposits further into two categories which are: current and time deposits whereas the disaggregation of deposits provided by Das & Ghosh (2006) is demand, fixed and savings deposits. Casu & Molyneux (2003) consider total cost and total deposits as inputs whereas Beccaili et al. (2006) involve only a single input i.e. total cost.

Studies like Casu & Molyneux (2003), Casu & Girardone (2006) use loans and earnings as the only two outputs. On the other hand, Sturm and Williams (2004) have further classified loans into housing loans and other loans. The categorisation of loans by Mukherjee et al. (2001) and Fare et al. (2004) comprises of personal, real estate and commercial loans. Isik and Hassan (2002) divides loans into: long term and short term loans. Tsionas et al. (2003) disaggregate earning assets into liquid and investment assets, Chen (2001) as investments in government securities, investments into public/private firms. An additional element i.e. number of branches is added by Canhoto and Dermine (2003) into the output set. Finally, Sturm & Williams (2004), Pasiouras (2008), Isik & Hassan (2002, 2003) and so forth have also added noninterest income and off-balance sheet sources into the output set.

Lastly, a deviation from the above stated literature is led by the approach given by Halkos and Salamouris (2004), where they don't assume any inputs with the hypothesis that all the banks have similar and equal inputs as they all have the same operation of money and financial services in the same market and the output set comprises of a five financial ratios' set.

2.2.4.2.6. The establishment of factors causing inefficiency

El-Gamal and Inanoglu (2005) in their study of inefficiency in the Turkish banking industry state that the results obtained for the sources of inefficiency in the banking industry are always contradictory due to different methodologies (parametric Vs. non-parametric) employed by different studies, different environment and nature of different institutions and; the different characteristics of different banking systems (variant regulation/supervision systems in different countries). Thus, it becomes difficult to generalize the results beyond the specific business environment in which they are derived and it is possible to produce only few general conclusions.

A plenty of studies can be found in the literature which have tried to pinpoint the inefficiency sources in banks, e.g. Kach and Borzabad (2011), Lizieri et al. (2012), ElGamal and Inanoglu (2005), Akhigbe and McNulty (2005), Birgul (2006), Grigorian and Manole (2006), Stefancic and Kathitziotis(2011) etc. to name a few.

Cuesta (2000) in his study of evaluating inefficiency of Spanish dairy farms concluded that the main reason behind inefficiency in any institution is mainly of managerial or technical nature and other inefficiencies i.e. scale, allocative etc. contribute only a small proportion to the total inefficiency value. Similar results were obtained by Drake et al. (2006), Pasiouras (2008), Lozano-Vivas et al. (2002) etc. In contrary to this, Tai-Hsin and Wang (2004) discovered that the allocative efficiency should be researched thoroughly as compared to the technical inefficiency as it constitutes about 23% of the total cost. The importance of technical inefficiencies was first noticed by Berger et al. (1993) where they stated that technical inefficiencies are responsible for more than 20% of the total cost in the banking industry whereas other inefficiencies such as scale, product and allocative inefficiencies together account for even less than 5% of the total cost.

Sufian et al. (2014) studied the scale efficiency and returns to scale for Malaysia's Islamic banks and concluded that domestic banks score lower for scale efficiency in comparison to their foreign peers. They further stated that the value for returns to scale is generally assumed without giving any justification for the choices made. Thus, the studies on scale efficiency or returns to scale might present misleading results as VRS frontier is artificially fit into the set of data underlined by CRS technology.

According to Podinovski (2004), the topic of returns to scale in case of banks has been studied extensively. Sufian (2007) states that different banks use different returns to scale measures i.e. VRS (Variable returns to scale), DRS (decreasing returns to scale), CRS (constant returns to scale). Thus, the generalization of results becomes difficult and the topic needs further analysis.

2.2.4.3. Previous research on efficiency of banks and its determinants

A lot of studies can be found in the literature which have attempted to pinpoint the factors influencing banks' efficiency. Some studies have focused only on the factors specific to banks while others concentrate both on bank as well as external environment specific factors in which an organisation operates. Based on researches such as Casu & Molyneux (2003), Ariff & Can (2008) and; Casu & Girardone (2004) etc., the factors specific to banks effecting the efficiency of banks are: size of the firm, market capitalisation, overall profitability and the value of loans/assets ratio. In addition to these factors, Isik and Hassan (2003) added two more variables to the list i.e. skills and talent of the workforce and the chairman affiliation of the CEO. Studies like Isik and Hassan (2003), Isik (2008), Canhoto and Dermine (2003) etc. researched the impact of age of a bank on its efficiency. Further to this, Isik & Hassan (2002) and Pasiouras (2008) studied the impact of a firm's international presence on its efficiency.

The country-specific indicators of efficiency stated by Haunter (2005), Ataullah and Lee (2006) can be summarized as: growth in GDP, market concentration, foreign banks' presence, private investments/GDP ratio, Fiscal deficits/GDP ratio etc. Pasiouras (2008) investigated the impact of government regulations on technical efficiency scores of a business.

The efficiency determinants of banks in Bulgaria were researched by Tochkov and Nenousky (2009). The study employed non-parametric approach for the same and studied the impact of bank-specific factors such as bank profitability, bank capitalization, liquidity and credit risk on bank efficiency and found out that the domestic private banks had lower efficiency scores in comparison to foreign banks. On the other hand, the study demonstrated the State banks to be inefficient. The study further concluded a positive impact of capital position, liquidity and EU membership and negative effect of bank reforms on its efficiency.

Another research was carried out by Fuentes & Vergara (2003) for estimation of bank efficiency in Chile using the SFA approach. The study discovered that the banks set up as open corporations have higher scores of efficiency than international banks' branches. It also concluded that banks which have high ownership concentration, are found out to be more efficient than banks with less concentration of bank ownership.

Ariff & Can (2008) estimated the Chinese banks' profit and cost efficiency scores for the time-period 1995-2004 using panel data employing DEA and further studied the relationship of efficiency with bank size, ownership, ROA, cost/income ratio, loan/deposit ratio and percentage of net interest income over total income using Tobit regression analysis. In this study, it was discovered that Chinese banks have higher scores for cost efficiency in comparison to profit efficiency, which in turn indicates that the cause of key inefficiencies lie on the profit side. The banks owned by the state were found to have lesser profit as well as cost efficiencies as compared to the combined stock banks in the research. The bank size didn't appear to have a clear relationship with efficiency as banks categorized as large and small were found to have lower efficiency than banks with medium sizes. Further to this, a positive relationship of bank efficiency was established with ROA, cost/income ratio, loan/deposit ratio and net interest/total income ratio in the study.

The cost and profit efficiencies of Turkish banks for the time period 1988-1996 were estimated using SFA and determinants of the same were established by Isik & Hassan (2002). The study indicated the mean scores for Turkish banks' cost and profit efficiencies to be respectively 90% and 84%. The study didn't discover any relationship between cost and profit efficiencies of banks, which means that banks with high scores of cost efficiency don't always have high scores of profit efficiency as well and vice-versa. The study further confirmed that bank efficiency is related to the structure of management positively, whereas negatively to state ownership.

Al-Khathlan & Malik (2010) made use of DEA to examine the relative efficiency scores of Saudi Arabia's banks for the time period 2003-2008 and the sample banks were found to be efficient in the management and utilization of their resources. Maudos & Pastor (2003) discovered a strong positive relationship between the cost and profit efficiencies of Spanish banks for the time period 1985-1996, estimated using the non-parametric approach DEA.

The determinants of efficiency and profitability for 78 Islamic banks operating in 25 different countries for the time period 1992-2009 were studied by Ahmed & Noor (2011) using a two-step approach comprising of DEA and Tobit regression model. The efficiency scores were calculated using deposits, assets and employee cost as inputs; and total loans, total income and other income assets as outputs. The study discovered the sample banks to have good technical efficiency scores over the given time period and the factors which strongly impacted the efficiency and profitability of banks were total assets, bank size, NPLs (i.e. non-performing loans), financial crisis, country's economic growth, equity and total operating expenses.

Another research paper to study the efficiency of Islamic banks is Al-Delaimi & Al-Ani (2006), where the cost efficiencies of 24 Islamic banks were studied for the time-period 1999-2001 using DEA and most of the sample banks were found to be efficient for the given time frame. Fries and Taci (2005) made use of SFA to measure the cost efficiency of a large sample of 289 banks in 15 countries in the Eastern Europe and determine the factors effecting the efficiency. Private Banks with foreign ownerships were found to be more efficient in the study as compared to banks with domestic ownership. Other factors which have strong impact on the bank efficiency, listed in the study were deposits, interest rates, capital/asset ratio, loan losses, market share and so forth. The use of SFA was also made by Maudos et al., (2002) to measure and study the cost and profit efficiencies of banks in 10 countries in the EU for the time-period 1993-1996. The sample banks were found to be efficient on the cost side but inefficient on the profit side, requiring a need for banks to focus not just on the cost side, but also on the profit side. The study reported a positive effect of factors such as growth rate of GDP, market concentration, ROA on its profit efficiency and a negative effect of the same factors on its cost efficiency. A linear relationship wasn't confirmed between the efficiency and bank size in the research paper.

The banks' efficiency determinants in transition countries using DEA were studied by Grigorian & Manole (2002). The study concluded that the bank efficiency is positively related to factors such as foreign ownership in the bank, bank capitalization, market share and GDP. Contrary to this, Casu & Molyneux (2003) didn't discover any significant impact of a bank's capitalization on its efficiency for the European banks for the time period 1993-1997. The study, however, established a positive relationship between efficiency and profitability of banks.

Pasiouras et al. (2007) researched the efficiency scores and efficiency determinants of cooperative banks in Greece using DEA approach. The study reported the Greek banks to have an average score of 82% for efficiency. A positive relationship of efficiency with bank size was reported, whereas the bank efficiency was reported to have a negative relationship with GDP and unemployment rates. Based on the efficiency measure used, bank capitalization, number of ATMs, bank branches' total number were found to effect the bank efficiency differently.

Nigmonov (2010) employed two models of DEA to analyse the efficiency of Uzbekistan banks for the time-period 2004-2006 and reported the significant impact of ownership, size and age of a bank on its efficiency. Naceur et al. (2009) employed a two-step approach for the analysis of efficiency of banks in MENA countries i.e. efficiency estimation using DEA in the first stage and exploration of determinants of efficiency in the second stage using Tobit regression analysis method. The research study reported an average efficiency score of 67% for the sample banks in the MENA countries. The study also reported a positive relationship of bank efficiency with bank capitalization, liquidity levels and developments in the stock market and a negative relationship with market concentration and credit levels.

Bader et al. (2008) conducted research to estimate and contrast three different types of efficiencies i.e. cost, profit and revenue for 43 Islamic banks and 37 conventional banks for the time period 1990-2005. The study also determined the impact of different factors affecting the three types of efficiencies mentioned above. The study reported the sample banks to have higher scores for cost efficiency as compared to profit and revenue efficiencies. The study confirmed that banks larger in size had high scores for all three types of efficiencies than smaller banks. The study also discovered the positive impact of age of a bank on its cost efficiency and negative impact on its profit efficiency.

Tecles & Tabak (2010) analysed and explored different determinants of cost as well as profit efficiency of 156 Brazilian banks for the time-period 2000-2007. The efficiency scores were estimated using SFA in the study using labour, capital and bought funds as inputs, whereas the outputs used were investments, deposits and total liabilities. The determinants of efficiency researched in the study were NPLs, equity/assets ratio, bank ownership and share of bank loans in the market. The study reported average scores of 66% and 75% for cost and profit efficiencies respectively for the sample Brazilian banks. Based on their ownership, the sample Brazilian banks were ranked on the basis of their cost efficiency as follows:

Public Banks (0.73) >Public Banks (0.71) >Foreign Banks (0.53)

Profit efficiency, on the contrary, demonstrated the following results:

Foreign Banks (0.79) > Private Banks (0.73) > Domestic Banks (0.70)

The research study confirmed no relationship between a bank’s cost and profit efficiencies. Further to this, bank size was found to be related positively to its cost as well as profit efficiency.

Daley & Mathews (2009) made use of DEA to estimate scores of technical efficiency for Jamaican banks for the time-period 1998-2007. Technical efficiency was found to be positively related to Jamaica’s GDP growth and negatively associated with size of a bank and its cost/income in the research paper. Fiorentino et al. (2006) measured cost efficiency of banks in Germany making a combined use of DEA and SFA. The inputs and outputs used in the parametric methods were determined using the intermediation approach. Labour, total fixed assets, borrowed funds were used as inputs, whereas customers' loans and investments in bonds and stocks were considered as outputs in the study. The study confirmed that SFA and DEA are not co-related and SFA approach resulted in higher scores for cost efficiency as compared to DEA.

Cadet (2008) researched the impact of bank ownership, and bank size on cost and profit efficiency of 12 banks in Haiti. SFA was employed to estimate the efficiency scores. Labour, total funds and capital were used as inputs, whereas the outputs used were net loans, total deposits and bills. The cost efficiency scores estimated in the research study were found to be higher for foreign banks in comparison to domestic banks. On the other hand, domestic banks demonstrated higher profit efficiency than the foreign banks. The study demonstrated unclear results on relationship between bank age and its efficiency.

Kalluru & Bhat (2009) measured the scores of cost efficiency scores for Indian commercial banks for the time-period 1992-2006 using SFA and studied the impact of bank diversification, non-interest activities, banks' earning capacity, time period on bank efficiency using Tobit Regression analysis. The cost efficiency of sample commercial banks in India was reported to decrease over the time period from 1992 to 2006. The study found a positive relationship of banks' cost efficiency with bank diversification, non-interest activities and banks' earning capacity.

Srairi (2010) estimated the cost and profit efficiency scores of banks in 71 Gulf countries for the time-period 1999-2007 using SFA. The research study employed the intermediation approach to determine the inputs and outputs of the banking activity. Labour, capital and total funds were used as inputs, whereas net loans and total other income based assets were used as outputs. The sample banks were reportedly found to be more profit efficient and less cost efficient. The study also reported that most of the factors effecting the banks' efficiency are bank-specific. The study further analysed the impact of different micro and macro determinants on the efficiency of banks such as capital adequacy[1] , bank size, loan/asset ratio, cost/income ratio, bank concentration, ROAA, operational expenses and credit risk. Capital adequacy of banks, loan/asset ratio[2] and ROAA were found to be positively associated with profit efficiency of banks. On the other hand, profit efficiency was reported to be negatively related to cost/income[3] ratio. The study further confirmed the significant positive impact of capital adequacy, size of banks and ROAA; and a significant negative impact of loan/asset [4] ratio and cost/income ratio on cost efficiency of banks.

Wu et al. (2008) investigated the profitability and operational efficiency of Hong Kong banks for the time-period 2004-2006 using a two-step DEA method. The DEA efficiency scores of the banks were calculated following the intermediation approach. The inputs employed in the first stage and second stage were deposits and loans; and total other income and interest income respectively. Similarly, total other income and interest income; and income before tax and total of assets were used as outputs in the first and second stage of DEA respectively. The study investigated the effect of bank size on its operational efficiency and demonstrated a significant positive relationship between the two, indicating that larger banks are more efficient as compared to smaller banks.

Frimpong (2010) analysed the relative efficiency scores of banks in Ghana in the year 2007 using the non-parametric method DEA. The research study also studied the correlation between a bank's profitability and its cost efficiency. The inputs and outputs used to calculate the efficiency scores in DEA were determined with the help of the Intermediation approach, where total deposits and total expenses were used as inputs and the outputs utilised in the method were total advances and investments. The study also researched the association between bank ownership and its efficiency.

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[1] Banks, which are well-capitalised are found to be more cost and profit efficient than banks which are not well capitalised

[2] Higher is the value of loan/asset ratio, higher is the risk taken by the bank, higher is the profit efficiency assumed from risk-return hypothesis.

[3] Lower is the value of cost/income, higher is the profit efficiency of banks

[4] Higher is the value of loan/asset ratio, higher are the bank expenses and thus, lower is the cost efficiency of banks

The results of the research indicated the ranking of banks based on their cost efficiency scores as follows:

Domestic banks>Foreign banks>State banks

Pasiouras (2008) estimated the technical and scale efficiency scores for banks in Greece using the non-parametric method DEA in the first stage. After this in the second stage, the study then determined the impact of market share, ROAA, capital/asset ratio, loan/asset ratio, total number of bank ATMs, total number of bank branches on technical and scale efficiencies using Tobit regression analysis method. The explanatory variables market share, ROAA, loan/asset ratio and total number of bank branches were found to be significantly and positively related to efficiency of sample banks in the research study. A similar study was conducted by Rangan et al. (1988) for 215 banks in the US, which confirmed a positive impact of bank size and a negative impact of bank diversity on its efficiency.

The finding of a positive correlation between bank size[5] and its efficiency was also confirmed by Miller & Noulas (1996) for 201 banks for the time-period 1984-1990. The study used DEA to calculate the relative, pure technical and scale efficiency scores for the sample banks in the first step. In the second step, the research paper analysed the impact of explanatory variables bank size, bank profitability[6], market power [7] and the bank location on bank efficiency. The study indicated that the profitable banks are also the efficient banks.

The DEA method was also used by Assaf et al. (2011) for the estimation of scores of technical efficiency of 9 Saudi banks for the time-period 1999-2007. The inputs and outputs used in the DEA model were confirmed with the help of the intermediation approach. Total number of assets, deposits and number of employees were used as inputs and; securities, loans granted to customers and interbank loans were used as outputs in the model. The paper further studied the impact of bank size, bank liquidity, bank ownership, net-profit margin and pay-out ratio on bank efficiency. The study revealed that size of a bank is positively associated with its

[5] Bank size, here, is calculated by calculating the total number of assets a bank has
[6] Profitability = net operating income/total assets
[7] Market power = Bank deposits/total market deposits

technical efficiency. A significant negative relationship of efficiency with net-profit margin and pay-out ratio was also confirmed in the research study.

Gardener et al. (2011) explored the efficiency of banks in 5 countries8 in the South-East Asia. The study employed input oriented DEA approach to estimate the efficiency scores of sample banks. The study further studied the impact of bank size, ROA before tax, equity/asset ratio, bank regulation, GDP and bank ownership on efficiency of banks. Bank size was found to be negatively and GDP was found to be strongly and positively related to bank efficiency in the research paper. The study further confirmed the State banks to be more efficient as compared to private banks.

The cost and profit efficiencies of banks in India for the post reformation period were estimated and analysed by Ray & Das (2010). The study employed the intermediation approach to identify the inputs and outputs of the DEA model. The inputs considered in the model were borrowings, employees' number, fixed assets and total equity. Investments, loans and non-interest income were used as outputs in the research. The study analysed the effect of bank ownership, size of a bank and product diversity on efficiency of banks. Bank ownership was found to have stronger impact on bank efficiency as compared to bank size and product diversity in the study. The study also confirmed the State banks to be more efficient as compared to private banks in India.

Das & Ghosh (2009) also made use of a two-stage DEA approach to estimate the cost as well as profit efficiencies of banks in India and to study the relationship of efficiency with deregulation, ROA, ROE, bank size, bank capital and bank concentration. The results obtained in the research study indicated that banks in India are more efficient on the cost side than the revenue side, which means that most of the inefficiencies are on the banks' profit side. The state owned banks of India were again found to be have higher efficiency than the privately owned banks. The research further confirmed a strong and positive impact of ROA, ROE, size, capital and concentration on the profit efficiency scores of banks.

The use of parametric approach can be seen in Maudos et al. (2002) for the estimation and analysis of cost and profit efficiency scores of 879 banks in the Europe for the time-period 1991-1996. The inputs and outputs of the model were again defined by the intermediation approach, where bank loans and other income were used as inputs; and deposits as outputs. Like previous studies, the study also demonstrated the sample European banks to have higher scores of cost efficiency as compared to profit efficiency. Cost and profit efficiencies were found to be strongly and negatively related to each other. A surprising result of the research was a positive association of banks' cost efficiency with per unit cost of assets. The study further showed positive relationship of profit efficiency with ROAA, but a strong negative relationship with per unit cost of assets.

Another study focused on the exploration of banks' cost and profit efficiency is Olson & Zoubi (2011), which is based on banks in MENA8 countries for the time-period 2000-2008. The paper is based on the comparison between the accounting measures of bank profitability and efficiency. Similar to previous researches, the study again confirmed the bank inefficiencies to lie more on the revenue side in comparison to the cost side. The sample banks in the MENA countries were found to have an average cost efficiency score of 70%-73% and an average profit efficiency score of 63%. The study further analysed the impact of independent variables ROA, ROE, net loans/total assets ratio, capital, inflation on the dependent variable i.e. profitability of banks. A positive relationship between the dependent and independent variables was confirmed in the research paper. The study also demonstrated a negative relationship of bank profitability with government ownership and total cost/total assets ratio and; a negative correlation of cost efficiency with profit efficiency, ROA and ROE.

In contrary to above discussed research papers in the literature, which have used DEA for efficiency estimations, Abdmoulah & Laabas (2012) made use of SFA for examining the cost, technical as well as allocative efficiencies of Kuwait's commercial banks for the time-period 1994-2009 and to analyse the impact of different policies of the labour market on the efficiency of banks. The inputs (total deposits, labour cost and non-current assets) and outputs (total earnings, investments and liabilities) used for the calculation of efficiency scores were determined by the intermediation approach. The Kuwaiti commercial banks were found to have

8 5 countries included Indonesia, Malaysia, Philippines, Vietnam & Thailand
[8] MENA stands for Middle East and North Africa

average scores of 79%, 95% and 81% for the overall, allocative and technical efficiencies respectively. Unlike above discussed literature research, no relationship was discovered between bank efficiency and bank size in the research.

Paul & Jreisat (2012) analysed the cost efficiency of 17 Jordanian banks for the timeperiod 1996-2007 using the input oriented DEA model. The inputs (labour cost and total deposits) and the outputs (investments and total loans) used in the model were determined using the intermediation approach. The study reported the sample Jordanian banks to possess average cost, technical and allocative efficiency scores of 74%, 81% and 90% respectively. The research further confirmed bank efficiency to be positively associated with its size.

Another study based on bank efficiency in Jordan is Al-Jarrah (2007), which explored the cost efficiency of banks operating in four different different countries, which are Jordan, Bahrain, Egypt and Saudi Arabia for the time-period 1992-2000. The scores of technical, cost and allocative efficiencies for sample banks were estimated using DEA. Labour, capital and total deposits were used as inputs and; total other income generating assets and off-balance sheet activities were used as outputs. The inputs and outputs in the research were determined using the intermediation approach. The research paper reported the average cost efficiency of sample banks to lie between 50% and 70%. The study also investigated the effect of size and location on bank efficiency. The study demonstrated a positive effect of size on efficiency of sample banks. Further to this, the Saudi Arabian banks ranked the highest, while Jordanian banks scored the lowest in terms of efficiency scores.

The efficiency of banks and efficiency determinants in Jordan were also researched by Ajlouni et al. (2011) for the time-period 2005-2008. The sample banks of Jordan were found to have high and steady scores of efficiency for the sample research time-period in the research study. The study further demonstrated a negative influence of a bank's capital adequacy and positive influence of bank size on its efficiency.

An example of a research paper based on the efficiency analysis of banks in China is Chen et al. (2005), which is based on the estimation of cost, technical and allocative efficiency scores of 14 banks in China using the intermediation approach oriented DEA model. The study found out that the banks in China are inefficient more on the allocative efficiency side than the cost and technical efficiency side. The paper further studied the impact of ownership, deregulation and bank size on the efficiency of banks. The banks owned by the government appeared to have higher scores for technical efficiency as compared to privately owned banks. The study further depicted that the cost and allocative efficiency scores of sample Chinese banks improved significantly after the period of deregulation, whereas the technical efficiency showed only a slight improvement. With regards to bank size, larger and small state banks were found to be more efficient in comparison to medium sized state banks.

Sufian & Noor (2009) evaluated 37 Islamic banks's efficiecny based in MENA and Asian countries for the time-period 2001-2006 using a two stage DEA method, where the technical and scale efficiency scores were calculated using the intermediation approach based DEA model in the first stage and Tobit regression method was used in the second stage to find how efficiency is related to independent explanatory factors loan intensity, bank size, bank capitalization9, preferred expense behavior10 of the bank, profitability, market share and loan loss reserves/total loans ratio. The efficiency scores obtained in the first stage indicated the Islamic banks in the MENA countries to be technically more efficient than the Islamic banks operating in Asian countries over the sample data time-period. The study also indicated the inefficiency to lie more on the technical side than the scale side for both the MENA as well as the Asian countries. Further to this, the research paper confirmed that bank efficiency for the sample data banks for the given time-period is positively related to loan intensity, bank size, bank capitalization and preferred expense behaviour of the bank; and is negatively related to bank profitability, market share and loan loss reserves/total loans ratio.

A combined use of DEA and SFA can be seen in Yildirim & Philippatos (2002), which is based on the examination of cost and profit efficiencies of banks in 12 transition economies based in the central and Eastern Europe for the time-period 1993-2000. The scores of cost efficiency obtained by DEA were lower as compared to the ones calculated using SFA. The inefficiencies were found to lie more on the

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[9] Bank capitalization here is measured by the ratio equity/assets

[10] The preferred expense behaviour of the bank can be estimated by calculating the rationon-interest expense/total assets

revenue side than the cost side in the study. The research further demonstrated a positive impact of bank size and bank's capital strength on its efficiency. Competition in the market and bank concentration were found to influence the efficiency of sample banks negatively.

These research studies discussed above and many others like this have made use of a two-step approach to evaluate the efficiency and explore determinants of efficiency. In the first stage, DEA method is employed to obtain the efficiency scores and in the second stage, the determinants of efficiency are explored by conducting a regression analysis between efficiency and the independent explanatory variables. Researchers have used different formats of regression models, for instance Tobit by Haunters (2005), OLS (Ordinary Least Squares) by Ataullah and Lee (2006), GLS (Generalized Least Squares) by Isik and Hassan (2003) etc. Tobit is used based on the rationale of efficiency scores lying between 0 and 1 only.

2.3. The impact of financial crisis on the efficiency and profitability of banks

In the development of financial market, the events of financial crisis are inevitable and play a very undesirable part. According to Dalaien (2016), many studies in the literature have attempted to deal with the reasons and events which caused the global financial crisis and proposed solutions to prevent it in future and treat the after-crisis situations. Das et al. (2012) states that most of the crisis own a common feature of a gap between an institution's capacity to bear risks and explore greater returns. According to Goudarzi and Ramanaryanan (2011), any crisis in a developed market doesn't just influence the country of its origin, but has impacts on the overall global economy.

The event of global financial crisis initiated in 2007 in the USA, the root cause of which was reported as the contraction of credits in the banking industry resulted as a consequence of few leniencies in the financial system of the US. This situation of financial crisis later got spread to the Europe and became a phenomenon at a global level. (Ojeaga, 2009)

The research conducted by Claessens and Horen (2014) concluded the practice effects to be not very straightforward and this in turn, boosted the worldwide risk taking, lowered the volatility of utilization and cultivated the financial growth in the economy. Ashamu and Abiola (2012) studied the impact of financial crisis on the banking sector of Nigeria and concluded that one of the main reasons behind the financial crisis is the disintegration of the analogy of free market dynamism. They further state that there are high chances of global financial crisis escalating into uncontrollable proportions for the banking sector dominated financial system.

According to Bajwa (2012), the big depression of 1930s is extensively acceded by the recent financial crisis initiated in the US. Celikkol et al. (2010) and Chaudhary (2011) investigated the causes of financial crisis and discovered that the crumbling of the market of sub-prime mortgage in 2007 in the US initiated the global financial crisis. Various other catastrophes in the financial market such as disintegration of AIG, Lehman Brothers, Fannie Mae, Merril Lynch etc. followed the mortgage market failure and as a consequence, a credit crunch at a global scale originated in full bloom from this liquidity crisis. As pointed out by Bordo (2008), within few months of the start of the crisis in the US, many countries across the globe got overwhelmed by this crash in the stock market and as Indian economy is also interconnected with the rest of the world, it couldn't keep itself confined from this global financial crisis. Sinha (2012) demonstrated the influence of financial crisis on the overall performance of businesses in the financial sector in India such as the banking industry, real estate sector, stock market and so forth.

Maiwada (2013) and Batrancea et al., (2014), in their attempt to pinpoint the main causes of financial crisis, stated that there are various factors responsible for the global financial crisis, some of which comprise of negative opinions of investment, fear and panic in the minds of investors, which led to financial institutions losing a large part of the value of their financial assets and these factors tend to interact with each other when there are sudden and wide scale drops in the value of financial assets. A close financial analysis done by Murphy (2008), in an attempt to find out the causes of financial analysis, stated that the credit default swaps, which in turn exploded upon the mortgage defaults catalytic rises, originated from theoretical modelling created by unfeasible speculations, were among the prime factors responsible for initiating the crisis.

The impact of the global financial crisis can be observed in numerous areas in different business sectors and industries, both in developing and developed economies to different extents and among those, banking industry has been the most sensitive and vulnerable, which can be observed from its size and quality of its activities in the post-crisis period. (Dalaien, 2016).

There are numerous research studies which have analysed the impact of global financial crisis on the performance of organizations in different industries, and the focus of this study is more on the banking sector. One of the research studies to study the influence of global financial crisis on the globalisation of banking sector is Claessens and Horen (2014). Based on this research study, the global banking sector is going through transformations in terms of its structure and instead of getting more fragmented, it is rather more focused regionally and involves a great variety of key players in the industry. Maiwada (2013) examined the impact of global financial crisis on the share price and capital adequacy of banks in Nigeria and found out that the average share price was the lowest during the crisis period.

Another study to study the impact of financial crisis on the banking system of Nigeria is Ashamu and Abiola (2012). The research revealed that the financial crisis caused a significant depression in the capital market, lowered bank credit quality provided by banks for trading in the capital market, increased provisions for the loan losses, slowed down growth in banks' balance sheets resulted as a response to the crisis, increased provisions causing reduced profitability levels. Accoding to Teglio et al. (2011), (which is based on the study of impact of financial crisis on Earache artificial economy and focused on the Eurace model of crisis related to the essence of endogenous money), real economic variables such as GDP, rate of unemployment and comprehensive capital stock has non-trivial dependency on the adequacy ratio of banks. This dependence exists due to the availability of different channels of credit and changes based on the selected horizon of evaluation.

Jack (2011), on the other hand, investigated the impact of financial crisis on the banking sector of low income Asian economies by examining the main channels of viable spill over exposures to crisis, which are: the changes in the financial valuation of assets from one market to another, lowered funding across borders and finally the rise in non-performing loans of banks induced by international economic interconnections. The study discovered that the impact of the crisis was more significant on the large banks and was detectable via loan –cross border funding nexus despite comparatively low economic integration.

Al-Tayeb (2011) made use of descriptive methodology to study the impact of financial crisis on Jordon's various financial and economic industries and concluded the impact of the crisis to be less on the Jordanian economy and more on other economies in the region and the outer world. The efforts made by the central bank of Jordan, before and during the crisis had a great contribution in maintaining its financial stability in terms of guaranteeing the interest rates consistent to the magnitude of the lucrative activities, provision of a sound financial system, maintenance of a strong banking organisation and insurance of deposits of citizens of Jordan without any limits.

A positive impact of global financial crisis was reported on the profitability of commercial banks of Saudi by Al-Musali & Ismail (2014) and; commercial as well as investment banks of America by Apergis (2014). In contrary to this, Haan & Poghosyan (2012) reported an adverse effect of the financial crisis on the performance of commercial as well as cooperative banks of America. According to Dietrich & Wanzenried (2014), there was a huge decrease in net interest margins and thus, huge increment in costs/expenses as a consequence of the crisis, which resulted in negative influence on the profitability of banks.

In general, most of the research studies have reported a negative impact of the global financial crisis on the performance of banks. Examples include: Sufian and Habibullah (2010) for Indonesian banks, Dietrich & Wanzenried (2011) for 372 commercial banks in Switzerland for the time-period 1999-2009, Acharya, Agarwal & Kulkarni (2012), Eichengreen & Gupta (2012) and; Dalaien (2016). According to Eichengreen and Gupta (2012), initially the Indian banks were viewed as noneffected from the global event of financial crisis because of huge public ownership and conventional management. To the contrary, the bank analysts noticed a rapid rise in the borrowing/lending rates between banks, lowered deposits and credits and thus, lowered returns as an outcome since mid 2008s.

In terms of efficiency of banks in India, Sinha & Khan (2014) reported that the global financial turmoil couldn't effect the performance of Indian banking sector and it continued performing efficiently in contrary to the negative impact of the crisis on most of the businesses around the world and the possible reason for the same was suggested as the strong base, timely stringent measures and a good governance structure managed by the Central Bank of India i.e. Reserve Bank of India (RBI).

Deb (2019) found out that there was no to little impact of financial crisis on the performance of Indian banks and the steady performance of Indian banks achieved during the crisis was attributed to the strong policies and measures in place to combat such situations. Similar results were obtained by Sufian (2009), where the Malaysian banks exhibited higher technical efficiency in the post-crisis period as compared to the pre-crisis period.

On the other hand, a negative impact of financial crisis was reported on the performance of Indonesian banks by Sufian & Habibullah (2010). Maredza & Ikhide (2013) concluded the event of financial crisis as one of the main determinants of efficiency of banks in South Africa for the time-period 2000-2010 and recorded a significant decreases of 16.96% in the efficiency of banks after the event of global financial crisis. Similar results were obtained by Mabwe & Web (2010), where a significant decline was recorded in profitability, liquidity and credit quality of top five banks in South Africa after the global financial crisis for the time period 20072009, but as the banking system in South Africa was well capitalised, the banks in South Africa remained stable during and after the crisis despite the decrease in profitability, liquidity and credit quality.

Singh et al. (2017) examined the impact of global financial crisis on the efficiency of 49 Arab banks employing DEA and a decline of 1.28% was observed during the financial crisis i.e. 2007-2010, but it increased significantly by 20.19% after the crisis during the time period 2011-2014 and the reason of this decline and then the increase afterwards was attributed to the interest expense in the research.

Very important effects of financial crisis were identified by Alnajjar et al. (2010). The study focused on the financial institutions listed on the Amman Stock Exchange and conducted a compendious survey of all the organizations and announced the severe diversification of financial services and the sequential decline in Jordan's financial sector after the financial crisis, with a sharp rise in their performance at the start of 2008 and the performance declining at the most alarming rate with the onset of Global Financial Crisis after that.

According to Dalaien (2016), financial globalisation caused the banking environment to change significantly in terms of expansion of the scope, space, circle and overall development, both internally as well as externally, and was reflected via the increment in the overall banking risk and was clearly evident from the balance sheets of banks. The main source of the banks' income wasn't just limited to credits and deposits, but expanded to so many other assets and banking activities and as a consequence the restructuring of the banking industry represented the entry of businesses which did not belong to the industry, for instance insurance companies posed biggest competition to commercial banks.

Studies such as Acharya, Agarwal and Kulkarni (2012), Eichengreen and Gupta (2012) and; Dalaien (2016) studied the impact of Global Financial Crisis on the performance of Indian banks. According to Eichengreen and Gupta (2012), initially the Indian banks were viewed as non-effected from the global event of financial crisis because of huge public ownership and conventional management. To the contrary, the bank analysts noticed a rapid rise in the borrowing/lending rates between banks and deposit volition since mid 2008s. The study further stated the decrease in the growth rate of deposits, particularly for private banks. The public banks, too, didn't continue with their superior performance for long, and observed a decline in the growth rate of their deposits and credits, lowered returns and heightened provisioning after 2010. This research project will study the impact of financial crisis on the profitability and efficiency of of Indian commercial banks, the relationship between profitability and efficiency of banks and the relationship of bank profitability with its micro and macro determinants in the pre and post crisis periods. In line with Eichengreen and Gupta (2012), the time period of 2002-2007 will be treated as the pre-crisis period and 2008-2017 as the post-crisis period, where the data for the year 2002 for example represents the fiscal year 2001-2002 (April 1, 2001-March 31, 2002).

2.4. Relationship between efficiency and profitability

Profitability is the estimation of the degree to which a firm earns profit or financial gains from the different production factors and portrays the relationship between incomings (revenue) and outgoings (expenses). On the other hand, efficiency focuses on the extent of the efficacious utilization of production factors and refers to the use of minimum possible inputs to produce the given outputs or using the given inputs to produce the maximum possible outputs.

In the literature, a very few research studies can be found which have tested the relationship between profitability and efficiency of firms. In general, a common assumption is that the better and efficient use of a firm's resources will lead to higher profits and thus, a better performance. However, mixed results can be found in the literature regarding the same.

Palečková (2016) tested the relationship between profitability and efficiency for the

Czech Commercial Banking sector for the time period 2004-2014, where ROA (Return on Assets) and ROE (Return on Equity) were used as indicators of profitability and efficiency of banks were measured using the slack-based, Variable Returns to Scale (VRS) DEA model and; the research paper confirmed that there exists no relationship between profitability and efficiency of Czech commercial banks. Similar results were also confirmed by Keramidou et al. (2013) for the Greek meat producing companies for the time period 1994-2007, which stated that the companies with the maximum efficiency of production aren't always capable of generating the maximum profits and long term survival of firms require the adoption of profit-enhancement strategies and; Shieh (2012) for 68 international hotels in Taiwan for the time period 1997-2006.

Košak & Zajc (2006) studied the profitability (measured by ROA and ROE) and efficiency of new member countries of the European Union (EU) and demonstrated a positive relationship between the two performance parameters. Tahtamouni et al. (2020) studied the relationhip of ROA and ROE with Pure technical efficiency (PTE) and Relative Technical Efficiency (RTE) of 13 commercial banks of Jordan for the time period 2010-2017 and demonstrated a positive relationship between the two. Similar findings were confirmed by Kosmidou et al. (2008) for commercial banks of the UK (United Kingdom) by demonstrating a positive relationship between profitability and efficiency in the management of expenses, Afsharian et al. (2011) for European publicly traded banks and Sharma (2018) for finding a significant relationship between operational efficiency and market performance of Indian banks. On the other hand, a negative relationship between efficiency and profitability (ROA) were confirmed by studies such as Palečková (2015) for banking industry of Czech Republic and; Kosmidou (2008), Pasiouras et al., (2006) for banks in Australia, Greece and Malaysia.

2.5. Efficiency and profitability of commercial banks in the Indian banking sector

This research project aims to investigate the efficiency and profitability of commercial banks of India in the pre and post crisis period. The Indian banking sector can be broadly classified into two main categories i.e. i. commercial banks and, ii. Co-operative banks. Out of these two categories, commercial banks amount for approximately 98% assets of the whole banking system in India. These commercial banks can be further classified into public sector banks, private sector banks and foreign banks. The Indian banking sector is mainly dominated by public sector banks with more than 80% of the total assets in the commercial banking system.

The Indian banking system has undergone a huge structural transformation after the introduction of regulatory and supervisory reforms in 1991. The Indian banking system was characterised as generously liberal with limited interest rates' and funds' pre-emption in 1950s. However, there was huge growth in misgivings with regards to the efficient allocation of resources in markets after the concerning investigations of All India Rural Credit Survey committee (RBI, 1954) related to unbalanced dispensation of credits issued by banks and the government responded by tightening the rules related to the acceptable credit allocation so as to facilitate credit flow towards projects which are genuinely productive in line with the priorities of the plan. Following the nationalisation of 14 banks in 1969 and 6 banks in 1980, regulations were introduced in the Indian banking sector related to the maintenance of adequate liquidity levels, lending rates to be imposed by banks and an overall banking development system serving agricultural field as well as different section of the banking industry.

Following these regulations, several other restrictions on how banks could carry out their operations were introduced. In the course of 1991, the cash reserve ratio (CRR) requirements for banks were increased to the highest level of 15% and the statutory liquidity ratio (SLR) was at maximum level of 38.5%. Banks had only a circumscribed connection with other financial markets. There were strict regulations in place related to interest rates of banks and the banking sector wasn't very competitive as the barriers of entry for new private banks were very high.

In order to improve the Indian banking sector in terms of its profitability, efficiency, resilience and diversification, the government started to liberalise the financial sector in India in 1991-1992. The main motive of initiating this liberalisation was to develop a more market orientation approach in the Indian banking, which in turn, implied shifting the RBI role from governance at micro level to macro level. The introduction of these reforms coincided with the implementation of changes in the global markets to achieve integration in the financial sector. The reforms in the Indian banking system in the current era are a blueprint of the banking sector regulations developed by the second committee appointed by the government i.e. Narasimham committee II. The important developments observed in the Indian banking system over time have been discussed below:

By year ending March 31, 2003, the CRR requirements have been lowered down to 4.75% and SLR to 25%

On the bases of predominant market forces, banks have the liberty to select their own rates for deposits and lending and thus, the interest rates' regulations have been dismantled.

The entry barriers for foreign and new private banks have been lowered allowing the banking sector to be more competitive.

Stipulation of micro avaricious policies with regards to regulations related to maintenance of minimum levels of capital adequacy, classification of assets, identification of income, regulations for loans, accounting and exposure etc.

(Bhide et al., 2002)

Before the introduction of reforms in 1991-1992, the public sector banks were fully government owned, however, these banks have been allowed to raise capital from the general public by up to 49% after the introduction of these reforms. According to Ahluwalia (2002), the highlighted element of the 1991-1992 reforms was their ‘gradualism’ which resulted from the democracy and pluralistic sovereignty in India, where the implementation of regulations can only happen in case of majority votes.

After the introduction of 1991-1992 banking reforms in the Indian banking sector, the five asset concentration ratio decreased from 0.51 to 0.44 in 1996, 0.41 in 2002 and there was a significant increase in the number of private and foreign banks operating in the Indian banking industry, which led to heightened competitive pressures. The deregulation resulting from the introduction of reforms led to decrease in both deposit and lending interest rates as well as the interest spread in line with the standards of the international banking system. To conclude, the financial deregulation in the Indian banking sector as a results of financial reforms introduced in 1991-1992 provided the banks the freedom to conduct their operations. In this scenario, it becomes significantly important to investigate the performance of Indian banks due to heightened viability of competitive pressures and ensure improved performance in the future and thus, provides the rationale to conduct this research.

The global financial crisis of 2007-2008, the environment in the financial market post the crisis period and the amendments to regulations and reforms controlling the banking system as a response to the crisis effected the performance of banks across the globe significantly. Responding to the new environments in which the banks operate, they have been amending and re-considering their business models and strategies. Alongside this, most of the banks around the globe have to suffer in terms of low profit levels. The Indian banking system too had to experience significant adverse effects of the crisis in terms of cash of the stock market, depreciation of Indian currency i.e. Rupee, credit flows and liquidity crunch and so forth. To deal with the adverse effects of the crisis, RBI introduced several regulations in the Indian banking system in line with the international laws such as maintenance of minimum level of liquidity and capital adequacy. The amendments to the banks' operational environment in the post-crisis period demand a close and regular monitoring. This research project aims to investigate the ongoing changes in the banking sector and thus, act as a source for detailed future research in the field.

Another important event which had a significant effect on the performance of banks in India was the demonetization policy announced in November 2016 and has been discussed in the following section 2.5.1.

2.5.1. Demonetisation and its impact on performance of Indian banks

According to Maity and Ganguly (2019), demonetisation was introduced in Indian banking to demonetise two higher currencies in November 2016 as an effort to deal with corruption, curb black money and stop fake currency often used for terror activities and the findings of the research study concluded that demonetisation impacted the efficiency scores of banks in India. Another study which researched the reasons and effects of demonetisation in India is Mali (2016). The research concluded that effects of demonetisation include online businesses stopping the cash on delivery option for customers and slowing down of microfinance firms' disbursement scale. Further to this, the study discovered the negative effects of demonetisation on performance of microfinance firms but positive effect on online wallet businesses and concluded the policy to be an effective measure towards controlling black money in the country. According to Chauhan and Kaushik (2017), no significant effects of demonetisation was observed on the performance of stock market in India. Kulkarni and Singhal (2018) researched the effect of demonetisation on society, economy, different industries and different firms operating in those industries and concluded that there were losses to be faced due to demonetisation, however those losses were short term in nature, while the benefits of the policies will last for the longer term.

Solanki and Tank (2018) conducted a research study to compare the performance indices based on different sector in the pre and post demonetisation periods and didn’t discover any difference between the two. In their research, Ramdurg and Basavaraj (2016) has concluded that demonetisation was announced in India for the third time in November, 2016 to achieve multiple objectives and has also been introduced in countries such as Nigeria, Ghana, Australia, Zimbabwe and so forth to deal with issues such as fake currency, black money, over-inflation etc. The study also investigated the advantages and disadvantages of demonetisation and concluded that though it has many pros, nations should avoid to repeat it. According to Maity and Ganguly (2019), there isn’t any empirical conclusive research study in the literature which has compared the efficiency of banks in the pre and post demonetisation eras.

2.6. Summary of the chapter

To summarise, this chapter highlighted different techniques which can be used to measure the performance of organisations, specifically banks. Some of the main methods which have been and are employed by researchers, scholars and technicians include ratio analysis, profitability, Balance Scorecard approach, and efficiency measures using parametric and non-parametric techniques. Though financial ratios specifically have been viewed as one of the easiest, simplest and a user friendly method for the computation and analysis of organisational efficiency, yet they have proved to be inadequate in the measurement of efficiency of banks as they are unable in handling the banks’ multiple input and output variables. Academicians and scholars’ shift towards the frontier methods can be clearly felt to overcome these limitations of ratio analysis.

There are two types of frontier methods i.e. parametric and non-parametric. Parametric methods are considered to be more useful while dealing with large sample sizes, whereas non-parametric methods are considered more useful for small sample data sizes. The chapter analysed different research studies in the literature based on the profitability and efficiency of banks based in different countries. The chapter also examined the research studies based on the determinants of bank profitability and efficiency in different countries, from which it can be concluded that the factors which have impact on the performance and efficiency of banks are not same in all the countries and vary from one country to another.

From the review of the literature, it has also been analysed that research studies have used one or the other method to analyse the performance of banks. The use of one performance dimension to explain the other has also been observed in the literature. Examples include Sinha & Sharma (2016), Ranajee (2018), Wasiuzzaman & Tramizi (2010), Tan & Floros (2012) to name a few. The researcher has also observed that some of the research papers in the literature (for instance, Alharthi, 2016) have tried to impose a relationship between the two dimensions of performance (i.e. profitability and efficiency) by regressing the two performance measures against the same explanatory variables without actually exploring the two in detail.

Though, the empirical research suggests that there are various micro and macro factors, which impact the performance of banks, but these factors are specific to a country and the experience of banks in one country cannot be extrapolated to banks in another country. Asserting on this finding, this research project titled as 'Efficiency and profitability of Commercial Banks' in the pre and post crisis period: The Case of the Indian Banking Sector' is based on the estimation of profitability (measured using ROE) and technical efficiency scores of commercial banks in India for the time-period 2001-2017 using intermediation approach based DEA method in the first stage. In the second stage, the determinants of profitability of banks in India have been determined using the regression method. The study also analyses the relationship between efficiency and profitability of banks (both calculated using the financial factors) to determine whether better efficiency also leads to higher profitability. Finally, the impact of global financial crisis have been studied on the efficiency and profitability of banks, the relationship between efficiency and profitability and the relationship profitability has with its micro and macro determinants. Based on the literature review, capital adequacy, bank age, bank size, market share, liquidity, net interest margin and non-performing assets have been chosen as the microeconomic factors and; GDP inflation, exchange rate and real interest rate have been taken as the macroeconomic factors effecting the profitability of banks. The research study is a first of its kind to: i. measure the performance of ICBs using both the profitability as well as efficiency measures ii. Study the impact of both internal as well as external determinants on bank profitability iii. Analyse the relationship between efficiency and profitability of banks iv. Study the effect of different business cycle stages on the above three (i-iii).

Chapter 3

Conceptual Framework

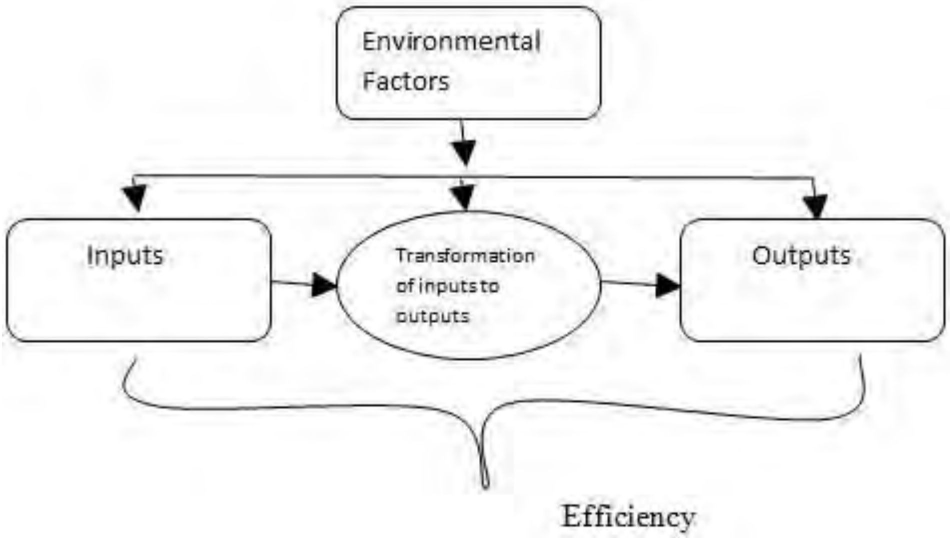
3.1. Introduction

This chapter discusses and presents the conceptual framework for the study on efficiency and profitability of banks, determinants of profitability of banks and finally, the relationship between efficiency and profitability of banks. For the development of the conceptual framework, the previous literature related to banks' profitability and efficiency will be taken into account. The main contents that will be discussed in this chapter are: definition of efficiency and profitability, detailed discussion on concepts of efficiency and profitability, the framework for efficiency of banks, a brief analysis of previous research done on banks' efficiency and profitability, outlining determinants of profitability, different theories in the literature related to the performance assessment of firms followed by concluding remarks.

3.2. The Notion of Efficiency

Farell was the first to discuss the concept of efficiency measurement empirically in 1957 taking inspirations from Koopmans (1951) and Debreu (1951). In general terms, the analysis of efficiency for any product or service means comparing the outputs produced with the inputs utilised in the production of that product or service and can be diagrammatically illustrated as follows:

Figure 3.1. The notion of frequency

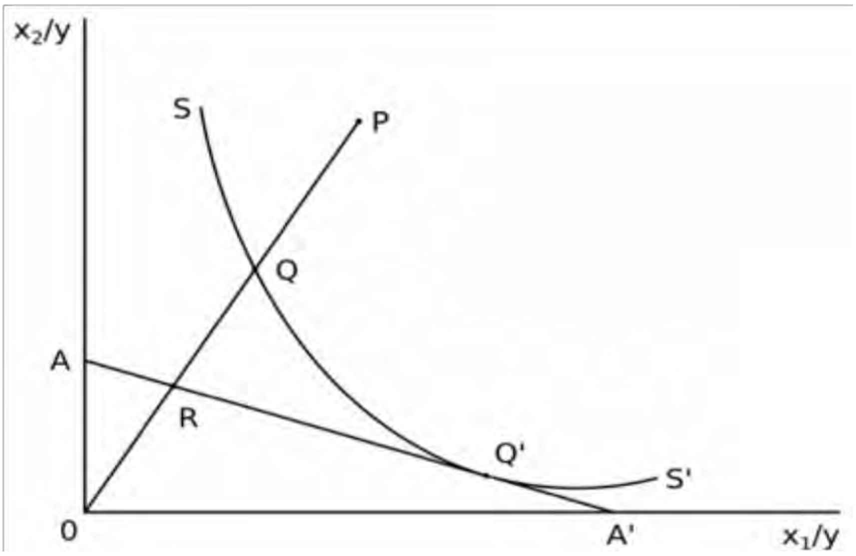


Source: Mokhtar, Alhabshi and Abdullah (2006)

One aspect of an organisation's performance is measurement of its efficiency. According to Mokhtar, Alhabshi and Abdullah (2006), the efficiency measurement can be done with regards to outputs'/profits' maximization and/or inputs/cost minimization. Kumbhakar and Lovell (2003) have classified efficiency into two categories: technical and allocative efficiency. A firm is said to be efficient technically, if it can minimize inputs to be used to produce given outputs or maximize outputs from inputs given, causing the minimum possible waste in the whole process. A firm can be called technically efficient in words of Koopmans (1951), if and only if, the production of more outputs is not possible, without any less production of other outputs or by more usage of some other inputs.

Allocative efficiency, on the other hand, deals with inputs' and outputs' optimal combination for a given price level. It aims for the attainment of high degree of cost, profit or revenue efficiency [out of which cost and profit efficiency are the two most important concepts of economic efficiency according to Berger and Mester (1997)] by producing given outputs using minimum inputs or by maximizing outputs/revenue by utilizing given inputs (Mokhtar, Alhabshi and Abdullah, 2006). Overall economic efficiency, i.e. OE is the combination of technical and allocative efficiency and can be illustrated by the following figure:

Figure 3.2. Allocative efficiency



Source: Coelli et al. (1998)

Looking at the above graph, assuming a firm ABC is involved in the production of an output, assuming it to be y, at a given point P consuming the inputs x1 and x2, then the slope SS' represents the possible inputs' combination used by the firm to produce the output and the slope AA' indicates the input/price ratio and the different inputs' combinations requiring the same expenses. The efficient production and thus, cost minimization is represented by the point Q', i.e. the intersection point of slopes

SS' and AA', which in turn implies that the combinations of inputs at point Q' is efficient, both technically and allocatively. If the business ABC is producing at point P using a combination of inputs, it is technically and allocatively inefficient; technically inefficient, because the production of the same outputs is possible by using fewer inputs by moving to point Q.

Thus, [TE] = OQ/OP = 1-QP/OP

Secondly, the firm is allocatively inefficient, as it is incurring more cost by producing at P than producing at Q' as the the selection of inputs' combination at the given prices is incorrect.

Thus, [AE] = OR/OQ

According to Farell,

Thus, overall efficiency is OE= (OQ/OP) * (OR/OQ)

3.3. Framework for Analysis of Banking Efficiency

The evaluation and analysis of the performance of any firm is not an easy task. The performance evaluation process goes complicated by the number of interactions. The efficiency scores are significantly influenced by a lot of factors, some examples of which include selection of input and output variables, diversions in the modelling technique etc. In order to make the evaluation process reliable, cost efficient, manageable and faster, it is advisable to develop a systematic step by step procedure with clearly defined phases. A standardized process makes the performance assessment easier with minor probabilities of any mistakes. In fact most of the studies handling large and complicated data (for instance data mining), involve a systematic, step by step framework. (Cerrito, 2007)

This research thesis has adopted the non-parametric DEA method for the evaluation and analysis of selected commercial banks in India. This is due to the minimum assumptions required in the DEA model for the estimation of the input-output relationship (Charnes et al., 1985). In case of parametric methods, a particular specification of the frontier is mandatory. As the researcher does not observe the production process, so it is better to adopt the non-parametric method which let the data speak for them.

The DEA framework is based on the technique of linear programming, where the efficiency scores of entities in discussion are estimated relative to the best practices (Charnes et al., 1978). This efficiency assessment model requires researchers to select the inputs and outputs, which will be used in the evaluation process. It might sound a very easy and straightforward task, but the large sums of data makes the process complicated. To handle these complications, this research makes use of a systematic framework of clearly defined steps for the evaluation of large and unfathomed sets of data. By doing so, the research joins the category of previous research studies such as Brown (2006), Hollingsworth (2008), Dyson et al. (2001) etc. Although there are some downfalls of DEA, guidelines and implementation tools have been discussed in a number of precious research papers such as Avkiran (1999), Hollingsworth (2008) etc., this research thesis specifically addresses both the experienced as well as novice analysts.

The framework for analysis and evaluation of selected banks' efficiency has been presented in the form of figure 3.4. The figure 3.4 shows the framework in the form of five steps from P1 to P5. The framework illustrates what is required and what is required to be known in the analysis of banking efficiency. It demonstrates the stages one has to follow for the measurement of efficiency of a business or a business unit.

Step 1, i.e. P1, is about the identification of the objective behind carrying out this research, which is the measurement and examination of technical efficiency of sample data banks. This would allow knowing where the particular bank stands in terms of technical efficiency. Though there is extensive research available in the literature for analysis of efficiency of banks from developed economies such as US and Europe (Pastor, 2002; Varias & Sofianopoulou, 2012; Raphael, 2013; Goddard, Molyneux & Wilson, 2001; Berger & Humphrey, 1997), only limited research has been conducted on banks from emerging economies such as India (Gulati & Kumar, 2011; Gudala & Rao, 2014; Swaroop, 2005; Hussein, 2013; Elzahi and Saaid, 2002).

Step 2 i.e. P2 demonstrates the different types of efficiencies that can be measured and two of the most commonly used ones are: Technical efficiency (TE) and Allocative efficiency (AE). Allocative efficiency can further be categorised into Cost and Profit efficiency. According to Kumbhakar and Lovell (2003), a business is said to be technically efficient if it can produce more outputs from a given set of inputs or if it can produce given set of outputs using less inputs. Also a firm is said to be cost efficient, if it can produce given set of outputs at a lesser cost. And a business is said to be profit efficient if it can maximize profits using the same set of inputs and outputs.

Step 3 i.e. P3 illustrates two commonly used methodologies for efficiency measurement which are; parametric approach and non-parametric approach.

Parametric approach uses econometric techniques, whereas non-parametric approach on the other hand uses linear programming. The difference between these two techniques lies in the way random error is handled in each and also in the assumptions about the efficient frontier shape. Both of these techniques have their own pros and cons.

The advantage of using parametric methods for efficiency measurement is that it allows noise. But, all the three parametric methods i.e. SFA, DFA and TFA cannot estimate allocative efficiency and are unable to deal with multiple inputs-outputs at one time. Also the methods require specification of the functional form for measurement of cost, profit or functional efficiency. (Coelli, 2004)

The non-parametric methods DEA and FDH are simple and easy to calculate as they impose less structural requirements on the frontier but they do not allow random data variations. If random variations occur due to luck or errors in measurements, efficiency gets compounded with the random deviations from the frontier.

Out of 130 researches conducted by Berger & Humphrey (1997), 70 research papers employed non-parametric approaches for efficiency measurement and 60 studies utilised parametric methods. This indicates that both the approaches are equally popular and no approach dominates the other. Emrouznejad et al. (2008) has presented the fact that the use of DEA for performance evaluation has been supported by over 4000 research papers in different industries. There is an opinion difference among different researchers about the preferred frontier method as both types of methods possess their own advantages and disadvantages (Pakistan Research Repository), so the topic lacks mutual agreement. If it is possible to accurately estimate the frontier's functional form and distribution of inefficiencies, then it is feasible to obtain strong results with strong assumptions, but if the required information is unavailable, it is preferred to have minimal assumptions. There is no theory or statistical tests available which allow the parametric methods (i.e. SFA, DFA and TFA) to specify the functional form of frontier or distribution of efficiencies. On the other hand, the assumptions estimated by DEA on functional form of frontier are very flexible. Additionally, DEA can handle multiple inputs and outputs at the same time and it also allows the decomposition of estimated efficiency into allocative, technical and scale efficiencies for individuals DMUs in a straight forward manner (Rickards, 2003).

Either the use of parametric or non-parametric methods can be observed in most of the research studies. The reason behind this can be that these approaches differ completely from one another in terms of the approach used towards the measurement of efficiency. There is limited and rare evidence available in the literature to illustrate the consistency between these two techniques. The robustness of the efficiency results obtained from using these two approaches have been compared by only a limited number of research studies in the literature. Jacobs (2001) compared DEA and SFA methods by measuring the efficiencies in the sector of hospitals and concluded that each method has their own pros and cons and each method measures different aspects of efficiencies. Jaw-Yang Day (2003) studied the link between cost efficiency and diversification levels employing different frontier methods and obtained similar efficiency results with all the methods. Jun-Yen (2005) employed SFA and DEA for the measurement and comparison of efficiencies of 79 different forest and paper firms and concluded that though there existed a slight difference in efficiency scores calculated by these two methods but the relative efficiencies' ranking remained the same. Similar results were obtained by Kiadaliri et al. (2013) in efficiencies' calculation of Iranian hospitals using both DEA and SFA and no difference was observed in the efficiency scores calculated by the two methods. On the contrary, Sav (2012) found out that the efficiencies of public colleges of US calculated by DEA and SFA had a big gap of 11.3 %.

After the determination of type of efficiency to be measured in step P2 and the approach to be used for the measurement of efficiency in P3, the next step i.e. P4 deals with deciding the inputs and outputs which have been employed in the measurements of efficiency scores. There are different approaches available in the literature which can assist managers in choosing the input and output variables which are: production approach, intermediation approach, asset approach, user cost approach; and value added approach (Berger and Humphery, 1992).

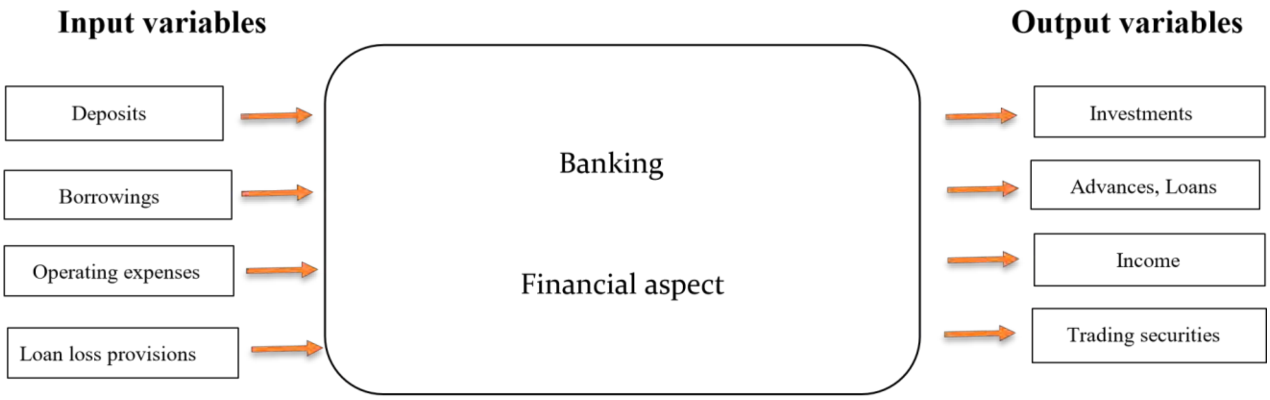
The production approach, introduced by Benston in 1965, emphasizes on banks ' operational activities and views banks as service providers to its customers which use inputs capital and labour to produce loans and deposits as outputs (Campbell, 2001; Livanis, 2004; Lozano-Vivas, 2009). The intermediation approach, on the other side, considers banks as funds' intermediators between investors and depositors. According to Daley and Matthews (2009), banks provide intermediating services by utilizing deposits, liabilities as inputs to produce outputs loans, securities and other investment funds. The asset approach, introduced by Sealey and Lindley (1977), is a modified form of intermediation approach. Unlike intermediation approach, the asset approach is very rigid in terms of choosing inputs and outputs of banking activities. The input variables under this approach are: deposits, liabilities, labour, capital and the outputs produced are assets of the banks.

The user cost approach, introduced by Hancock in 1985, defines the financial products as inputs or outputs based on the percentage share of those products in total revenue. The assets for which the financial returns exceed or the financial liabilities decrease their associated opportunity cost is classified as outputs, whereas if they fail to do so, they fall under the category of inputs. Lastly, the value added approach explains outputs as the assets or liabilities in the balance sheet which are related to value added activities. Under this approach, the outputs consist of deposits (term, savings and demand deposits); loans (commercial loans and mortgages) and the inputs are capital, labour and purchased funds. (Berger and Humphrey, 1992)

Kwan (2002) found out the intermediation approach to be the most widely used approach for the determination of inputs and outputs in the literature related to banking industry. Berger and Humphrey (1997) further adds that as the intermediation approach takes account of interest expense, it is the best method to evaluate the efficiency of entire bank as the interest accounts for about 1/2-2/3 of a bank's total cost. He further recommended the production approach the most suitable option in order to evaluate efficiencies of different branches of a bank. This is due to the fact that the documents of customers are processed by a bank's branches as a whole for the banks.

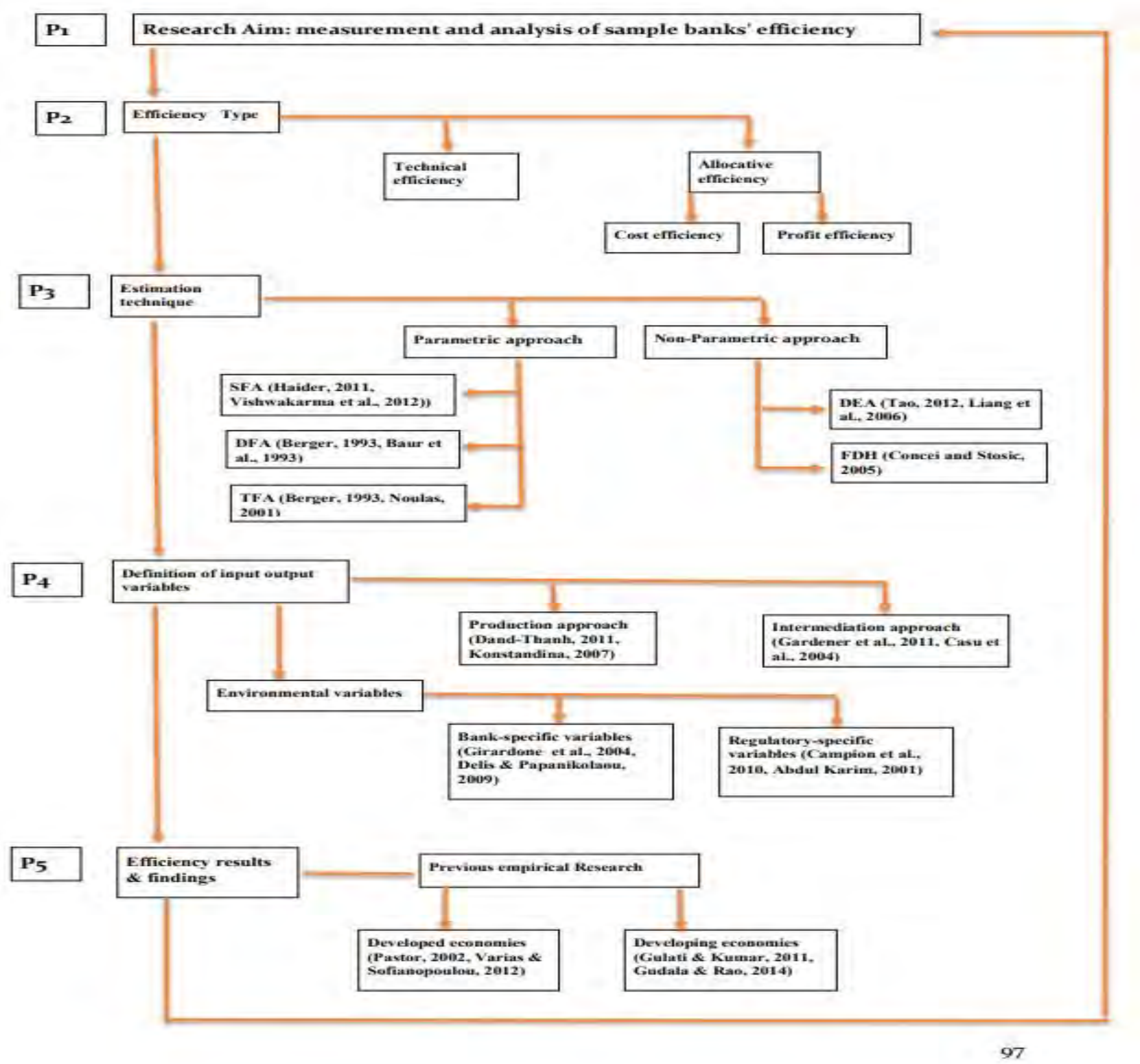
The intermediation approach used to determine the inputs and outputs of banking activity in this research thesis can be illustrated by figure 3.3 presented below:

Figure 3.3. Intermediation approach of banking activity



Source: Kwan (2002)

Figure 3.4. Conceptual framework for analysis of banking efficiency



Source: ALS (1977), Meusen & Van Den Broeck* (1977)

3.4. Different types of efficiencies

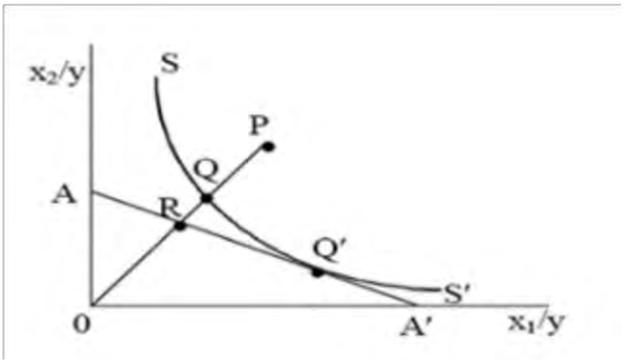
As discussed above, efficiency can further be classified as: technical efficiency, cost efficiency, revenue efficiency and profit efficiency.

3.4.1. Technical Efficiency

The concept of technical efficiency, defined by Farell (1957), has often been considered as a tool for the measurement of firm efficiency, where it was argued that the ability of the firm with respect to the achievement of maximal output with given set of inputs can be reflected through the firm's technical efficiency. This was further elaborated by the author through the use of assumptions based on two inputs (X1 and X2) for the production of Y output, where the production is based on the assumption of Constant Return to Scale (CRS). In simpler words, the example considered by Farrell suggested that an increase or decrease in the inputs for the production of output leads to its proportional increase or decrease. Meanwhile, the unit of SS' focuses on describing the technological set used for the production of certain amount of outputs through the combination of inputs (X1 and X2), instead of producing two different outputs based on the two different inputs. In simpler words, the isoquant SS' demonstrates the minimum amount of inputs that are required for the product of 1 unit of output, which implies that production along the curse of SS' leads to be perfect in terms of efficiency; whereas production on any other points (i.e. either above or below) are considered to be highly inefficient. In this regards, the author further clarified that points above or below the SS' curve are inefficient based on the fact that the amount of inputs required for the production of a single unit are greater than the minimal requirement of inputs; thus making the production to be inefficient. Likewise, the distance QP in the following figure has highlighted the firm's technical inefficiency. In simpler words, it demonstrates the amount of the inputs that can be reduced for the production of the output, without having any negative impact on the output or its production. Considering this, the reduction of input or the technical inefficiency levels can be measured through the ratio QP/0P; meanwhile the firm's efficiency can be measured through

0Q/0P, where the value of the technical efficiency, according to the author, ranges between 0 and 1. The value of 1 in the aforementioned case indicates that the firm under investigation is completely or fully technically efficient.

Figure 3.5. Measuring Technical Efficiency



Source: Coelli (1996)

3.4.2. Cost Efficiency

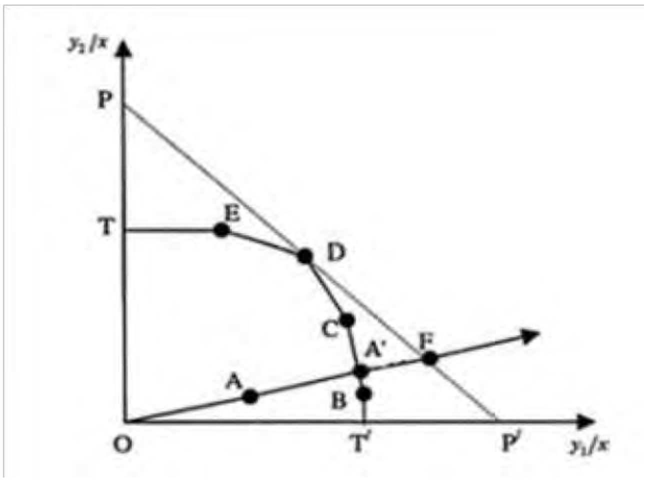
The banking regulatory authorities as well as the bank managers have continually focused on reducing and minimizing the overall costs associated with the banking operations (Fries and Taci, 2005), instead of focusing on the manipulation of the inputs and outputs for the achievement of technical efficiency (Maudos et al, 2002). In this regards, the most commonly considered determinant of the cost associated with the banking operations is through the cost efficiency, which is commonly known as economic efficiency. In simpler words, the cost efficiency or the economic efficiency is represented through the ratio, where the focus remains on minimizing the costs through the use of the best practice, which allows the banks to reduce the actual cost incurred. In this regards, it has been suggested that banks that have higher economic efficiency have better opportunity and ability with respect to the selection of the inputs and/or combination of inputs with respect to their prices; thus allowing the banks to minimize their costs (Pasiouras, 2008). Considering this, it has been suggested that there are two sources of cost-inefficiency, where one of the sources is attributed to technology (i.e. the economic inefficiency is due to the technical inefficiency); whereas the other source is often associated with the inappropriate or sub-optimal resource allocation (i.e. economic inefficiency is the result of allocative inefficiency). This implies that the bank's cost efficiency determinant can be calculated by taking account of both the sources (i.e. technical efficiency x allocative efficiency) (Weill, 2004).

3.4.3. Revenue Efficiency

According to Fethi and Pasiouras (2010), it has been argued that the revenue efficiency determinant focuses on measuring the change in the revenues of the bank that are adjusted based on the random errors relative to the revenues estimated by the banks based on their production of the output bundle based on the efficient practices implemented throughout their operations (Fiordelisi et al., 2011). In simpler words, the determinant of revenue efficiency encourages the revenue maximization throughout the banking operations, and this efficiency determinant can be assessed/measured through the ratio of the revenue (actual) to the optimal level of revenue (Hsiao et al., 2010). However, it has also been indicated that there are two sources for the revenue inefficiency, where one of the source can be attributed to the output-oriented allocative inefficiency and output-oriented technical efficiency. In the aforementioned case, the output-oriented allocative inefficiency implies that the banks have considered the non-optimal combination of inputs for the production of outputs based on their prices; whereas the technical inefficiency refers to the inefficient processes adopted by the banks that result in the wastage of inputs (i.e. simply put, the bank failed to produce too few outputs given the maximum input quantities (Vennet, 2002).

The revenue efficiency can be further elaborated through the following figure in related to the frontier methodological framework, where it can be assumed that the bank has used the input X for the production of two outputs; Y1 and Y2. With respect to the assumptions related to output-orientation, a bank can be considered to be highly technically efficient if the operations of the bank falls at the point marked TT', which in the following figure has made it evident that the banks B,C, D, and E are highly technically efficient. Since Bank A is located under the frontier, it can be argued that the bank has not optimally capitalised upon the operations; thus making the bank to be inefficient. In other words, the revenue efficient banks that are located at point A are in better position to increase their production level as well as their output level; thus making bank A to be regarded as output-oriented technically inefficient.

Figure 3.6. Revenue Efficiency

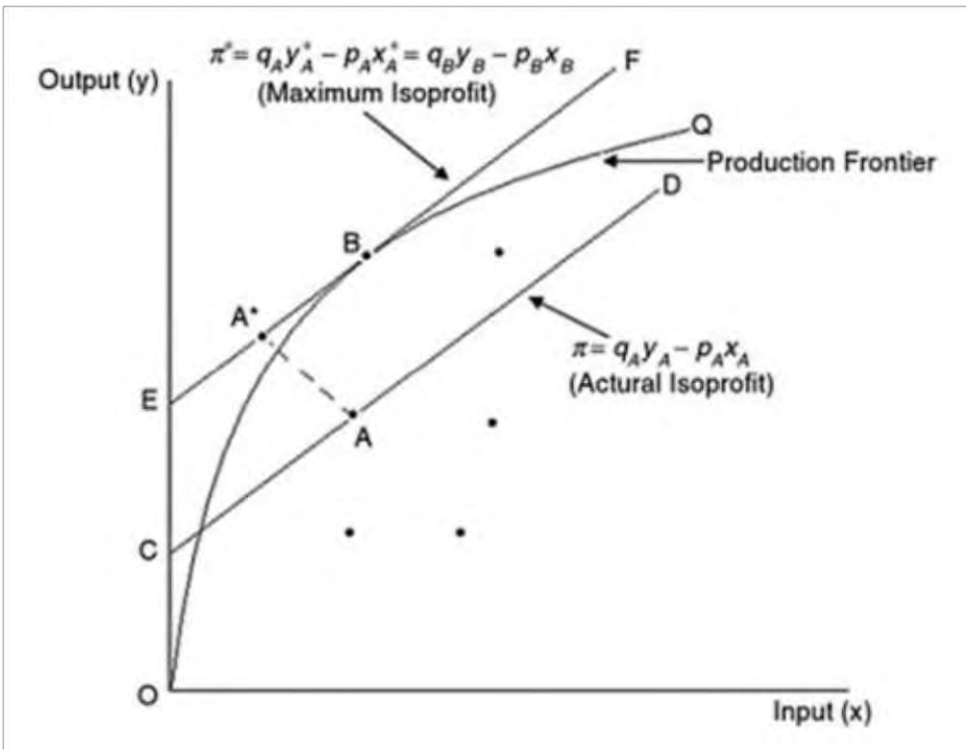


Source: Kumar and Gulati (2013)

3.4.4. Profit Efficiency

In light of the literature, profit efficiency can be argued to be a determinant, which not only considers costs, but takes account of both factors of costs and revenue performance (Chu and Lim, 1998). In the profit efficiency, it is assumed that both the factors of costs and revenues are in complete control of the manager. In majority of the empirical researches, the profit efficiency analysis is commonly preferred to the cost efficiency based on the fact that loan losses and the operating revenues are ignored within the cost efficiency (Ariff and Luc, 2008). Thus, profit efficiency, in simpler words, can be argued to be a process of evaluating the proximity of the banks with respect to the production of maximum possible profits under the available levels of inputs and outputs, while taking account of the exogenous conditions (Ariff and Luc, 2008). Under this condition, it has been suggested that the profit efficiency of the banks can be significantly improved if those banks worked towards getting their profits closer to the profits of the banks that are considered to be a benchmark in the industry (i.e. benchmarked based on their remarkable practices and higher profit margins). In this regards, it has been suggested that the efficiency of the banks can be assessed through its ratio (Pasiouras et al., 2009). Considering this, the highest or the maximum value of the profit efficiency is 1; thus making the range of the profit efficiency to be in between -infinity to 1. The only possible way of reaching the lowest negative score in the profit efficiency is to be completely inconsistent (i.e. throwing away the profit margins). This concept can be further illustrated through the following figure (i.e. figure 3.7).

Figure 3.7. Profit Efficiency



Source: Kumar and Gulati (2013)

In the aforementioned figure, the OQ curve focuses on representing the production frontier, where the actual combination of bank's input and output, which is represented by point A; thus the profit margin or the actual profit of the Bank A can be calculated through qAyA − pAxA. Since all the points of production are located on the yield line (i.e. represented by CD), which is at the same height as point A. In this regards, the most profitable objective of the bank would be to reach the CD line for the highest level of profit. With point B as the highest point, it can be assumed that the combination of input and output at this point would be x* and y*; meanwhile the OE line intercepted demonstrated the maximum profit achieved, which implies that Bank A can reach the highest or maximum profit as long as it reaches the point A*.

3.5. Theoretical framework for the measurement of efficiency

The frontier methods of efficiency evaluation can be categorised into:

- Parametric methods and
- Non-parametric methods

The difference between parametric and non-parametric methods lies in the type of efficiencies that can be calculated using each method and the structural requirements imposed by each method. The parametric methods cannot estimate allocative efficiency and are unable to deal with multiple inputs-outputs at one time. On the other hand, non-parametric methods impose less structural requirements on the frontier but they do not allow random data variations. If random variations occur due to luck or errors in measurements, efficiency gets compounded with the random deviations from the frontier.

The parametric methods of efficiency evaluation can be further divided into three categories, which are:

- Stochastic Frontier Approach (SFA)
- Thick Frontier Approach (TFA)
- Distribution Free Approach (DFA)

The non-parametric methods can be further divided into two categories, which are:

- Data Envelopment Analysis (DEA)
- Free Disposal Hull (FDH)

3.5.1. Stochastic Frontier Approach (SFA)

The most commonly and widely used technique for the measurement of efficiency, especially the bank efficiency, can be argued to be stochastic frontier analysis (SFA), which is based on the assumption that the deviation from the frontier cannot be totally controlled by a decision-making unit (Mohamad et al., 2008). In addition, this technique focuses on linking the random errors with the functional forms; thus making the model to be closely associated with the composed error model, where the terms included and considered are the statistical noise that follows the symmetric distribution; whereas the other term focuses on representing the inefficiency by following the one-sided distribution (Bogetoft and Otto, 2011). The concept of the SFA can be further illustrated through the following stochastic cost function;

$$\ln C_i = \ln C\left(y_{i,} w_i\right) + \varepsilon_i = \ln C\left(y_{i,} w_i\right) + v_i + \mu_i$$

In the aforementioned function; C focuses on representing the total costs; whereas i focuses on representing the specific bank. In addition, the y in the function represents the vector of outputs, and w is the price for the input. With respect to the banking operations, the most commonly input prices are associated with the price of capital, price of labour, and the price of funds. v in the function represents the statistical noise and the non-negative disturbance in the function is demonstrated by u.

According to the Mester (1993) and Aigner et al. (1977), the SFA technique takes account of vi that follows the normal distribution and the ui focuses on the exponential distribution. In this regards, Berger (1993) has argued that the exponential distribution focuses on the inefficiency, where it is assumed that majority of the banks are capable of achieving full efficiency; thus reducing the possibility of higher inefficiency to be significantly lower. However, it has also been suggested that not all of the firms have achieved higher efficiency, which can be argued to be due to the DMU, which results in higher degrees of inefficiencies.

3.5.2. Thick Frontier Approach (TFA)

This parametric model focuses on measuring the efficiency based on the thick frontier approach (TFA), which is significantly different from other parametric models based on the fact that this model focuses on estimating the thick frontier, where the frontier edge is used for the measurement of efficiency (Wagenvoort and Schure, 2006). With this into consideration, the TFA model avoids the use of distributional assumptions for the data (i.e. cross sectional), which implies that the highest average cost quartile and the lowest average cost quartile are considered for the estimation of efficiency (Haron and Tahir, 2008). In simpler words, it is assumed in this model that the efficiency is greater than the average in the case of lowest average cost quartile; thus resulting in the formation of the think frontier. On the contrary, firms that have the highest average cost quartiles are in the position to have efficiency levels that are lower in comparison to the average level (Haron and Tahir, 2008). The difference between the lowest average cost quartile and the highest average cost quartile represents the overall inefficiency. In this regards, luck, and random error are considered to be amongst the assumptions within each of the frontiers.

The overall difference in the lower cost frontier and the upper cost frontier are taken into account by the TFA model for measuring the cost efficiency, while taking account of the exogenous factors, which are estimated by considering the differences amongst the highest cost function and the lowest cost function (Pasiouras and Kosmidou, 2007). Though, this model is continually taken into account for measuring the efficiency, it has been suggested that the most prominent disadvantage of this model lies within the fact that it focuses on the overall level of efficiency, instead of the individual decision making unit's (DMU) efficiency. Thus, TFA has been suggested to have limitations with respect to the generation of estimating the overall levels of efficiency.

3.5.3. Distribution Free Approach (DFA)

As suggested by its name, the distribution free approach (DFA) is free of any distribution needs of the inefficiencies. It is based on the assumption that the efficiency scores of any firm stay constant over a given period of time, while there are changes in random errors over time. The DFA approach utilizes the panel data. The efficiency scores over a given time period are added and the mean of the total efficiency scores is then calculated to determine the unit efficiency. The DFA approach is very useful, if the time-series data is available. (Noulas, 2001)

There are less specific assumptions involved in the DFA method, but it demands data sample for a large time period. It assumes the efficiency scores of any firm to stay constant over time.

Also, the random noises are considered to be null.

According to the DFA approach,

$$\ln y_j = \sum_{i=1}^{m} \beta_i \ln X_{ij} - \varepsilon_j$$

Where y is the output and X is the input

yj means that there are j number of outputs produced using Xi number of inputs.βi represents the coefficient estimated using the OLS technique, εj represents the efficiency of the jth unit.

Now$y_j \geq \ln (yj)$, thus,

$$\sum_{i=1}^{m} \overline{\beta}_i \ln X_{ij} = \ln \overline{y}_j \geq \ln y_j$$

$$\text{Min} \sum_{j=0}^{m} \varepsilon_j$$

$$\text{s.t.} \quad \ln \overline{y}_j \geq \ln y_j$$

Finally, technical efficiency can be calculated as:

$$TE_j = \frac{y_j}{\bar{y}_j},\ j = 1, \cdots, n$$

3.5.4. Data Envelopment Analysis (DEA)

The DEA, a non-parametric efficiency model, focuses on measuring the efficiency of the DMUs, which implies that the approach can be applied to measure the efficiency with respect to firm's input and output, especially in the banking sector

(Bhatt et al., 2001). Within the DEA approach, it has been suggested that there are two different models for the input and output respectively. In particular, the input-oriented DEA focuses on minimizing the total amount of inputs for the production of outputs; whereas the output-oriented DEA focuses on increasing the overall output production by keeping the inputs constant (Cooper et al., 2004). This implies that the selection of the model lies upon the decision taken by the manager based on the fact that they have complete control over the orientation decision. In this regards, Coelli (1998) argued that input-oriented approach is more beneficial and appropriate for the firms which focus on freely adjusting the usage of inputs to meet the demands in the marketplace; however the limitation of resource availability for the maximization of output production makes the output oriented approach to be more appropriate and feasible.

$$\begin{array}{ll} \text{maximize} & \dfrac{\Sigma_i u_i y_{iq}}{\Sigma_j v_j x_{jq}} \\ \text{subject to} & \dfrac{\Sigma_i u_i y_{ik}}{\Sigma_j v_j x_{jk}} \leq 1 \quad k = 1, 2, \ldots, n \\ & u_i \geq \in \quad i = 1, 2, \ldots, s \\ & v_j \leq \in \quad j = 1, 2, \ldots, m \end{array}$$

Where y is the output and x is the input, k is the number of units being evaluated, i is the number of outputs and j represents the number of inputs.

yik represents the ith output of the unit k and xjk represents the jth input of the unit k.

This model can be converted into a linear programming model[2] and transformed into a matrix:

$$\begin{array}{lll} \text{maximize} & z = u^T Y_q & (2) \\ \text{subject to} & v^T X_q = 1 & \\ & u^T Y - v^T X \leq 0 & \\ & u \geq \epsilon & \\ & v \leq \epsilon & \end{array}$$

3.5.5. Free Disposal Hull (FDH)

The Free Disposal Hull (FDH) is a non-parametric frontier method, which can be used for the measurement of efficiency scores of DMUs or production units. It was introduced by Deprins, Simar & Tulkens in 1984 and was updated by Lovell et al. (1994). Unlike the DEA method, the convexity assumptions in the FDH model are more relaxed. The FDH program contemplates the combined integer programming issues, rather than the linear programming problems in case of DEA method (Lim, Lee and Lee, 2016).

The main principle behind the FDH method is that if the production of a specific number of outputs is possible using a given number of inputs, the production of lesser number of outputs using more inputs is also feasible. Thus, the free disposability grant allowed in the FDH method from the given set of inputs and outputs dictates the frontier line of the model.

The efficiency scores in FDH method can lie between 0 and 1. If the the assumption is CRS and the condition of the model is input orientation:

For $DMUk$:

$min\theta k$

Subjected to

$\theta xk - X\lambda \geq 0$

$Y\lambda \geq y_k$ $\lambda \geq 0$

Here λ represents the semi-positive point and its components have restriction of being bivalent, which implies that $e\lambda = 1$ and $\lambda_j \varepsilon (0, 1)$.

3.6. The concept of profitability

The term profitability refers to the ability of a business to earn or make profits. It also denotes the earning power or the operational performance of a firm. A profit can be defined as the revenue earned by the business after paying for all the expenses directly related to the creation of the revenue such as labour cost, bills, raw material, production of the product, machinery, rent and all other expenses for conducting the activities of the business. There are three main different tools which can be used by businesses to measure and evaluate their profitability, which are: ROA (Return on Assets), ROE (Return on Equity) and NIM (Net Interest Margin). Apergis (2014) made use of ROA to evaluate performance of banks in the US. ROE was employed by Lee & Kim (2013) to measure the profitability of commercial banks of Korea. Tan & Floros (2012) utilised NIM to study the profitability in China's commercial banking industry.

Rose (2002) defines ROA as the efficiency of the management in terms of converting their assets into returns and denotes the income earned from their assets. ROA can be calculated by dividing the net income of the business with its assets. According to Rose (2002), ROE indicates management's effectiveness in terms of management of shareholders' funds to earn profits and can be calculated by dividing net income by average shareholders' equity held by the business. Finally, NIM indicates the net income earned by the business from interest earned from loans, overdraft as well as financing based trade activities and can be calculated by dividing the difference between net interest income and net interest expenses with the average assets of the business.

According to Athanasoglou et al. (2010), the research into the performance of banks began in late 1970s, using the two main models based on the performance of organizations, which are: The Market Power Theory and The Efficient Structure Theory. According to Atemnkeng & Joseph (2010), greater insights into the research based on profitability of firms were added with the introduction of the theory of the

Balanced Portfolio. Since then, detailed research has been carried out in the field of profitability of banks and its determinants, both in developed as well as developing economies. However, the research into the performance of banks and its determinants is still limited in a developing country like India (Pastor, 2002, Varias & Sofianopoulou, 2012). Most of the research conducted in the field of performance evaluation of banks mainly focus on the banks in the US (Berger, 2009).

This section reviews the empirical evidence based on the profitability of firms and; its micro and macro determinants, focusing particularly on the most recent research papers based on the topic. The section will also review some of the theories based on this.

3.6.1. Determinants of profitability

The ability of firms to produce profits can be impacted by various micro and macro variables such as external environmental factors and/or explanatory factors, e.g. location, GDP, inflation etc. which are out of control of the providers of services. According to Akkus et al. (2015), it has been suggested that identifying the factors for explaining the differences in the profitability holds significant importance for the overall improvement of the firms although, unfortunately, the application of the economic theory in this matter does not provide sufficient information with respect to the determinants of performance. On the contrary, studies conducted by Caves and Barton (1990) as well as Caves (1992) have focused on the development of strategies for the identification of determinants of performance of firms, which include the factors which are internal as well as external to the firms.

3.6.1.1. External Factors of the Firm

With respect to the competitive conditions in which a firm operates in, it has been indicated that perfect competition in the industry reduces the overall performance of the firm based on the fact that there exists a large number of firms in the same market and industry, which implies the use of identical technology along with offering the consumers and customers with homogeneous products. In this regards, Petria et al. (2015) as well as other authors like Almazari (2014) suggested that the competitors ' presence play an influential role in the diffusion of technological knowledge as well as information based on their years of experience in the industry, which further leads to an improvement in company's performance participating in the specific industry and the economy. This concept has further been indicated in relation to its effect, which can be valued based on the concentration in the marketplace, where companies carry out their activities; thus increasing the possibility of negative relationship based on the degree of concentration and performance, which implies that companies and firms with least market power are more inclined and stimulated towards the development of strategies to differentiate their product offerings in accordance with the market conditions; whereas the firms with higher market power are more inclined to focus on their efficiency level without being concerned or threatened based on the potential competition in the industry (Drake et al., 2006). However, the scenario is completely different in intensely competitive industries, where the entire stimulus with respect to the development of strategies disappears based on the fact that the gains in the industry are immediately cancelled by the competing firms in the industry (Baselga-Pascual et al., 2015).

On the contrary, the internal competition reduces in the case, where the market is dominated by export or import-oriented firms (Sillah et al., 2015). This implies that the test to measure the degree of external competition of the firm can be evaluated based on the international trade, followed by the propensity to export, and/or through the degree of openness. In particular, firms with higher degree of openness are often formed to work on improving their efficiency to ensure that they can effectively compete against their local and foreign counterparts (Sufian, 2009). Considering the latter, it can be indicated that the degree of foreign competition reduces or decreases the inefficiency of the business, and based on a priori, it can be argued that external competition has positive impact on the efficiency of the companies operating in the marketplace.

3.6.1.2. Firm specific characteristics

In the case of company's internal characteristics, it can be argued that the performance of companies is significantly different based on the size of their operations. In this regards, the profitability can be directly as well as indirectly related to the size and scale of the firm and its operations, which Chiu and Chen (2009) highlighted in the study, where it was assumed that improving or sustaining the performance requires extensive costs from the firm's management. In simpler words, the management remains under constant pressure to determine the costs that must be invested within the organisation to preserve the results of the company. However, Olson and Zoubi (2011) argued that the output of the firm and increasing costs are not proportional, which implies that the greater size of the firm reduces the costs associated with the unit costs; thus presenting the companies with an opportunity to focus on their internal characteristics for the improvement of overall performance (Nguyen and Swanson, 2009).

3.6.2. Profitability determinants in the case of banks

The measurement and evaluation of performance in the banking industry holds a significant importance. Different researchers have conducted research into the field of determinants of banks' profitability and have proposed different micro and macro determinants of profitability. According to Raphael (2013), a fruitful and meaningful analysis on performance of banks should take into consideration both the internal as well the external factors surrounding the banks. He further states that the internal environment comprises of the factors specific to the bank and the overall banking industry whereas the external environment comprises of factors which are out of the reach of the management.

The literature often considers the research studies with respect to the results of performance and its determinants to be highly controversial. For instance, Ongore and Kusa (2013) suggested the linking of capital requirements in relation to the performance, while recommending the concerned authorities to provide the banks with an opportunity to assume higher risks with respect to their investments.

Considering this, Flamini et al. (2009) also highlighted the fact based on the phenomenon that asset impairment leads to the reductions in the overall performance of the banks in the economy.

Overall, the credit institution's income statement reveals the performance, where the purpose remains on measuring the percentage of gross income, which is represented by the overhead costs. In this regards, Andries (2011) indicated that some of the influential factors that can have an effect on the overall bank's performance are often in control of the bank; for instance, the size of assets, resources used, capital invested, management style. On the other hand, the author also argued that there exists some of the uncontrollable factors i.e. (exogenous factors) that are beyond the management's control in the case of banks including; price, market share, legislations, and resource availability.

The literature has suggested that a variety of factors affect the performance of financial institutions in relation to the risks (Tecles and Tabak, 2004; Sufian, 2009). For instance, Fiordelisi et al. (2012) have argued that risks and the financial institutions' performance have a relevant relationship, which is quite evident in terms of the bank's financial leverage, as well as its size, and the income based on the bank trading. However, no sufficient relationship between the bank performance and the bank risk or its type has been reached an agreement. In this regards, Dermine and Schoenmaker (2010) have suggested that crisis has played an important role in the creation of financial institutions, where the systemic risk is even greater; however the authors also argued that the concentration of the aforementioned type of risk in financial institutions is quite beneficial in comparison to smaller financial institutions, which was based on the fact that smaller institutions face a variety of difficulties with respect to the diversification of their business, especially in terms of international expansion.

Sufian & Habibullah (2010) examined the factors effecting the performance of Malaysian banks and have suggested capital adequacy, loan intensity, bank diversification, cost ratio, inflation and GDP to be significant determinants of profitability of banks. The internal determinants of performance of banks suggested by Westman (2011) include bank type, bank size, capital adequacy and bank diversification. Ćurak et al. (2012) evaluated the micro and macro determinants of bank profitability (indicated by ROA) in the banking sector of Macedonia and found the bank profitability to be significantly related to capital ratio, loans/assets ratio (credit risk), operating expenses, bank liquidity, GDP growth and bank concentration.

Tan & Floros (2012) studied the factors effecting the profitability (indicated by ROA and NIM) of 101 banks in China for the time-period 2003-2009 and established the factors such as efficiency of labour (revenue/number of employees), development in the Chinese banking sector (assets/GDP), development in the stock market (listed firms' market capitalization/GDP), inflation, credit risk, taxation, capital ratio and bank concentration to be significant determinants of profitability of banks.

Lee & Kim (2013) investigated the effect of independent variables bank size, bank ownership, GDP, mergers & acquisitions and credit risk (loans/deposits) on the profitability of sample Korean banks. Apergis (2014) evaluated the profitability (using ROA as the indicator) determinants of 1725 non-traditional US banks for the time-period 2000 to 2013. The independent variables employed in the research were loans/assets ratio, index of insolvency risk, number of non-traditional operations, capital ratio, NPL (non-performing loans), consumer prices, bank concentration, financial crisis and real per capita income. Smaoui & Salah (2012) studied the determinants of profitability of Islamic banks in the Gulf Cooperation Council (GCC) region and concluded the bank profitability to be positively related to asset quality, capital adequacy, bank size, GDP and inflation.

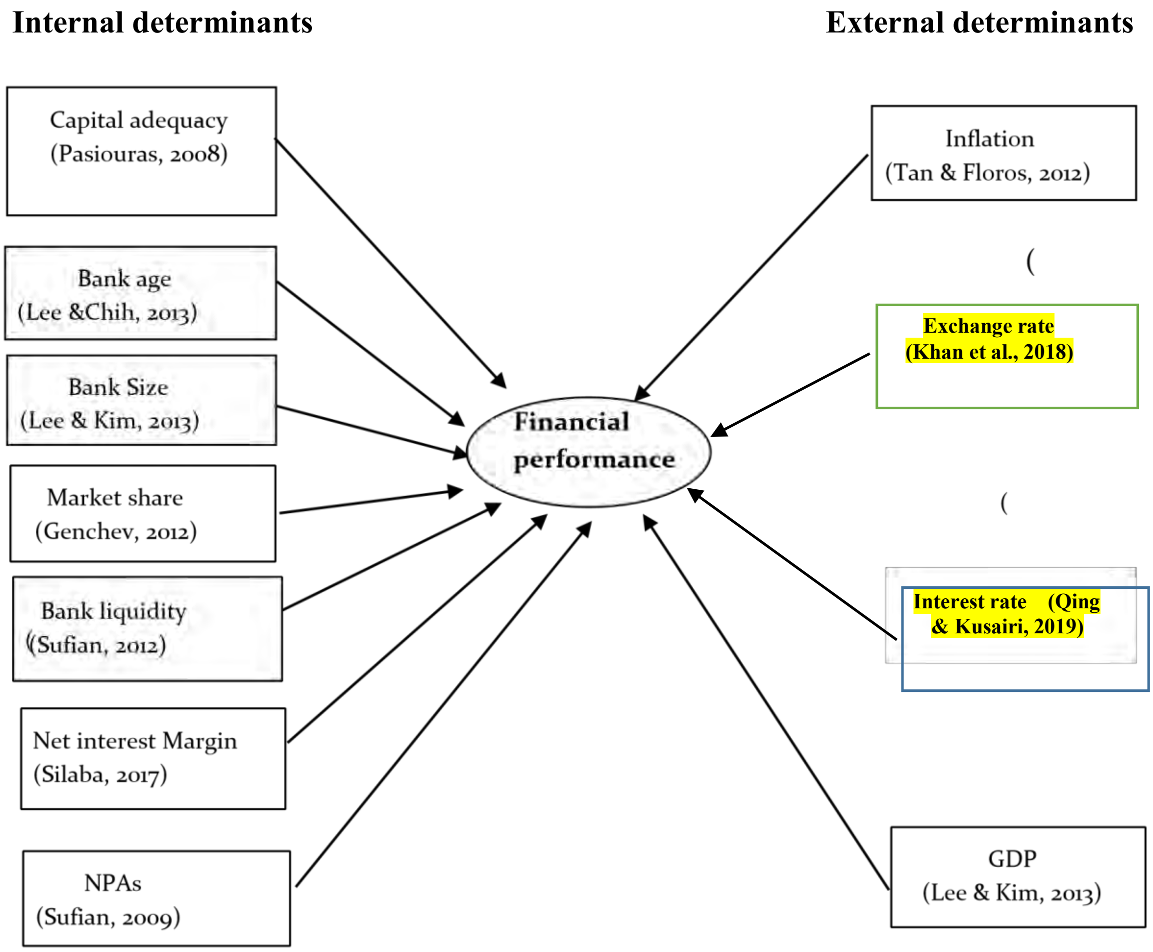
Some examples of research studies based on the profitability determinants of banks in India include Ranajee (2018), Bhatia et al. (2012), Sinha & Sharma (2016) and so forth. The determinants of bank profitability proposed by these research studies include bank size, non-interest income, operating expenses, capital strength, operational efficiency, deposits/GDP ratio, credit risk, cost of funds, NPA (Non-performing assets), GDP and inflation.

3.6.3. Micro and macro determinants of profitability to be used in this research study

Based on various factors such as literature review, different theories, researcher's own understanding on the significance of research variables and availability of data, this research study has chosen capital adequacy, bank age, bank size, market share, net interest margin, non-performing assets, bank liquidity, as internal variables and; GDP, inflation, exchange rate and real interest rate as the external variables. The study has analysed the impact these different micro and macro variables have on the profitability/performance of banks in India.

Figure 3.8 illustrates the framework for determinants of profitability of banks. These independent and dependent variables have been regressed in the regression analysis stage to estimate the regression model.

Figure 3.8. Conceptual framework for profitability determinants of Banks



Source: Author's own updates

The previous research related to the relationship of profitability with above mentioned micro and macro variables have been presented in table 3.1 below and the theoretical framework for the same has been explained in the following section.

Table 3.1. Micro and macro determinants of profitability

Variable	Previous research
1. Capital adequacy Capital adequacy refers to the regulations imposed by the financial authorities on the capital reserves to be held by banks. A general understanding would be that stricter capital adequacy requirements demonstrates strong supervision and higher power achieved by greater market discipline and thus, result in better performance by the banks. (Pasiouras, 2008)	Milne & Whalley (2001), Rime (2001), Aggarwal & Jacques (2001), Pasiouras & Kosmidou (2007), Yildrim & Philippatos (2007), Pasiouras (2008), Tochkov & Nenousky (2009), Ani, Ugwunta & Imo (2012), Adeusi, Kolapo & Aluko (2014), Grigorian & Manole (2002), Naceur et al. (2009), Das & Ghosh (2009), Sufian and Noor (2009), Chortareas, Garza-Garcia & Girardone (2009), Yildrim & Philippatos (2002), Wapmuk (2016), Barth et al. (2013b), Pessarossi and Weill (2014), Pasiouras (2008), Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques (2001), Rime (2001), Jeitschko and Jeung (2005), Kaparakis et al. (1990), Elyasani et al. (1994), Girardone et al. (2004), Berger (1995), Alexiou and Sofoklis (2009), Haron (2004), Kosmidou (2008), Demirguc-Kunt & Huizinga (1999), Goddard et al. (2004), Sufian & Chong (2008), Alunbas et al. (2007), Hafez (2018), Guru et al. (2002), Ali et al. (2011), Chronopoulos et al. (2012), Ayaydin & Karakaya (2014) etc.

2. Bank age Age of a bank can be calculated by the time (years) it has there been in operation. Based on Learning-doing hypothesis given by Mester (1996), older banks are more experienced which makes them more efficient in managing their operations better. Further according to Mester (1996), a positive relationship between bank age and performance would imply that older and thus, more experienced banks are more likely to survive as compared to newer banks.	Mester (1996), Alber (2015), Isik & Hassan (2003), Abul Alkheil et al. (2012), Satub et al. (2010), Chiou (2009), Lee & Chih (2013), Hasan & Marton (2003) etc.
3. Bank size On the basis of size, banks can be categorised as small, medium and larger sized banks. Size = ln (total assets) i.e. natural log of total assets. The impact of size on performance can be studied by studying a regression analysis between performance and size.	Mokhtar, AlHabshi & Abdullah (2006), Berger & Mester (1997), Karim (2001), Majid et al. (2003), Petris et al. (2015), Lee & Kim (2013), Flamini et al. (2009), Shehzad et al. (2013), Houston et al. (2010), Chronopoulos et al. (2015), Altunbas & Marques (2008), Lin & Zhang (2009), Barry et al. (2011), Haan & Poghosyan (2012) found a negative relationship between a bank's profitability and its size. Some studies such as Ghosh (2015), Ćurak et al. (2012), Tan & Floros (2012), Delis et al. (2012), Althanasoglou et al. (2008) etc. demonstrated a positive impact of a firm's size on its performance.

4. Market share Market share can be calculated by a company's share in total assets, sales or deposits in the industry. Banks with high market share are expected to perform better due to economies of scale and their highly competitive performance. (Grigorian and Manole, 2002)	Genchev (2012), Laverty (2001), Buzzell (2004), Gale (1972), Aeteaga (2001), Bahtti & Hussain (2010), Samad (2008), Athanasoglou et al. (2008) etc.
5. **Bank Liquidity** Liquidity measures the cash as well as other current assets which are quickly available and can be used by banks to pay off their short-term bills and other financial obligations. In general, liquidity represents banks' cash reserves. Banks with higher liquidity are expected to experience improved profitability (Bordeleau and Graham, 2010).	Lukorito et al. (2014), Sufian (2012), Dang (2011) and Ibe (2013), Lartey et al., (2013), Munteanu (2013), Nimer et al., (2013), as Ongore & Kusa (2013) and; Mohanty & Mehrotra (2018) etc.

6. Net Interest Margin (NIM) NIM of banks can be measured by calculating the difference between the earned/generated interest income and the interest amount paid to their lenders, for instance deposits. NIM is expressed in percentage and can be calculated as: NIM = Interest income generated from loans or other assets-interest paid on borrowings/average earning assets	Silaban (2017), Almilia & Herdiningtyas (2005), Wasiuzzaman & Gunasegavan (2013), Doliente (2003), Wasiuzzaman & Tarmizi (2010), Gul et.al (2011), Park & Weber (2006) etc.
7. Non-performing assets (NPAs) NPA is a ratio and can be calculated by dividing total NPAs with total advances i.e. NPA ratio = Total NPAs/total advances According to Cooper et al. (2003), NPA ratio explains a bank's ability to manage its loan portfolio. Lower the value of NPA ratio, better is the management of loan portfolio, which in turn implies better performance.	Pastor (1992), Sufian & Habibullah (2009) Sufian (2009), Manthos (2009), Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017), Mehta & Malhotra (2014), Ibrahim & Thangavelu (2014), Alam, Haq & Kader (2015), Alagarsamy & Ganapathy (2017), Sengupta & Vardhan (2017) etc.

8. Inflation Inflation refers to a variation in conventional price status in an economy and is normally measured as annual percentage change in price. Inflation causes depreciation in the value of money. (Santoni, 1986) According to Raphael (2013), a negative relationship is expected to prevail between inflation and bank performance as inflation causes non-interest expenses of a bank to go up, which in turn implies that the input utilization of resources and output production do not go hand in hand and thus, result in lower efficiency scores as a consequence.	Khan et al. (2014), Boyd. et al. (2001) Huybens & Smith (1998-99), Bertay et al. (2013), Tan & Floras (2012), Sufian & Habibullah (2010), Delis et al. (2012), Kutan et al. (2012), Flamini et al. (2009), Pasiouras & Kosmidou (2007), Lee & Kim (2013), Shehzad et al. (2013), Houston et al. (2010), Kanas et al. (2012), Liang et al. (2013), Petris et al. (2015), Mirzaei et al. (2013), Althanasoglou et al. (2008) etc.
9. GDP GDP i.e. Gross Domestic Product represents economic growth in the country. As per Raphael (2013), A positive relationship is expected between GDP and efficiency of banks as the economic growth facilitates higher deposits and demands for loans to be used in investments, which in turn encourages higher efficiency.	Chronopoulos et al. (2015), Houston et al. (2010), Flamini et al. (2009), Pasiouras & Kosmidou (2007), Dietrich & Wanzenried (2011), Kutan et al. (2012), Lee & Kim (2013), Chitan (2012), Shehzad et al. (2013), Delis et al. (2012), Sufian & Habibullah (2010), Boubakri et al. (2005) etc.

10.Exchange rate Growth in exchange rate plays a significant role in costs of production and prices of commodities. These rising costs causes heightened needs for financing and this, in turn affects the performance of banks. Fluctuations in exchange rates gives birth to uncertainties for businesses, which causes adverse circumstances for economies. This can further exacerbate the economic conditions of recession and rise in no-performing assets (NPAs) for businesses. (Keshtgar et al., 2020)	Manyok (2016), Kiganda (2014) Suhadek & Socian (2020), Keshtgar et al., (2020), Chauque & Rayappan (2018), Mbithi (2009), Khan et al., (2018), Nguyen & Do (2020), Qing & Kusairi (2019), Kasman et al., (2011) etc.
9. Real interest rate Interest rate denotes the interest sum which is due each period as a percentage of the sum lent, loaned or invested. The total interest amount is dependent upon the principal sum that is loaned or lent, the duration, rate of interest. Interest is one of the one sources of income for banks and interest rate plays a significant role in their performance. (Alsharif, 2021)	Suhadek &Suciany (2020), Tamtelahitu & Mubin (2020), Rashid & Khalid (2017), Khan et al., (2018), Kasman et al., (2011), Qing & Kusairi (2019), Basabeh & Abdelkader (2019), Ndlovu et al.,(2018), Alsharif (2021) etc.

Source: Author’s own updates

3.6.3.1. Capital Adequacy and performance

The Basel has suggested three concepts based on the capital for financial institutions which are: actual capital, regulatory capital and economic capital.

Actual capital represents the equity capital and long term loans in the balance sheet and can by calculated by capital ratio i.e. the ratio of equity to sum of all the assets.

Regulatory capital, on the other hand, can be measured by calculating the ratio of capital to total value of risk-weighted assets. It represents the capital bearing risks and has to be maintained in lines with the supervision and regulations. The regulatory capital level is determined by the economic state conditions as well as the bank assets' risk profile.

Last, but not the least, the economic capital, refers to the highest level of capital that needs to be operated by a bank for the effective and efficient operations of the strategies of its business. (Sentero, 2012)

According to Pasiouras (2008), performance of a bank is highly impacted by strict supervision, discipline in the market and strict capital adequacy requirements.

With respect to the efficiency, banks often consider RWA calculation accuracy, which focuses on ensuring the most appropriate and accurate measurement of regulatory capital, while allowing the banks to adjust their sources of usage (Carmassi and Micossi, 2012). In this regards, it has been indicated that banks can achieve the desired level of improvements in the level of capital efficiency through the use of RWA that focuses on addressing the accuracy, while allowing the banks to closely align their calculations in accordance with the level of risks taken by the banks. Moreover, it has been suggested that banks have often considered the application of advanced calculations with respect to regulatory capital; thus increasing their overall potential with respect to increasing their accuracy (Carapeto, 2011) . However, in the case of Asian banks, it has often been indicated that banks have often considered the use of traditional and standardised approaches; thus reducing their effectiveness and efficiency. In this regards, RWA calculation accuracy has focused on the following areas:

Improving the overall infrastructure and the data system which focuses on the identification of the potential deficiencies in the source system that could eventually lead to the conservatism with respect to the collateral allocation, risk exposures, or the modelled risks parameters. This implies that the use of RWA calculation accuracy can help in the identification and the closure old accounts followed by the unused products, while allowing the banks to update their collateral values as well as the source for the external ratings for companies that are not-rated (Lee & Chih, 2013).

Banks that have considered the use of the IRB approach, the use of RWA focuses on addressing the inefficiencies that are embedded into the IRB models through the development of parameters by;

- RWA focuses on the review of granularity and the adequacy of the internal master scale for rating
- It revises the central tendency of the assumptions based on the optimizing rating model cyclicality, through the cycle (TTC) vs. point in time vs. hybrid based on their longer historical data
- It ensures that the unsecured loss given default (LGD) amongst the portfolio is differentiated, and the key assumptions are continually reviewed and updated with respect to the discount rates and the cure rates.
- RWA model focuses on the tightening of the product classification based on its nature, which eventually leads to the optimal risk classification as well as the management of portfolios that are directly or indirectly related.

RWA can be used to measure capital adequacy through the following equation;

$$RWA = \sum_{i=1}^{N} \alpha_i E_i + \sum_{j=1}^{M} w_j C_j$$

3.6.3.2. Bank age and performance

Age of a firm is considered as one of the main determinants of its performance among various other variables (Pervan, Pervan & Curak, 2016). Age of a bank in a given year can be calculated by counting the total number of years from its year of foundation in this research thesis. Age of a bank represents its learning curve. A positive impact of age of a bank is expected on its profitability.

Many studies in the literature have researched the relationship between age of a bank and its eperformance such as Abu-Alkheil et al. (2012), Satub et al. (2010), Chiou (2009), Lee & Chih (2013), Hasan & Marton (2003) and so forth.

According to Alkheil et al. (2012), older banks are found to possess higher scores of efficiency and thus, profitability compared to newer banks due to the experience they have gained in terms of better managing their operations, provision of better product and service quality to its clients, strategies to tackle and prevent failures and losses, strategies to lower their inputs and maximize their outputs etc.

Many studies such as Satub et al. (2010), Alber (2015) and Chiou (2009) agreed with this research finding in their research work. On the other hand, in contrary to this, Lee & Chih (2013) demonstrated a negative relationship between bank age and bank performance in case of Chinese banking industry and discovered the newer banks to be more profit efficient as compared to older banks. No relationship between bank age and its performance was found by Hasan & Marton (2003) for conventional banks in Hungary.

3.6.3.3. Bank size and performance

Bank size here denotes the total size of a bank in terms of its assets. In line with Amindu & Wolf (2013), Sufian & Habibullah (2009) and Adusei (2015), size of a bank can be computed by taking natural logarithm of total assets of a bank i.e.

SIZE = log (total assets)

Based on the market power hypothesis, it is expected that size of a bank effects its performance positively. According to Sufian & Habibullah (2009); and Hauner (2005), the bank size tends to have positive impact on its performance due to two reasons: first reason is the concept of market power i.e. large sized banks benefit from paying less for the inputs they utilize and secondly the banks with larger size enjoy increased returns to scale through the minimization of fixed cost from skills such as large number of services or through higher efficiency gained by the use of skilled workforce.

3.6.3.4. Market share and performance

The determinant of market share with respect to the banks are often argued to be dependent upon the micro and macro determinants, where the internal bank determinants include; investment in the quality of services, cost-efficiency, capital, risk-taking, and the ownership structure (Maslovych, 2009). On the contrary, the external determinants of bank performance with respect to market share include; macroeconomics variables, and the supervisory and the regulatory practices. Since the direct theory with respect to market share in underdeveloped and rarely been in the consideration of scholars and academicians, several strands of theories have been examined over the years for the development of a model for the primary purpose of estimation (Schaeck and Čihák, 2008).

In this regards, the foremost model that has often been taken into account is the Boone Indicator, which focuses on the market share efficiency, where it has been argued that the use of higher concentration does not imply significantly lower level of competition in the marketplace (Ariss, 2010). However, the literature has suggested that higher measures of concentration often leads to significantly reduced level of competition; whereas Boone demonstrated that the rise in competition has no significant impact on the HHI (Herfindahl-Hirschman index) i.e. a measure of market concentration; thus arguing that using HHI as an indicator of competition was misleading (Tabak, Fazio, and Cajueiro, 2012). Moreover, Boone proposed that competition in the marketplace intensifies under several circumstances, where the most prevalent circumstances include; 1) the decrease in the exogenous entry cost that leads to a significant increase in the number of firms, 2) aggression with respect to the interaction between the firms, which ultimately leads to the availability of closer substitutes that eventually leads to switching to the Bertrand from the Cornet type competition, 3) the reduction in the marginal costs. In addition, Boone argued that when companies face increased competition, or works for the increase in competition, they tend to reduce their X-inefficiency; whereas the situation completely changes under the increased competition, which indicates that they must become more efficient that could lead to a significant increase in their market share (Ariss, 2010).

Furthermore, Boone argued that the relative profit difference acts as a monotonic indicator in the case of competitive industry, which implies that banks with higher level of efficiency have higher possibility of higher relative profits; whereas firms with increased inefficiency are often penalised with respect to their lower relative profits (Schiersch and Schmidt-Ehmcke, 2010). The Boone indicator suggests two prevailing effects of the competition in the marketplace including; selection effect and the reallocation effect. With respect to the reallocation effect, it has been suggested that the market share of the efficient firms significantly increases in comparison to the inefficient banks based on the increase in competition. This implies that in extremely competitive markets, the market share of the inefficient firms would be significantly lower than the efficient banks (Bikker, 2010).

3.6.3.5. Bank liquidity and performance

Liquidity measures the cash as well as other current assets which are quickly available and can be used by banks to pay off their short-term bills and other financial obligations. In general, liquidity represents a bank's cash reserves and involves the direct cash holding by the banks as well as the money held in bank accounts. Some of the ways which can be adopted by banks to improve their liquidity position include shortening asset maturities, issue of more equity, getting liquidity protection, reduction of contingent commitments and so forth. Liquidity position of a business can be demonstrated by calculating a set of ratios such as current ratio, quick ratio and cash ratio, where:

Current ratio = Current assets/Current liabilities

Quick ratio = Current assets-Inventory/Current liabilities

And Cash ratio = Cash +Marketable securities/Current liabilities

Liquidity has been demonstrated as one of the most important determinants of banks' performance as it ensures their proper functioning. Inadequate levels of liquidity can have adverse impact on the market value of bank assets.

According to Bordeleau and Graham (2010), banks holding some liquid assets experience improved profitability, however, there is a point where holding any further liquid assets diminishes its profitability. Waleed at al. (2016) also showed a significant impact of bank liquidity on its performance.

3.6.3.6. NIM and performance

NIM stands for net interest margin. NIM of banks can be measured by calculating the difference between the earned/generated interest income and the interest amount paid to their lenders, for instance deposits. NIM is expressed in percentage and can be calculated as follows:

NIM = Interest income generated from loans or other assets-interest paid on borrowings/average earning assets

According to Saksonova (2014), NIM is the most appropriate and the most suitable criterion which can be used to assess and evaluate a bank's effectiveness and its operations' stability.

Research studies such as Naceur and Goaeid (2003), Rosly and Bakar (2003), Ahmad and Matemilola (2013) and Guru et al. (2002) have demonstrated a positive impact of NIM on profitability of banks as lower overhead expenses such as interest expense and thus, a better and more efficient expense management helps the banks in terms of high profitability.

3.6.3.7. NPA and performance

A non-performing asset in banking is defined as a loan or an advance offered by the bank to a client for which the payment of principle amount or the interest is overdue by more than 90 days. Non-performing assets (NPAs) of banks are further classified into three categories which are explained below:

- **Sub-standard assets:** Sub-standard assets are the category of NPAs which have endured as NPAs for a time-period of one year or less than one year.

- **Doubtful assets:** A doubtful asset is a type of NPAs which have remained in the category of sub-standard assets for a time-period of one year.

- **Loss assets:** A loss asset is a type of NPAs which have been cpnsidered as unrecoverable by the bank. Due to the little value of the asset, the bank doesn't find it feasible to consider this NPA as an asset for the bank, though it is associated with some residual value.

NPAs have further categorized into two main types which are:

- **Gross NPAs:** Gross NPAs refer to the total sum of all assets on the balance sheet which have been identified as non-performing by the central bank of the country. The quality of the loans/advances offered by banks can be judged from looking at its gross NPAs figure. Gross NPAs comprise of all three types of NPAs i.e. sub-standard, doubtful and loss assets. Gross NPA ratio can be calculated by the formula:

Gross NPA ratio = Gross NPAs/gross advances

- **Net NPAs:** A bank's net NPAs can be calculated by deducting the provisions banks have made for the loan losses from the gross NPAs figure. The net NPA figure represents the correct financial burden or the losses of the banks. The formula which can be used to calculate net NPA ratio of banks is:

Net NPA ratio = Gross NPAs-provisions for loan losses/gross advances

(Singh, 2013)

According to Balasubramaniam (2001), performance of a bank doesn't get effected just by the magnitude of numbers booked on a balance sheet, but also gets highly impacted by returns earned on its assets. The areas of the performance of banks which get impacted by NPAs according to Singh (2013) and Balasubramaniam (2001) are:

- **Profitability:** NPAs imply to registering money as bad assets on the financial statements. As the money gets blocked, the performance of a bank doesn't get effected just by the amount of NPAs, but also imposes a negative impact on its performance in terms of opportunity cost. Thus, in addition to negative impact of NPAs on performance of banks in present, NPAs also tend to impact the performance of banks negatively in future.

- **Liquidity:** NPAs cause the blockage of money and low profitability, which in turns causes lower cash and heightened borrowings by the banks causing interest costs to the banks and thus, hurdles in running their day to day business operations.

- **Credit loss:** When the banks have issues related to NPAs, their value in the credit market goes down. Due to this, the brand image and goodwill of the banks get affected negatively which in turn effects the investors cynically and demotivate any future investments.

- **Other costs:** Another significant cost faced by banks in terms of NPAs is the time and endeavours of the employees involved in the management of NPAs.

3.6.3.8. Inflation and performance

Inflation measures macroeconomic stability of the country and can be calculated from annual CPI (Consumer Price Index). The impact of inflation on the performance of banks has been studied widely. Reseach studies such as Tan and Floros (2012) for China, Ishfaq and Khan (2014) for Pakistan, Hooshyari and Moghanloo (2015) for Kuwait, Khan et al., (2014) for Pakistan, Athanasoglou et al. (2008) and Ramadan et al. (2011) for Pakistan have reported a positive impact of inflation on the performance of banks. The reason behind the positive impact of inflation on performance of banks (contrary to the usual assumption of a negative impact of inflation on a firm's performance) reported by these research studies is the heightened planning activities and thus, a better utilization of resources. According to Khan et al. (2015), inflation causes rise in interest rates and this, encourages institutions to invest in risky ventures for higher returns and thus, results in better efficiency and performance.

Contrary to this, a negative impact of inflation was reported in research studies such as Owens (2006), Andrew (2005), Bruce (2008) and; Saksonova & Solovjova (2005). According to Andrew (2005), inflation causes a decrease in real value of money and other related items with an attached monetary value and; uncertainty about future condition of inflation in the economy, which in turn discourages firms to make investments. According to Bruce (2008), rationing occurs only when inflation rises above a critical level. Below the threshold value, higher rates of inflation are associated with performance improvement. In general, the lowered purchasing ability of individuals during inflation results in lower deposits of banks.

This forces banks to lower their loans, which in turn, negatively effects their performance.

3.6.3.9. GDP and performance

A research study conducted by Aminu (2013) argued that the growth of GDP had negative impact on the profitability of Nigerian banks, where the results were obtained through the use of panel regression of seven Nigerian banks during the time-period 2005-2011. Likewise, the research study conducted by Adeusi et al. (2014) considered the use of CAMEL model with a purpose of capturing internal determinants by taking macroeconomics variables as the external determinants. With this into consideration, the empirical findings of the study revealed that the coefficient of GDP had a negative relationship with Return on Assets (ROA), which indicates that an increase in the economic growth rate would lead to a decrease in the profitability of the banks. Similarly, the research study conducted by Ferreira (2012) considered the variable of GDP and its components of gross fixed capital formation, final consumption expenditure, and export and import of goods and services. In this regards, the basic model used based on the aims and objectives was as follows;

$$\text{Growth}_{i,t} = \alpha_0 + \alpha_1 \text{ year dummies}_i + \alpha_2 \text{ country dummies}_t + \alpha_3 \text{ lag1 growth}_{i,t-1} + \alpha_4 \text{ bank efficiency}_{i,t} + \alpha_5 \text{ bank market concentration}_{i,t} + \alpha_6 \text{ control variables}_{i,t} \quad (1)$$

The results of the study indicated that bank cost efficiency contributes positively to the increase of the variation of the Gross Domestic Product (GDP) growth. The same findings were applicable to the ROE and ROA ratios, which indicate that both contribute to the positive variations to the growth of GDP.

3.6.3.10. Exchange rate and performance

Exchange rate can be defined as the value of one currency in another currency. The worth of one nation's currency in respect to some other currency too is referred as the exchange rate. Each nation chooses the regime of exchange rates that will be used for its respective currency. There are three main types of exchange rate regimes, which are:

- Floating exchange rate, where exchange rates are set on the forex market that is accessible to a variety of market participants and where trading activity is constant: i.e. 24 hours a day, 7 days a week, excluding weekends
- Forward exchange rate system, which is stated and exchanged today but is intended for payment transactions on a certain future date
- Spot exchange rate system, which refers to the rate in effect at the time.

(O'Sullivan and Steven, 2003)

Growth in exchange rate plays a significant role in costs of production and prices of commodities. These rising costs causes heightened needs for financing and this, in turn affects the performance of banks. Fluctuations in exchange rates gives birth to uncertainties for businesses, which causes adverse circumstances for economies. This can further exacerbate the economic conditions of recession and rise in no-performing assets (NPAs) for businesses. (Keshtgar et al., 2020)

As per Keshtgar et al., the bank profitability is significantly impacted by exchange rate changes either intrinsically and extrinsically. Because banks take actions regarding foreign exchange, exchange rate fluctuations has a direct impact on such institutions' performance. Exchange rate fluctuations has a negative impact on banking credit risk while also having an indirect impact on creditor and debtor behaviour and performance. The volatile currency rate will have a stronger effect on decreasing production, increasing prices, and restricting foreign commerce, as claimed Keshtgar et al., (2020). However, a variation in exchange rates may alter how competitively advantaged domestic manufacturers are. The cost of imported items in relation to the local currency increases as the exchange rate rises, but the consumption for foreign products drops.

3.6.3.11. Interest rate and performance

Interest rate denotes the interest sum which is due each period as a percentage of the sum lent, loaned or invested. The total interest amount is dependent upon the principal sum that is loaned or lent, the duration, rate of interest. Interest rates can be real or nominal.

The real interest rate (RIR), as opposed to the nominal interest rate, indicates a shift in buying power resulting out of an expenditure or by the debtor giving up something. The nominal interest rate, on the other hand, refers to the interest effectively paid on a debt or purchase. A RIR thus, is a rate of interest which has been modified to account for the impact of inflation. It represents the real cost of money to a borrower after adjustment and the real return to a lending institution. (Brock, 2022)

Thus, RIR = nominal interest rate-inflation rate (real or predicted)

According to Alsharif (2021), Interest is one of the one sources of income for banks and interest rate plays a significant role in their performance. Wheelock (2016) states that the fact that banks often "lend long and borrow short" is the fundamental to assessing the link among interest rates and bank profitability. In other words, a bank's pool of loans often has debts with a longer total lifespan than its deposits as well as other liabilities. As a result, if marketplace interest rates decline, financing costs for banks typically decline relatively rapidly than interest revenue, increasing NIMs and thus, their profitability. Nevertheless, as debts are eventually paid or extended at reduced lending rates, NIMs decrease. NIM and thus, bank profitability are therefore, essentially unconnected to the basic level of interests rates throughout the medium and long term.

3.7. Theories based on the relationship between bank performance and; its micro and macro determinants

This section looks at revising the different theories available in the literature which are based on the relationship of performance of banks with different micro and macro determinants. These theories explained in sections 3.6.1-3.6.12 explain the basis and reasoning behind the positive or negative association bank performance has with different micro and macro determinants.

3.7.1. The Theory of Economic Efficiency

The idea of economic efficiency originated from the neoclassical microeconomic theory, which is based on the allocation and utilization of resources. This theory emphasizes on the minimisation of cost by advocating no wastage of resources and attempting to produce the maximum possible number of outputs from given number of inputs and available technology. The theory of economic efficiency promotes the concept of value creation. This implies that an organisation can achieve competitive advantage by performing efficiently than the rival businesses performing less efficiently in the same industry. Any change which maximizes the value in the overall process of transformation of inputs into outputs is classed as an efficient change and on the other hand, the change resulting in decreasing the value is categorized as an inefficient change. The concept of efficiency has often been used in intervention of policies for the evaluation of effectiveness of different alternatives of policies. (Sentero, 2012)

The concept of economic efficiency is related to the perfect competition market structure and is based on the idea of maximization of profit or minimization of cost. In a highly competitive industry, firms emanate the efficiency gains in the long term by earning just the usual profits and responding to alterations in customers' tastes and expectations by output maximization. According to Griffiths and Wall (2000), the long-term cost curves' position dictates whether the selling price of that output will be same, lower or higher than the existing price.

The efficiency of firms is dependent on various factors, some of which are internal to the organisation such as expertise of the management team, a firm's organisational structure, workforce's skills' level and experience; and so forth. Some of the internal sources which can cause efficiency or inefficiency in firms comprise of human errors, laxity, disturbances in technology used for production, inadequate capacity in reacting to varying incentives etc.

External factors of (in) efficiency can consist of factors such as constraints due to regulation and supervision, the overall market structure in which the organisation operates, workforce strikes or disputes etc. The internal factors are firm specific and thus, can be controlled by the management, whereas the external factors are outside management's approach. Both these micro and macro factors can impact a firm's performance substantially. Caution is advised to carefully choose the micro and macro factors while assessing a firm's efficiency.

3.7.2. The Capital Buffer Theory

As discussed by Marcus (1984) and; Milne & Whalley (2001), capital buffer theory states that banks try to hold levels of capital more than what is required under the capital regulation requirement as an insurance, in case something goes wrong. Thus, the buffer represents the extra capital held by a bank than the minimum capital requirement. Under the implications of capital buffer theory, banks, which have low buffer of capital, they try to raise money and rebuild that capital buffer and banks with high levels of capital buffer, attempt to maintain that level. High capital buffers helps banks to prevent any likelihood of failure by absorbing shocks against the stored high capital buffer. As a consequence, regulatory capital is presumed to be positively related to the portfolio risk, which implies that as the raising capital by banks in order to maintain the capital buffer, raises the portfolio risk.

3.7.3. The Trade-Off Theory

The trade-off theory helps businesses and banks in general, in managing their portfolio of equity and debt finance for use by management of their costs and benefits. The classic interpretation of this hypothesis was demonstrated by Kraus & Litzenberer (1973), which suggested a symmetry between reaping benefits of debts in terms of saving on tax and the encumbering bankruptcy costs. As per the trade-off theory, matching funds with debts has its own pros and cons. Debt financing has its benefits in terms of saving on taxes, but at the same time, it's also related to the financial costs, i.e. the risk of financial distress.

As per Brealey & Myers (2003), the costs associated with the financial distress negatively effects the value of the firm, which in turn acts as an opposing force to the tax benefits of debt financing. Another argument that has been put across is the costs associated with capital. The heightened risk of bankruptcy associated with the odds of financial distress and consequently, low value of capital ratio makes investors also demand for premiums as a compensation to cover the risks of losses. As a result, banks tend to incur high risks by issuing high levels of capitals/debts to their clients in order to earn increased risk premiums on their investments and thus accomplish a commensurate "return on equity". Hence, the heightened risk demands higher equity proportions in an organisation's overall capital structure in order to prevent an incompetent capital cost. There is some ambiguity in place related to the overall impact of this incentive and buffer effect. There is a possibility of increase in the default risk with an increase in the level of capital held by a bank.

3.7.4. The Theory of Moral Hazard

Moral hazards can arise in scenarios when economic agents are made to believe that the institutions and their creditors will be protected, when there are chances of their failure but the government, central banks and regulative intermediator institutions. A good number of research papers including Rime (2001), Aggarwal & Jacques (2001), and Jacques & Nigro (1997) have attempted to test the theory of moral hazard and have concluded that as banks tend to increase their capital levels in line with the minimum capital regulations, it also tends to increase the amount of risks they have to bear. Most of the research papers have demonstrated a positive relationship between the capital levels held by banks and their risk adjustments, which implies that banks with high capital levels also tend to face heightened risks consequently (Sentero, 2012). This research finding supports the theory of moral hazard.

According to Jeitschko & Jeung (2005), banks with better capital management tend to have fewer moral risk incentives and thus, are more susceptible in adopting careful practices for cost reduction. For instance, shareholders play more active role in cost control or allocation of capital in banks.

According to Gropp & Heider (2010), banks can also be forced by the regulation for heightening the capital levels in proportionate with the extent of hazards taken. The main objective behind holding additional capital as compared to the minimum regulatory capital requirement is to lower the costs involved in issuing fresh equity at an urgent notice.

3.7.5. Neo-Classical Theory

The idea of a firm being technically efficient originated from the neo-classical theory, which focuses on the maximization of profits for organisations. According to this theory, there might be technical reasons behind the technical inefficiency of firms such as insufficient training, less levels of human capital, outdated or inferior technology in place in operations etc. The acquisition and utilization of new technology takes time and can't be done instantaneously all the time. Cooper et al., (2003) states that banks can improve on the efficiency frontier with the modernization of capital and further training. The variation in skills or speed with which the new technology is acquired, doesn't cause X-inefficiency, but it depends on the resource (skills as well as technology) utilization and organisation in contrary.

According to Adongo, Stork & Hasheela (2005), there is a wide use of neo-classical theory for the analysis of performance of banks and thus, the theory of rational behaviour of banks is hugely accepted by most of the economists. The fact that organisations operate in a constantly changing and uncertain external environment, proposes that traditional measures of efficiency alone shouldn't be used to assess their performance and should take into account the risk factors along with the efficiency.

3.7.6. Agency Theory

The agency theory, based on the concept of agency costs, was introduced by Jensen & Meckling (1976). The agency costs emerge because of the contractual allowed added benefits and salaries and arise as the management is enticed to make possible arrangements for the benefit of stakeholders at the cost of bonds' bearers in the absence of any restrictions.

According to the agency theory, different stakeholders in a firm can have conflicting interests and the owners try to minimize these conflicts by constraining ability of the management for the maximization of their own personal efficacy by introducing contracts offering higher salaries and benefits than what they would have allocated for themselves in case they were in control of the organisation.

As the interests of bondholders are given a back seat, they try to create arrangements and restrictions which pose risks to the legitimate operations of the corporation. Further to this, the bondholders tend to monitor a firm's performance to make sure that those arrangements are maintained. Ncube (2009) states that the stockholders have to bear these heightened costs in terms of increased debt costs. All these arrangements cause a decline in the efficiency of the firms. This efficiency loss and the cost of monitoring are classed as agency costs, and decrease the benefits of debt by increasing the cost of debt and decreasing the equity value.

Jensen & Mecking (1976) further states that a firm should weigh the pros and cons of debt and develop the optimum debt, which is attained at a point where the debt's agency cost is equivalent to its marginal benefits. Similar to the assumptions of the agency theory is the concept of profit efficiency which is based on a bank's leverage and equity levels. Size plays a role in determining the profit/cost efficiency of banks, where small sized banks have higher profit efficiency, whereas, medium and large sized banks are found to be more cost efficient.

3.7.7. Efficient Structure Theory

The concept of efficiency hypothesis and the alternative explanation on the relationship between market structure and performance was first proposed by

Demsetz (1973). It is based on the theory that the banks operating more efficiently as compared to their competitors result in low operational costs and thus, benefit from higher profits. These efficient banks have a considerable share in the market. As a consequence, the difference in efficiency scores cause intense concentration in the market by generating non-uniform positions in the market. As the performance and the structure in the market get influenced by the efficiency of firms, it seems superficial to claim positive relationship between efficiency and structure in the market.

The co-existence of stringent capabilities and proficiencies have created a complicated and parallel set, which can neither be neglected nor minimized and this in turn, justifies the multi-dimensional interest in the key factor of competitiveness in the market, i.e. efficiency. As per the efficient structure theory, out of all the capabilities mentioned above, banks should be proficient in five skill areas in order to be classed as fully efficient, which are: ability of reinforcing training mechanism and the relational circuit, ability to predict and select, cost shrinking, ability to adjust costs to quality, mass production to achieve efficiency.

According to Smirlok (1985), the market share of firms acts as a proxy for efficiency. The prevalent of the efficiency hypothesis by the signalling of a significant positive relationship between market share and profitability. Based on this, market power of any firm is dictated by its concentration in the market. This method was criticised by Shepherd (1986) by introducing the hypothesis of Relative Marker Power (RMP), which is based on the idea that the ultimate source of market power for any firm is the domination of participants in the market. The banks with large market share and diverse range of products exercise their market power by dictating the product prices and thus, the revenues.

Further according to the RMP hypothesis, the market shares of individual firms can help the accurate determination of the market power and imperfections in the market. The application of the RMP hypothesis to the banking sector implies that banks with better efficiency scores as compared to their competitors benefit from low operational costs, and thus, higher profits, and have significant share in the market.

3.7.8. Market Power Theory

The theory of market power has focused on explaining the relationship between profitability and size of the bank. In this regards, Olweny and Shipho (2011) argued that performance of the banks are significantly influenced by the structure of the industry. Similarly, Olweny and Shipho (2011) further argued that the market power theory is based on the assumption that bank profitability is amongst the external market factors. According to the market power hypothesis, the market concentration has been found out to have a non-significant relationship with performance as compared to market share, which is significantly positively related to price and profitability.

As per the Quiet life hypothesis given by Hicks (1935), a bank with high share in the market focuses less on efficiency as the profiteering of market power allows them to reap all the benefits automatically. The increase in market power causes efficiency deterioration, which in turn, makes it difficult for them to make huge profits. The explanation in the absence of an assumed usual relationship between market structure and overall profitability of the bank is given by the quiet life hypothesis.

Banks, which own a strong market position, has two options, it can either boost its market domination or can work on obtaining high efficiency scores by the proper utilization of its resources and assets and thus, the total assets play a crucial role in overall efficiency of banks.

3.7.9. Signalling Theory and Bankruptcy Cost Hypothesis

The signalling theory argued that organisations with the ability to generate higher profits in comparison to others within the same industry are in better position to offer valuable and accurate information (Moss et al., 2015). In this regards, Ommeren (2011) argued that banks with higher level of capital indicates and signals about its positive market value; meanwhile lower leverage demonstrate the ability of the bank to outperform its competitors in the marketplace based on the inability to raise equity without deteriorating their profitability.

On the contrary, bankruptcy cost hypothesis argues that when the bankruptcy costs are significantly higher, the banks capitalises upon its equity for the avoidance of distress (Islam et al., 2017). With this into consideration, the bankruptcy cost hypothesis and the signalling theory have indicated that a positive relationship exists between profitability and capital.

3.7.10. Risk-Return Hypothesis

The risk-return hypothesis suggests that an increase in the risk can lead to higher returns; however this can only be achieved by increasing the leverage of the firms (Rao and Jandhyala, 2018). However, in the case of banks, the equity to asset ratio would significantly be reduced if the banks focus on increasing their returns (profitability) by engaging in riskier investment. With this into consideration, Sharma and Gounder (2012) argued that the use of risk-return hypothesis suggested a negative relationship between the profitability and capital.

3.7.11. Structure-Conduct Performance (SCP) Paradigm Hypothesis

The Structure-Conduct Performance (SCP) hypothesis was originated from the neoclassical theory. The SCP hypothesis identifies the relationship between the structure in the industry and the performance of a firm and has resulted in the application of anti-trust laws. Two hypothesis i.e. Structure-Performance Hypothesis and Efficient Structure Hypothesis can be found within the SCP paradigm.

As per the structure-performance hypothesis, the extent of market concentration is negatively related to the competition in the market, as the market concentration inspires organisations to merge. The SCP paradigm specifically states that there is a straight relationship between the market concentration and the competition in the market. In support of this paradigm, a positive relationship between concentration in the market, calculated by the concentration ratio and firm performance i.e. profitability is expected, no matter what the efficiency score (market share) of the firm is. This is turn, implies that that firms have higher chances of earning better profits in a concentrated industry, irrespective of its efficiency. (Edwards, Allen and Shaik, 2005).

3.7.12. The X-Efficiency (ESX) and The Scale-Efficiency (ESS) hypothesis

According to Berger (1995), there is a chance of misspecification of existing models on market power because of the some excluded variables and thus, recommends that the models based on profitability of banks should take into account direct computation of X-efficiency (ESX) and scale efficiency (ESS).

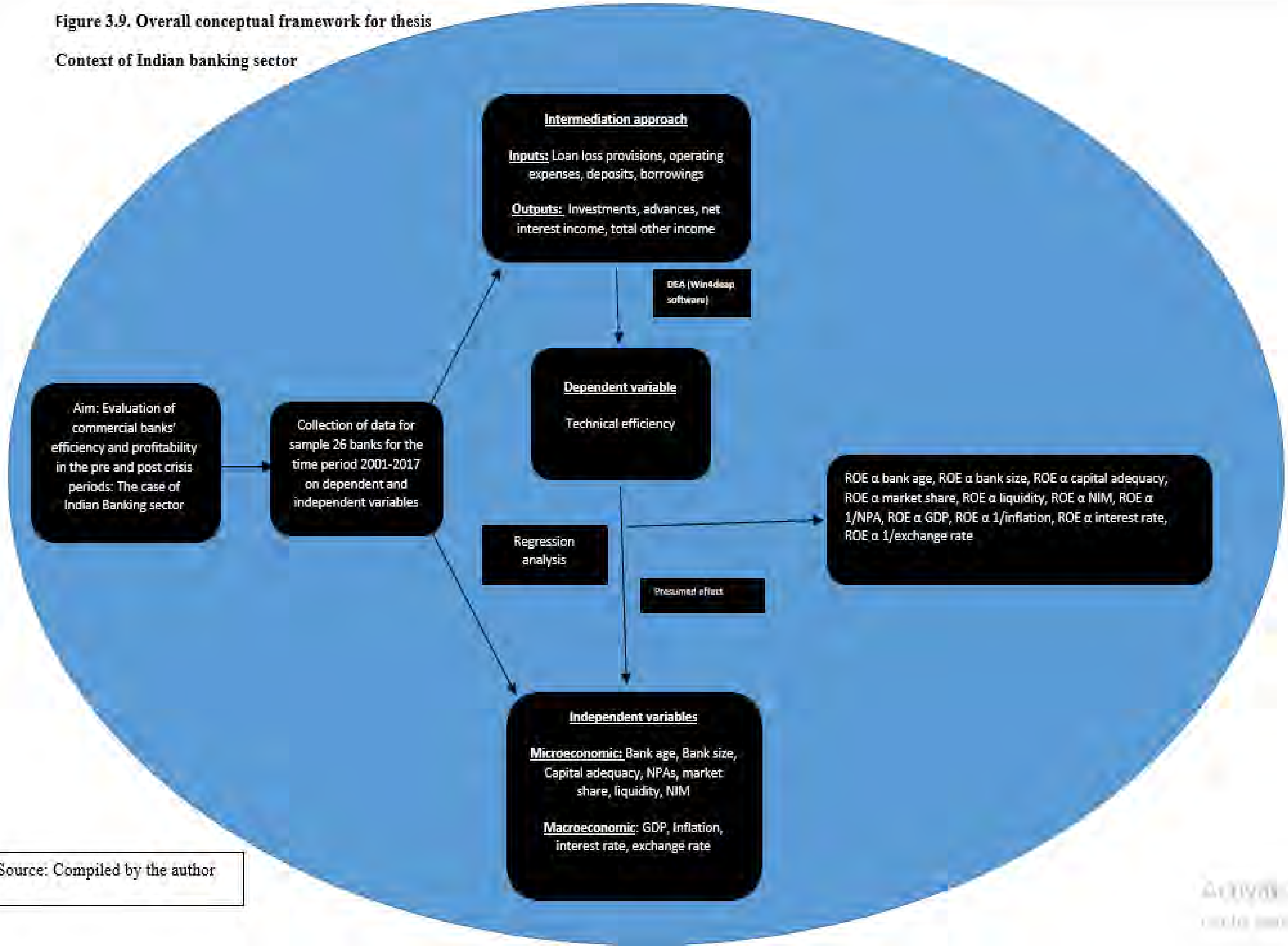
According to the ESX hypothesis, the organisations can lower their costs and thus, increase their profit levels as a consequence of talented and experienced management team and latest and efficient technology in place.

On the other hand, as per the ESS hypothesis, it's the efficient working structure of the firm, which helps them in cutting per unit costs and thus, improve per unit profit levels. Berger (1995) tested the ESS and ESX hypothesis on firms in the US and found out that a firm's profitability is positively related to the market share and variables of X-efficiency.

3.8. Overall conceptual framework for the research thesis

The overall conceptual framework for the research thesis, explained in sections 3.1-3.7 above can be represented by the figure 3.9 presented below.

Figure 3.9. Overall conceptual framework for thesis



Source: Compiled by the author

3.9. Summary of the chapter

To summarize, this chapter i.e. chapter 3 presented the conceptual framework which is followed in this research thesis. The chapter also presents and discusses different theories relevant to the research topic. The research follows a three step approach to study and evaluate the efficiency and profitability of sample commercial banks of India. In the first stage, the technical efficiency scores and profitability (ROE) of banks in the pre and post crisis periods are determined, where parametric methods are utilised for the calculation of technical efficiency scores. There are different parametric techniques which can be employed to measure efficiency of firms and out of all these techniques, the non-parametric method DEA has been employed to measure the efficiency of banks. There are two well-known and frequently used approaches which can be used to determine the inputs and outputs to be used in DEA i.e. production approach and intermediation approach and out of these two methods, this research thesis has employed the intermediation approach. In the second stage, the relationship between technical efficiency and profitability has been determined in the two research time-period samples and finally in the third stage, the relationship of bank profitability with different micro and macro variables has been determined and analysed using the regression analysis. The findings of the research project are finally explained using previous research work in the literature from developing and developed economies.

Chapter 4

Research Methodology

4.1. Introduction

The research methodology chapter outlines the philosophical prescription explaining the design, strategy and ontological assumptions, which were employed to conduct this research. The selection process for the research variables and the explanation of the research methodology used to achieve the research aims and objectives have been described concisely in this chapter. Furthermore, a research framework has been suggested to study the relationship between its dependent variable (ROE) and independent variables (bank age, bank size, non-performing assets, capital adequacy, market share, net interest margin, bank liquidity, inflation, GDP, exchange rate and real interest rate). The subsequent exploration of empirical findings of the literature review forms the rationale for the selection of above mentioned dependent and independent variables.

4.2. Problem statement

For the development and the smooth running of the overall economy of any country, the efficient working of financial institutions in that country is crucial. The banking industry is very competitive and to achieve a sustainable competitive advantage, it is vital to attain high performance standards at all times. To ensure the efficient working of these financial institutions, it is crucial to monitor and evaluate their performance in a timely manner.

According to Alharthi (2016), different methods have been used by researchers in the literature to determine the performance of banks such as profitability ratios (i.e. ROE, ROA,NIM), efficiency measurements (Technical efficiency, Pure technical efficiency, scale efficiency, allocative efficiency, profit efficiency, cost efficiency), bank stability (z-score, capital ratios) etc. According to Arslan and Ergec (2010), the traditional methods used for performance evaluation and management such as ratio analysis come with flaws. In terms of MacDonald and Koch (2006), the evaluation of economic entities merely on the basis of financial statements is not very wise and is difficult as the probability of the manipulation of those statements by the managers for the disguise of potential problems is quite high. Prior (2006) further adds that traditional performance evaluations methods can evaluate only one activity of a firm at a time which makes it difficult for the analysers to gain an overall perspective of the performance. According to Daley and Matthews (2009), the ratio analysis can be useful only to calculate the efficiency values, but the identification of the reasons responsible for causing inefficiencies still remains a task.

To overcome these limitations of traditional performance assessment methods, a rising trend can be observed towards the adoption of frontier methods (specifically DEA) for performance evaluation. The reason for the popularity of these new methods was given by Berger et al. (1993), where it stated that the scale and scope economies used in traditional methods account for less that 5 percent of the total cost while on the other hand; efficiency contributes more than 20 percent of the total costs of the banks. The extensive use of DEA for the evaluation and improvement of performance can be seen across various different manufacturing and service industries, such as: schools (Grosskopf and Moutray, 2001); hospitals (Prior, 2006); production companies (Liang et al., 2013); banks (Isik and Hassan, 2002).

In developing economies such as India, most of the research studies focus on overall performance and profitability of banks and little emphasis is given to efficiency and effectiveness (Raphael (2013). Also, the existing literature on banks' performance and its determinants focuses on banks from developed economies and less attention is being given to banks from emerging economies (Pastor, 2002, Varias & Sofianopoulou, 2012). Also, the studies on performance determinants of banks in India had methodological shortcomings e.g. small sample sizes, short time period data etc. (Debasish & Mishra, 2005). This research thesis addresses these limitations by studying efficiency as well as profitability of 26 commercial banks of India to gain a better overview of their performance, over the time period of 17 years (from 2001 to 2017), employing a two-step analysis , where the efficiency and ROE and; the relationship between the two performance indicators have been studied in the first step and the determinants of sample banks' performance are determined in the second step using Regression analysis (Raphael, 2013, Leigh et al., 2005, Wanke, Barros, Macanda, 2015). The research project also evaluates the impact of financial crisis on the efficiency, profitability and the relation profitability has with its determinants.

4.3. Research aim

The aim of this research is to evaluate technical efficiency and performance of Indian commercial banks before and after the crisis of 2008-2009 and then to examine the relative value of these concepts from the point of view of stakeholders.

4.4. Research objectives

This research thesis aims to achieve the following research objectives:

i. To extensively review the available literature on efficiency evaluation and determinants of banks' efficiency and performance in developed and emerging economies.

ii. To measure the technical efficiency of Indian commercial banks and compare and contrast them in the pre and post crisis periods.

iii. To empirically evaluate the performance of Indian commercial banks, and compare and contrast them in the pre and post crisis periods.

iv. To examine the relationship between technical efficiency and performance of Indian commercial banks.

v. To provide recommendations on the basis of empirical findings to bank managers and regulators for improvements in the Indian banking sector.

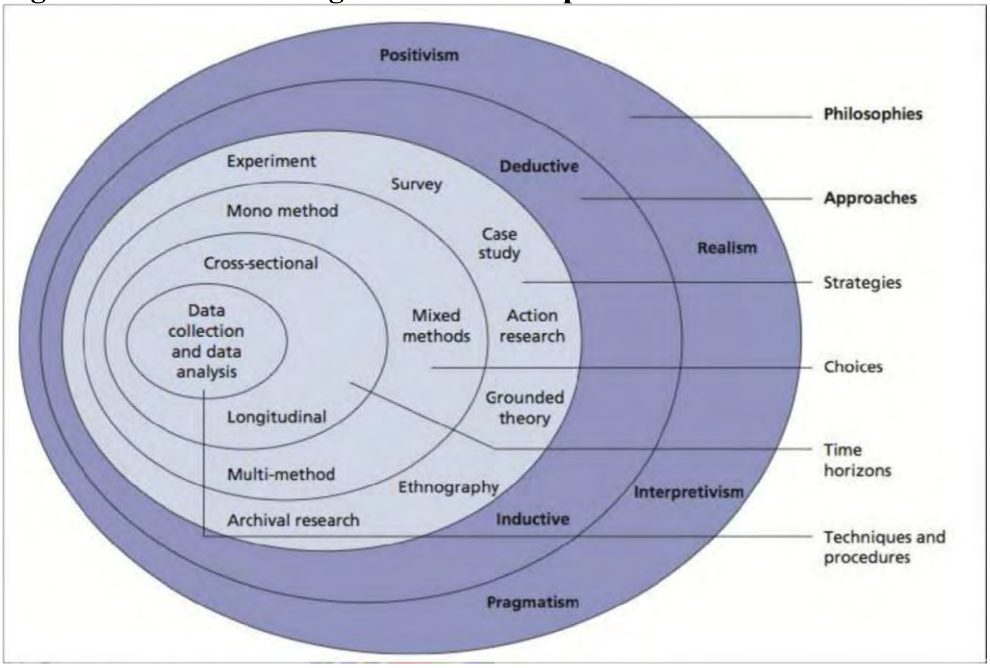
4.5. Research Philosophy

Saunders et al. (2009) states that any research's value lies in what does it contribute towards the evolution of contemporary knowledge, no matter what its motives are in terms of proposal of solution to specific issues. Thus, it's important to have a philosophical background before starting any research study to make sure the evolution of some new knowledge as a result. Creswell (2014) further endorses importance of research philosophy by emphasizing the identification of research philosophy as one of the most important players in the determination of research practice. However, Slife and Williams (1995) states that not all research studies clearly mention related philosophies.

4.5.1. Background of the research philosophy

Bryman (2012) defines Social research as providing answers to questions related to social scientific fields through academic research on relevant topics. Researchers have addressed their concerns via several approaches resulted from their expression of various considerations on conducting social research. Creswell (2014) has framed research design on the basis of three components, which are: methods of research, research strategy and research philosophy. Crotty (1998) introduced four elements for the process of research, which are i. epistemology (the theory of knowledge), theoretical perspective (the philosophical stance), ethnography (methodological strategy and design for the research) and research methods (the techniques and procedures utilised for data collection and analysis). Instead of sticking to Saunders et al. (2009), paradigms or the concept of ontology and epistemology as designed by Crotty (1998), Creswell (2014) further employed the "world views" concept which refers to the basic beliefs of actions for guidance such as post-positivism, pragmatism, interpretivism and realism. The approaches for research methods and strategies get influenced by these four philosophical views. The figure (4.1), presented below, illustrates the different research stages, given by Saunders et al. (2009), further clarifies the research process.

Figure 4.1. Different stages in a research process



Source: Saunders et al. (2009)

In order to avoid any confusion caused by the use of different concepts and terminologies invented by different researchers in the description of a specific research philosophy, this research thesis follows the approach given by Saunders et al. (2009). Each of the four approaches of research philosophy given by Saunders at al. (2009) i.e. realism, positivism, interpretivism and pragmatism, has three major concerns which are: ontology (the essence of reality), axiology (the character of values in research study) and epistemology (constitution of acceptable knowledge). Different researches have viewed these views in different manners and this in turn, can influence the approach towards a specific research study. For example, Saunders at al. (2009) stated that two of the issues i.e. epistemology and ontology tend to emerge together instead of their tendency towards their conceptually separate existence. Guba and Lincoln (1994) identified the similar link.

4.5.1.1. Realism

Opposing the concept of idealism, the realism approach represents the fact that certain things exist independent of human minds and their perceptions. Realism can be further classed into two categories: critical and direct. There are two stages to experience the world according to critical realism which are: the entity itself and sensation of that entity; and how the mind processes it afterwards. The second step is missing in direct realism.

4.5.1.2. Positivism

Under the positivism approach, researchers use existing theories to develop hypothesis, which are then tested via different statistical techniques. According to Remenyi et al. (1998), positivism allow researchers to perform their research with observable social materiality and like physical and natural scientists, the end product obtained from such researches are law like generalisations, grounded on the assumption that the researcher is free, doesn't affect or get affected by the research subject.

4.5.1.3. Pragmatism

According to the pragmatism approach, the main determinants in choosing epistemology, ontology and axiology is the research question. The concept of pragmatism lies between the two antipode philosophies: positivism and interpretivism.

4.5.1.4. Interpretivism

In contrary to positivism, the argument put forward by the interpretivism approach is that unlike physical sciences, the business and management studies are very complex in nature and can't be put into theory. It further states that humans should be treated as social characters rather than treating them as objects. The concept applies to research relevant to management studies, where the humans' actions and behaviour are the main focus of the research.

4.6. Research paradigm

Further to the approaches discussed above, Saunders (2009) further clarifies the research philosophy by introducing four paradigms of research philosophy which are: radical humanist paradigm, interpretive paradigm, functional paradigm and radical structuralist paradigm.

4.6.1. Radical Humanist Paradigm

This paradigm justifies the need for revolutionary change and breaks down the social barriers which pose limitations to the human potential.

4.6.2. Interpretive paradigm

Under the interpretive paradigm, a better understanding of the world's spiritual nature and human nature by researchers is achieved by continuous on-going observation of processes.

4.6.3. Functionalist Paradigm

The functionalist paradigm is mainly utilised for research studies on organisations. Under this paradigm, humans are believed to behave rationally and the organisational behaviour can be tested by testing of hypothesis.

4.6.4. Radical Structuralist Paradigm

According to this research paradigm, the constant changes arisen because of the crises in the economic and political environment are seen as the intrinsic structural dissension within the society.

4.6.5. Research paradigm followed by this research

In order to conduct an effective research, it's very important for a researcher to identify the most appropriate research paradigm and clarify all the assumptions associated with the character of the relevant science as well as the society.

After the consideration of various assumptions as well as different research philosophies, based on which a researcher forms its beliefs on the research questions, the functionalist paradigm has been found to be the most appropriate research paradigm for this research thesis as according to Saunders et al. (2009), the functionalist paradigm is the most suitable and popular paradigm for studies related to business and management fields.

According to Saunders et al. (2009), there are two dimensions to the functional paradigm, which are: objectivity and the regulation. The existence of social realities as entities in the external environment surrounding social characters forms the objectivist perspective. On the other hand, the regulatory perspective claims the organisational affairs' existing state and the means to improve from that state is proposed. These perspectives under the functional paradigm accomplish the requirements of researcher's task surrounding the impact of micro and macro determinants on the performance of Indian Commercial Banks.

Based on the assumption that profitability of banks is a reality and it exists as a social entity surrounding other social characters independently and objectively, it can be concluded that this research study follows objectivism. The rational explanation of the impact of bank age, bank size, non-performing assets, capital adequacy, market share, net interest margin, bank liquidity, inflation, GDP, exchange rate and real interest rate on the profitability of Indian commercial banks fulfils the regulatory perspective of the paradigm. Thus, the research is in line with Burrell and Morgan (1982), where a problem oriented approach is followed to propose practical solutions to practical issues.

From the point of view of epistemology grounds, this research has adopted the positivism and critical realism philosophy. Firstly, it is important to measure the efficiency and profitability of selected banks and investigate the micro and macro determinants of the performance of banks. The efficiency scores as well as profitability of banks are observable and thus, the research comes under the critical realism approach. Secondly, the research study requires the collection of secondary data related to the research variables. The data on the variables was collected in a value-free mean, which allows to test the chosen research hypothesis. There are two types of research approaches that can be utilised, on the basis of the association between the research and theory i.e. deductive and inductive. Under the deductive approach, a hypothesis is deducted from a relevant theory, the hypothesis is then tested and the theory is revised, if needed. On the contrary, the inductive approach follows a completely opposite path, where the findings from the collected data are analyzed, based on which a new theory is devised.   This research has followed the deductive approach. According to Bryman (2012), a deductive approach can be described as:

Figure 4.2. A deductive approach for research analysis

[Source: Bryman (2012)]

The reason for making use of deductive approach is that the research does not intend to develop a new theory or concept; instead it is testing the validity of existing concepts and models in a new market.

4.7. Research Design

According to Burns and Grove (2003), a research design can be defined as the blueprint to conduct the research study with the factors that may interfere with the research findings' validity, controlled to the maximum level. Parahoo (1997) defines a research design as the plan for the collection and analysis of data. According to Polit et al. (2001), a research design is the overall plan designed by the researcher on how to answer the research questions and test the research hypothesis.

This research study first attempts to ascertain the technical efficiency scores of sample Indian commercial banks using DEA in the pre and post crisis period. Secondly, the relationship between technical efficiency and financial profitability (ROE) have been studied in the two time frames. Thirdly, the determinants of ROE have been estimated and ascertained in the pre and post financial crisis period using regression methods. The study has utilised the descriptive type of research design as the main emphasis of the study is on the determination of cause-effect relationship between research variables.

The way this research has been conducted demonstrates the impact of each independent variable on the dependent variable.

4.8. Research population

Research population according to Cooper and Emory (1995), is the complete collection of all the research elements on which the research intends to make inferences. As per Cooper and Emory (1995), an element is the subject of measurement and the point of research. For this research thesis, the interest population is 26 commercial banks of India, all of which have been in existence in past 17 years.

4.9. Research Hypotheses

In order to shed light on the performance of banks, the researcher assumed the following research hypothesis:

H1. On the basis of DEA approach, the efficiency scores among different banks are similar.

H2. Efficient and inefficient banks in India cannot be characterized by any common features.

H3. There is no impact of the event of global financial crisis on the technical efficiency scores and profitability of banks in India. The technical efficiency and profitability of banks remains the same before and after the crisis.

H4. There exists no relationship between technical efficiency and financial profitability of banks.

H5. There exists no relationship between bank's ROE and microeconomic variables (capital adequacy, bank age, bank size, liquidity, market share, non-performing assets and net interest margin) for Indian commercial banks.

H6. There exists no relationship between bank's ROE and macroeconomic variables (GDP, inflation, exchange rate and real interest rate) for commercial banks in India.

H7. There is no impact of global financial crisis on the relationship ROE has with different independent micro and macro variables.

4.10. Data collection

The research methodology employed for this research project demands collecting relevant data from particularized documents and collating databases so as to analyse and develop a complete understanding of the subject in discussion. The study has adopted a panel data methodology to collect data on input and output variables of sample commercial banks.

The study has employed the well-known quantitative paradigm to collect the secondary financial panel data on inputs and outputs of sample banks. The required data has been collected from the published annual financial statements of sample banks and the central bank of India i.e. Reserve Bank of India database from 2001 to 2017. This chosen time period also covers the important event of global financial crisis. The examination and study of world financial markets show a dip in the years 2008-2009. Based on this as well as in line with Eichengreen and Gupta (2012), the data for this period has been excused in the research and the period 2002-2007 has been considered as the pre-crisis period, whereas the period 2010-2017 has been taken as the post-crisis period. The data for a given year represents the financial year from 1 April in the previous year to 31 March in the current year. For example, the data for the year 2002 represents the data for the financial year 1 April 2001 to 31 March 2002.

4.10a. Justification for the split of data into pre and post-crisis periods

As explained in chapter 4, the evaluation and analysis of technical efficiency and profitability of sample commercial banks of India has been conducted by collecting the data on dependent and independent variables from the Reserve Bank of India database for the time-period 2002-2017. The research data sample has been divided into two samples, where 2002-2007 has been considered as the pre-crisis period and 2010-2017 is the post crisis period. The data sample has been split into these two time-periods following the lines of previous research studies such as Eichengreen and Gupta (2012). The visual inspection of the data was also conducted by generating the graphs for the research variables' mean values for the time-period

2002-2017 to reach that decision. The data used to generate the graphs has been presented in table 4.1a and the visual presentation of research variables has been presented in graphs 4.1a-4.1h in appendix 1a.

From the visual inspection of the data, some effects of the global financial crisis can be observed on some of the research variables for the time-period 2007-2009. As the Indian banking sector is strictly regulated by the RBI, the effect isn't as much as it can be observed in banks across other countries and it can be said that the Indian banking sector didn't get directly affected by the financial crisis (Sinha & Khan, 2014).

4.11. Data diagnostic tests

For all the data on input and output variables to be used in DEA technical efficiency calculations and; dependent and independent variables to be used in regression analysis, descriptive statistics such as mean, median, maximum, minimum, standard deviation (S.D.), skewness, Kurtosis, probability, Jarque-Bera statistics etc. have been generated using E-Views 11.0 and presented.

According To Baltagi (2005), the research data needs to be diagnosed to assess its stability before any regressions are conducted to verify that the specified models' residuals are free of non-normal distribution, heteroskedasticity, serial-correlation and misspecification. The user guidance for E-Views 11 has suggested to conduct the diagnostic tests such as normality test, data stationarity test, on the panel data to assess its suitability for regression analysis.

4.11.1. Normality test

The data is tested for normality to ensure that the data comes from a population with normal distribution. According to Alejo et al. (2015), the data to be used in the regression analysis should be free from non-normal errors due to conceptual and methodological reasons. According to Montes-Rojas & Sosa-Escudero (2011), non-normal data can affect the performance of heteroskedasticity for panel data severely.

The data on dependent and independent variables to be used in regression analysis in this research thesis has been tested for normality by drawing the histograms, JarqueBera statistics and the associated probability value of the panel regression model residuals and will be tested against the following hypothesis:

Null Hypothesis, $H0$: The variables are not normally distributed

Alternative hypothesis, Ha: The variables are normally distributed

If the probability value is less than 5%, then we accept the null hypothesis. If the probability value is more than 5%, then we reject the null hypothesis and accept the alternative hypothesis.

4.11.2. Data stationarity test

The stationarity of data is assessed by checking the presence of a unit root. The data is said to have stationarity, if the shifting in time doesn't result in causing the change of the distribution shape. Some of the tests which can be employed to check the presence of unit root and thus, data stationarity are:

- Levin, Lin & Chu (LLC) test
- Im, Pesaran & Shin (IPS) W-stat test
- Augmented-Dickey Fuller (ADF) test
- Phillips-Perron (PP) test

For all these four tests mentioned above to assess the data stationarity, the following hypothesis is tested:

Null hypothesis, $H0$: Panels contain unit root i.e. the data is not stationary

Alternative hypothesis, $H1$: Panel don't contain unit root i.e. the data is stationary

The occurrence of unit root in the data for each research variable is tested by comparing their probability values. If the p value exceeds the 5 percent significance level, then the data contains a unit root and we accept the null hypothesis. If the p value is lower than 5 percent significance level, then we reject null hypothesis and accept the alternative hypothesis.

4.11.3. Correlation analysis

A correlation analysis can be explained as a statistical method, which evaluates the strength of association between two measurable variables. According to Baltagi (2005), the extent to which two independent variables are correlated can be drawn from the value of correlation coefficient. The value of correlation coefficient between 0.00-0.20 implies no correlation between two variables. Correlation coefficient value between 0.21-0.40 states low correlation between variables. If the value of correlation coefficient lies in the range 0.41-0.60, it means that the variables are moderately correlated. The correlation coefficient value in the range 0.61-0.80 implies highly correlated variables and finally 0.81-1.00 range correlation coefficient values imply perfect correlation between research variables. The research thesis first generates the correlation matrix of ROE with the explanatory variables and then checks for the correlation among the independent explanatory variables.

4.12. Technical efficiency of the sample commercial banks of India

The technical efficiency scores of Indian banking sector in general as well as the individual banks in the data set have been ascertained using DEA i.e. Data Envelopment Analysis.

There are two main efficiency types which have been most commonly used in the literature i.e. Technical efficiency (TE) and Allocative efficiency (AE). Allocative efficiency can further be categorised into Cost and Profit efficiency. According to Kumbhakar and Lovell (2003), a business is said to be technically efficient if it can produce more outputs from a given set of inputs or if it can produce given set of outputs using less inputs. Also a firm is said to be cost efficient, if it can produce given set of outputs at a lesser cost. And a business is said to be profit efficient if it can maximize profits using the same set of inputs and outputs.

The reason behind choosing technical efficiency for analysis in this research project is that the most of the research studies in the literature based on efficiency measurements have evaluated technical efficiency of firms. Examples include Drake et al. (2006), Daley & Mathews (2009), Assaf et al. (2011), Pasiouras (2008) and so forth. Secondly the main purpose of any business is to minimise inputs and maximise outputs and technical efficiency is based on the same principle. Thirdly the data relevant to different input and output variables to be used in the calculation of technical efficiency scores was readily available and accessible and finally the software utilised by the researcher for the calculation of efficiency scores is efficient in the calculation of technical efficiency scores.

The technical efficiency results in the pre and post crisis time-periods have been compared and critically assessed to determine whether the bank efficiency was higher in the pre or the post crisis period. The components of technical efficiency have also been compared and contrasted in the two time-periods. The inputs and outputs to be used in the calculation of technical efficiency scores are discussed below in the following sections i.e. 4.12.2.1 and 4.12.2.2. t-tests have also been conducted additionally on the inputs and output variables in the pre and post crisis periods to get insights on the technical efficiency of banks.

4.12.1. Selection of input and output variables to be employed in the DEA model

There has been a debate in the literature over the two main approaches i.e. production approach and intermediation approach which can be employed to choose inputs and outputs for the DEA model to calculate efficiency scores. No consensus can be found in the literature on the superiority of one approach as compared to the other.

4.12.1.1. Production approach

The production approach gives the same level as a normal company to banks and identifies the physical entities such as labour, capital etc. and other assets, liabilities etc. as outputs. As the deposits are produced using capital and labour, so they are considered as outputs under this approach.

4.12.1.2. Intermediation approach

In this approach, the classification of inputs and outputs is based on the basis of assets and liabilities where all the assets including labour are treated as inputs whereas all the liabilities play the role of outputs. It views financial institutions acting as mediators between the demand and supply of funds. Thus, the deposits are treated as inputs and the interest on deposits is a component of the total costs together with labour and capital expenses.

This research has adopted a variation of intermediation approach for the identification of inputs and outputs as it better represents the research objectives and it measures the operations' efficiency rather than efficiency of capital investments.

The variables used in the research to calculate the technical efficiency of sample banks using DEA are listed below.

4.12.2.1. Input variables

The input variables used in the calculation of technical efficiency of sample commercial banks of India using DEA are: Loan loss provisions, operating expenses, deposits and borrowings. These inputs have been determined using the intermediation approach and have been discussed in detail in following sections 4.12.2.1.1. – 4.12.2.1.4.

4.12.2.1.1. Loan loss provisions

The expenses which are kept aside as allowances to cover loans and which have not been paid or collected are treated as loan loss provisions. It is a provision to cover any losses occurred as a consequence of factors such as bad debts, customer defaults, renegotiations of terms of loan, which incur initially estimated payments and so forth. Also familiar as valuation allowance, loan loss provisions are considered as an adjustment to reserves of loan losses. (Ozili and Outa, 2017)

4.12.2.1.2. Operating expenses

Operating expenses are the expenses incurred by businesses through their normal everyday basis business operations. They can be abbreviated as OPEX. Expenses such as rent, payroll, insurance, marketing expenses, funds kept aside or used for research and development activities, inventory costs, equipment and machinery cost, repairs, taxes, travel and transportation costs, commissions, depreciation etc. One of the main responsibilities that the management needs to comply with is to determine how low the operating expenses can be reduced to without losing the firm’s ability to gain competitive advantage. (Damodaran, 1999)

4.12.2.1.3. Deposits

According to Nguyen, Tripe and Ngo (2018), deposits are liabilities that banks or financial institutions in general owe to their depositors. Deposits refer to the finances deposited in financial institutions for safekeeping. There are different types of deposit accounts in banks where the clients can deposit their money such as savings account, current deposit accounts, time deposit accounts, call deposit accounts, money market accounts, checking accounts and so forth. The depositor possesses the right to withdraw the money from the deposit accounts as per the terms and conditions of the accounts. When a client opens an account with a bank and deposits money in it, he/she gives a legal right to the bank to access the funds, thus it becomes as an asset for the bank, but the account itself acts as a liability for the bank. (Downes and Goodman, 2014)

4.12.2.1.4. Borrowings

When cash reserves of banks get low before the business day closures, banks need to borrow money from other banks or the central bank of the country, which is Reserve Bank of India in case of Indian economy. For the smooth running of business operations, bank need to make sure that they have the minimum threshold cash reserves at all times and when it gets low, banks can borrow money from the central bank utilizing this facility, which is called discount window. Borrowing at discount window has both pros and cons.

The advantage of discount window borrowing is that it's readily available and banks don't have to go into huge documentation or fight for negotiating terms, but the downfall of discount window borrowing is that the interest rates are higher than the borrowing rates offered by other banks. (Downes and Goodman, 2014)

4.12.2.2. Output variables

The outputs used in the research for the evaluation of DEA technical efficiency scores of Indian commercial banks, determined using the intermediation approach are: investments, advances, net interest income and total other income. These variables have been discussed in detail in following sections 4.7.2.2.1-4.7.2.2.4.

4.12.2.2.1. Investments

An investment, can be of both long term and short term in nature, is considered as an asset or a product, which is attained with the goal to generate remuneration or appreciation. In financial terms, an investment can be defined as the acquisition or purchase commodities with the purpose of not to consume them in present, but to use them in the future to generate wealth. In economic terms, investments are the monetary assets, which can later be utilised in future to generate income in terms of profits through interest, rent or by selling them at a higher price. Institutions can invest money in stocks, bonds and/or real estate. (Downes and Goodman, 2014)

4.12.2.2.2. Advances

Advances are the financial sources which are provided by financial institutions to their clients to meet their interim financial needs. In other words, advances are facility of credit, offered to clients by financial institutions for interest, which need to be paid back as per their terms, conditions and norms. Clients need to secure the credit against one or more of securities such as machinery, land or building mortgages, debtors' hypothecation, stock pro-notes, guarantees issues by partners, managers or directors etc. depending on the credit facility's terms and conditions.

The advances can be issues to the clients in following forms:

- **Overdrafts:** Overdraft is a facility offered by the financial institution to the client where a client can overdraw money from their accounts up to a certain limit.
- **Cash credit:** Cash credit is a financial service, where the clients are allowed to advance money up to a specified limit against the asset that they have pledged.

- **Bills purchased:** It is again a facility provided by financial firms where customers can get advances against the security of bills.

- **Interim loans:** Interim loans are an advance facility where the clients can have the access to the entire financial sum in one go. (Downes and Goodman, 2014)

4.12.2.2.3. Net interest income

Net interest income can be defined as the difference between the revenue that is earned from the assets of the banks and the expenses incurred by banks from paying out the liabilities. The assets of banks typically encompass all types of commercial as well as personal loans, financial securities, mortgages etc. and the liabilities are generated from the deposits made by the customers. Thus, Net interest Income i.e.

NII = interest earned from assets – the interest paid on deposits

Some banks are more sensitive to interest rate changes in terms of NII as compared to other banks. The sensitivity depends on the category of assets or liabilities held by the banks as well as on the fact whether the assets and liabilities are associated with fixed or variable rates of interest. Banks which have assets and liabilities with variable rates are more sensitive to fluctuations in interest rates as compared to banks with fixed rate assets and liabilities. There is a negative impact of interest rate fluctuations on banks which have assets with reprise often. Other factors which can have impact on a bank's NII are loan portfolio's quality, economic conditions, type of assets etc. (Downes and Goodman, 2014)

4.12.2.2.4. Total other income

Total income represents the income a business generates by means other than its normal day-to-day business operations. Some sources of other income are: income generated by sale of fixed assets of the business, rent, interest income generated from investment operations, gains made from foreign exchange operations, gains made from pension plans, and so forth. As other incomes are not always recurring in nature, some businesses don't include them in the income statement. (Downes and Goodman, 2014)

4.13. Performance

Walsh (2008) has suggested ROA (Return on Assets) and ROE (Return on Equity) as two of the fundamental measures of profitability and thus, performance, where

ROA= Net income/Book value of total assets and,

ROE= Net income/Book value of total equity

ROA measures how well an organization is taking advantage of its earning assets, whereas ROE measures how effectively a firm is managing its earning equity/capital. For larger banks, ROE has been recently gaining more popularity as compared to ROA as a measure of their financial profitability due to the fact that ROE is not dependent on the assets of the organization, due to which the organization can even compare the performance of its internal product lines or different business departments/units. This research thesis is also based on the measurement of performance of sample banks of India using ROE.

ROE of sample ICBs has been measured and compared in the pre and post crisis periods to determine whether the banks were more profitable in the pre or post crisis period. The micro and macro determinants of ROE have been determined in the pre and post crisis periods to ascertain whether the significant parameters of bank profitability are different in the two periods and whether the relationship of ROE with its determinants different or same in the two research time-period samples. The next section i.e. 4.14 discusses the tools/methods used to calculate technical efficiency and ROE estimation models in detail.

4.14. Data analysis

The research follows a two stage analysis like previous studies (Casu and Molyneux, 2003). The first stage is the estimation of technical efficiency scores of sample Indian commercial banks employing the well-known non-parametric approach i.e. DEA in the pre and post financial crisis periods. 2001-2007 has been taken as the pre-crisis period and 2010-2017 has been considered as the post crisis period. The efficiency scores have been calculated using the CCR version of the DEA model.

The calculations involved in the DEA model are done based on the selection of inputs and outputs as explained above in 4.7. The application of DEA in the research is based on the context of the total performance of the firm. Followed by this, the relationship between technical efficiency and financial profitability of banks indicated by ROE has been tested to determine whether the banks which are technically efficient are also financially profitable. In the second stage, a regression analysis has been performed between the dependant and independent variable to determine the relationship dependent variable has with the independent variables.

In general, the main indicator of a strong performance of a company is its profitability. Thus, ROE has been chosen as the dependent variable and the independent variables comprise of different microeconomic (bank age, bank size, capital adequacy, total assets, market share, net interest margin and non-performing assets and macroeconomic (GDP, Inflation, exchange rate and real interest rate) variables.

DEA has been chosen to calculate the efficiency scores due to many reasons: firstly, it can be used even for small sample sizes and secondly it does not demand assumptions about the frontier's functional form or the component of inefficiency. Sentero (2012) prefers the use of DEA over SFA for efficiency calculations due to the reason that DEA can be used even when it's hard to justify the traditional functions of cost and profit as they depend on boosting reactions to prices. Sentero (2012) further favours the use of DEA over SFA by stating that there is no requirement of measuring output prices in DEA which are generally not available specially for transactions, services, or outputs based on fees. The inputs and outputs of the business activities should generally work towards efficiency maximisation as:

Efficiency = Weighted sum of outputs/weighted some of inputs

Thus, a firm is fully efficient if it has efficiency score of 1 and inefficient if the efficiency score is less than 1.

There are two orientations available in DEA: input minimisation and output maximisation. This research thesis follows input orientation which is based on the assumption that during heightened competitive situations or times of changes in regulations, the companies tend to focus on cost cutting. Thus, the use of inputs is closely related to market structure changes. The estimation of input or cost efficiencies can be seen to be very popular in the literature (Berger, 2007, Goddard et al., 2001) due to the fact that management has more control over costs as compared to the outputs produced.

4.14.1. Data Envelopment Analysis (DEA)

Since the time researchers have started utilizing Frontier methods to measure and evaluate efficiencies of different firms, there has been no stop to the debate and discussion for the establishment of the best Frontier method for efficiency measurement. In parametric frontier methods (i.e. TFA, DFA and SFA), the shape of the frontier is presupposed, which makes it difficult to get rid of the specification errors from the estimated values of inefficiency. The non-parametric methods (i.e. FDH and DEA) are also not free of criticism due to the fact that they abolish the impact of random errors. Based on the data characteristics to be utilised in the empirical part of the research, the selection of the particular approach for the performance evaluation is made by the researchers. This research thesis has employed DEA to assess the technical efficiency of selected commercial banks of India. This is due to the fact that very few restrictions are imposed by this method on the selection of inputs and outputs. Additionally, this method does not limit the random errors in case of detailed data to be used in the empirical part of the research and imposes very few assumptions on the shape of the frontier.

Farrell (1957) introduced a single input-output model for performance assessment which was further extended by Charnes et al. (1978) to develop DEA. The original research of Charnes et al. (1978) described DEA as a non-parametric technique of linear programming which provided a new and revolutionary way to measure efficiency. It allows the calculation of the relative efficiency of a particular Decision Making Unit i.e. DMU by computing the ratio of outputs to inputs. The basic DEA model was input oriented, represented as CCR (i.e. Charnes, Cooper and Rhodes) and can be illustrated as follows:

Consider a set of j DMUs, where j=0, 1, 2, 3......, n

Assume that these DMUs produce s number of outputs after consuming m number of inputs.

More precisely, consider a DMUj, it consumes Xij amount of input i to produce Yrj amount of output r, where Xii ≥ 0 and Yrj ≥ 0.

In this case, the efficiency for each DMU is calculated by taking the maximum of the ratio of weighted outputs to weighted inputs, with the imposed condition that virtual ratio of output to input for every single DMU, taking itself into consideration must not transcend the value unity. For the subscript j, this programming problem for a given DMU can be mathematically illustrated as follows:

$$Maximum\ \theta = \frac{\sum_{r=1}^{s} \quad Y_{rj}\, U_r}{\sum_{i=1}^{m} \quad X_{ij}\, V_i} \text{............}\mathbf{(1)}$$

Where θ = the efficiency rating of the DMU being evaluated by DEA

X is the input, Y is the output

J = the number of the DMU being evaluated by DEA i = number of inputs consumed by the DMU, i = 1, 2, 3, ...,

m r = number of outputs produced by the given DMU, r=

1, 2, 3, ..., s

Yrj is the rth ouput of DMU j

Xij is the ith input of DMU j

Ur = coefficient assigned to the output r by DEA

Vi = coefficient assigned to the input i by DEA

If the value of θ is less than 100%, then the given unit is inefficient and there is scope for production of more output for the same given number of inputs.

The above mentioned equation for efficiency evaluation is subjected to the condition:

1, j = 1, 2, 3, ..., n

$\sum_{s}^{r=1} \quad YrjUr / \sum_{m}^{i=1} \quad XijVi \leq$

$Xij, Yrj \geq 0$

It implies that when the same set of coefficients U and V are applied to all the units being compared, no unit can have more efficiency than 100%.

The equation (1) has a problem that it generates an infinite solution. To address this issue, Charnes et al. (2006) added one more constraint to this equation, i.e.

$\sum_{i=1}^{m} \quad ViXio = 1$

and solved this equation following the duality theorem. The new refined model can be

expressed as:

minimum θ (2)

Subjected to the condition:

Xio, i= 1, 2, 3, ..., m

$\sum_{j=1}^{n} \quad Xij \curlywedge j \leq \theta$

Yro, r=1, 2, 3, ..., s

$\sum_{j=1}^{n} \quad Yrj \curlywedge j \geq$

And $\curlywedge j \geq 0$

And is a non-negative vector variable and is equal to ($\curlywedge$ 1,$\curlywedge$ 2,$\curlywedge$ 3, $\ldots \curlywedge n)T$

λ

In case of $\theta = 1$, $\lambda\, 0 = 1 and \lambda\, j = 0$ and $j \neq 0$

The optimal value of θ, i.e. $\theta* < 1$

As it is assumed that the data is non-zero, the equation Yro makes the value

$\sum_{j=1}^{n} \quad Yrj \lambda\, j \geq$

of λ as non-zero as well. This is due to the reason that Yro ≥ o and Yro ≠ 0. Thus, the optimal value of efficiency for a given DMU i.e. $\theta*$ can be estimated between 0 and 1 only. This basic form of the DEA model i.e. CCR assumes that there is always a constant return to the scale. The improvements in this basic model were brought down by Banker et al. (1984) with the introduction of another constraint to the equation i.e., which makes it possible to evaluate the effect of returns

$\sum_{j=1}^{n} \quad \lambda\, j = 1$

to scale. This research project will employ both the CCR (1978) model as well as BCC (2006) (i.e. Banker, Charnes and Cooper) model to evaluate efficiency so that a more objective efficiency can be measured.

4.14.2. Model for estimation of determinants of ROE

The second stage of research analysis is about the analysis of the relationship between banks' financial profitability i.e. ROE and; microeconomic (bank age, bank size, capital adequacy, total assets, market share, net interest margin and non-performing assets) and macroeconomic (GDP, inflation, exchange rate and real interest rate) determinants of performance using the regression methods in the pre and post crisis periods to determine whether the significant parameters of profitability of banks are different in the two periods.

4.14.2.1. Analytical model

The regression analysis is useful especially in cases where the dependent variables are limited by a restricted threshold value. The work of other researchers (i.e. Stavarek, 2004) in the literature is followed in this analysis:

$yo* = \beta xo + \varepsilon o$

, otherwise

$y_o = y_o{}^*$, if$y_o{}^* > 0$

yo= 0, εo≈ N (0, σ2),

Where xo is the vector and β is the coefficient of the independent variable, $yo*andyo\ are\ the$ vectors of the profitability of banks.

After we fit in all the explanatory variables, the extended equation for the regression analysis comes out as follows in the equation 4.1:

ROE = β1 CAPAD + β2 LAGE+ β3SIZE + β4MSHARE + β5NIM + β6

NPA+β7 LIQ+ $\beta 8INF$+ $\beta 9GDP$ + β10 LEXR + β11 RIR ……………………………(4.1)

The terms used in the above equation for Regression analysis are explained below:

1. **ROE** stands for return on equity and represents financial profitability of a business.
2. **CAPAD:** CAPAD stands for capital adequacy ratio and it measures the capital reserves held by a bank. It refers to the adequate amount of equity held by the bank, which enables them to absorb any shocks they may face. In other words, CAPAD ratio represents capability of banks to withstand any financial shocks or losses.

Also known as CRAR i.e. capital to risk weighted assets ratio, it can be measured by percentage of risk weighted credit exposures of a bank. The ratio provides a mean of depositors' protection and it promotes a stable, efficient and effective financial system around the world. The capital held by banks can be put into two categories:

- **Tier 1 capital:** The tier 1 capital helps banks in absorbing losses without forcing them to cease their trading.
- **Tier 2 capital:** The tier 2 capital helps banks in the absorption of losses when they are working towards winding up their operations, thus providing less protection to depositors. CAPAD can be measured by the following ratio:

CAPAD = tier 1 capital + tier 2 capital / risk weighted assets

Sentero (2012) states that it is critical for banks to follow the requirement of maintaining minimum capital adequacy ratio to make sure that they have a cushion to absorb the maximum possible losses before they become insolvent and stop trading thus, giving at least some protection to the depositors. Tier 2 capital can be utilised in the absorption of losses during the winding up of banks' trading operations after they have lost all the tier 1 capital.

Credit exposures of banks can be measured by adjusting the value of assets appearing on the balance sheets of lenders. All the loans which are present on lending bank's balance sheet are weighted against their risk. For instance, the loans issued to the government have risk weightage of 0 percentage and on the other hand, loans issued to individuals have 100 percent risk factor associated with them. Sentero (2012) and Pasiouras (2008) have demonstrated a positive relationship between capital adequacy and performance of banks.

3. **LAGE:** LAGE here represents the age of a bank, i.e. total number of years, a bank has been operating for. The age of a bank in a given year has been calculated by counting the total number of years from its year of foundation in this research thesis.

LAGE=log(age)

Age of a bank represents its learning curve. A positive impact of age of bank is expected on its profitability. According to Alkheil et al. (2012), older banks are found to possess higher scores of efficiency and thus, profitability compared to newer banks due to the experience they have gained in terms of better managing their operations, provision of better product and service quality to its clients, strategies to tackle and prevent failures and losses, strategies to lower their inputs and maximize their outputs etc.

4. **SIZE:** SIZE here denotes the total size of a bank in terms of its assets. In line with Amindu & Wolf (2013), Sufian & Habibullah (2009) and Adusei (2015), SIZE of a bank has been computed by taking natural logarithm of total assets of a bank i.e.

SIZE = log (total assets)

Based on the market power hypothesis, it is expected that size of a bank effects its performance positively. According to Sufian & Habibullah (2009); and Hauner (2005), the bank size tends to have positive impact on its performance due to two reasons: first reason is the concept of market power i.e. large sized banks benefit from paying less for the inputs they utilize and secondly, the banks with larger size enjoy increased returns to scale through the minimization of fixed cost from skills such as large number of services or through higher efficiency gained by the use of skilled workforce.

5. **MSHARE:** MSHARE i.e. market share can be explained as a company's share in the total sales, deposits or total assets in the market and can be expressed as:

MSHARE = Market share in terms of assets/sales/deposits

For this research study, the market share of banks in terms of their deposits have been taken into consideration, joining the lines of Victorija (2015).

According to Grigorian and Manole (2002), there tends to be a positive relationship between bank performance and its market share, MSHARE due to economies of scale and also, better performing and more efficient banks tend to compete more competently to increase their market shares.

6. **LIQ:** The essence of a banking based business is to translate short-duration deposits into long-duration loans. Thus, banks would always find themselves stuck in the dilemma of maturity mismatch related issues. Thus, it becomes foremost important for banks to keep adequate liquid assets at all times, which can be converted into cash to circumvent insolvency issues.

Liquidity measures the cash as well as other current assets which are quickly available and can be used by banks to pay off their short-term bills and other financial obligations. In general, liquidity represents banks' cash reserves. Liquidity has been demonstrated as one of the most important determinants of banks' performance as it ensures their proper functioning. Inadequate levels of liquidity can have adverse impact on the market value of a bank's assets. Based on the availability of data, the liquidity ratio has been calculated as follows for this research thesis:

$$LIQ = (Cash/deposit * deposits/total\ liabilities)/100$$

According to Bordeleau and Graham (2010), banks holding some liquid assets experience improved profitability, however, there is a point where holding any further liquid assets diminishes its profitability. Waleed at al., (2016) also showed a significant impact of bank liquidity on its performance.

7. **NPA:** A non-performing asset in banking is defined as a loan or an advance offered by the bank to a client for which the payment of principle amount or the interest is overdue by more than 90 days. For this research study, NPA ratio has been calculated by dividing total NPAs with total advances i.e.

NPA ratio = Total NPAs/total advances

A negative relationship between bank performance and its NPAs is expected. NPAs effect the funds' recycling negatively, which in turn effects the credit deployment negatively. When loans become non-recoverable, it not only has negative impact on credit availability in the future, but also has bad effect on banks' financial soundness. As per Mittal & Suneja (2017), NPAs negatively impact the performance of banks due to their undermining and negative influence on liquidity position, future funding, risk, productivity.

8. **NIM:** NIM stands for net interest margin. NIM of banks can be measured by calculating the difference between the earned/generated interest income and the interest amount paid to their lenders, for instance deposits. NIM is expressed in percentage and can be calculated as follows:

NIM = Interest income generated from loans or other assets-interest paid on borrowings/average earning assets

According to Saksonova (2014), NIM is the most appropriate and the most suitable criterion which can be used to assess and evaluate a bank's effectiveness and its operations' stability.

Research studies such as Naceur and Goaeid (2003), Rosly and Bakar (2003), Ahmad and Matemilola (2013) and Guru et al. (2002) have demonstrated a positive impact of NIM on profitability of banks as lower overhead expenses such as interest expense and thus, a better and more efficient expense management helps the banks in terms of high profitability.

9. **INF:** INF stands for inflation. It has been considered as a macroeconomic and external variable in this research thesis. Inflation measures macroeconomic stability of the country. Inflation can be calculated from annual CPI (Consumer Price Index). The annual rate of inflation can be computed using Fisher's equation, which is:

$$í \approx \Pi + r$$

where r represents the real rate of interest, í represents nominal rate of interest and inflation rate is represented by Π. According to Marinkovic & Radovic (2014), the above mentioned Fisher equation assumes that on the basis of future market expectations regarding inflation rate, the nominal rate of interest adjusts itself and thus, widens the gap between interest expenditure and interest income.

A negative impact of inflation is expected on performance of banks as per Andrew (2005), Bruce (2008) and; Saksonova & Solovjova (2005). According to Andrew (2005), inflation causes a decrease in the real value of money and other related items with an attached monetary value and; uncertainty about future condition of inflation in the economy, which in turn discourages firms to make investments.

10. **GDP:** GDP stands for Gross Domestic Product. It can be defined as the monetary value of all the products and services produced within a country in a given time period. It is usually calculated on an annual basis.

$$\text{GDP} = \text{Annual Economic growth}$$

A general assumption would be that the performance/profitability of banks are positively related to the macro-economic factor of GDP as a growth in financial services and their quality is observed when the economy is booming and boosting. But results obtained by some of the research studies are completely different. Tan and Floros (2011) has demonstrated a negative relationship between GDP and banks 'profitability for Chinese banks for the time period 2003-2009 and a positive relationship between profitability and cost efficiency of those banks.

Similar results were obtained by Combey and Togbenou (2017), where a negative relationship between profitability and GDP has been shown for banks in Togo for the time period.

11. **LEXR:** LEXR here denotes log of exchange rate. Exchange rate can be defined as the value of one currency in another currency. The worth of one nation's currency in respect to some other currency too is referred as the exchange rate. Each nation chooses the regime of exchange rates that will be used for its respective currency. There are three main types of exchange rate regimes, which are:
    - **Floating exchange rate**, where exchange rates are set on the forex market that is accessible to a variety of market participants and where trading activity is constant: i.e. 24 hours a day, 7 days a week, excluding weekends
    - **Forward exchange rate system,** which is stated and exchanged today but is intended for payment transactions on a certain future date
    - **Spot exchange rate system**, which refers to the rate in effect at the time.

(O'Sullivan and Steven, 2003)

Growth in exchange rate plays a significant role in costs of production and prices of commodities. These rising costs causes heightened needs for financing and this, in turn affects the performance of banks. Fluctuations in exchange rates gives birth to uncertainties for businesses, which causes adverse circumstances for economies. This can further exacerbate the economic conditions of recession and rise in no-performing assets (NPAs) for businesses. (Keshtgar et al., 2020)

Previous research studies such as Manyok (2016), Kiganda (2014) and Suhadek & Suciany (2020) etc. have demonstrated a non-significant/weak relationship between exchange rate and financial performance of banks. A significant negative impact of exchange rate fluctuations on financial performance was reported by research studies such as Keshtgar et al., (2020), Chauque & Rayappan (2018) and Mbithi (2009). Khan et al., (2018), Nguyen & Do (2020), Qing & Kusairi (2019) and Kasman et al., (2011) demonstrated a positive relationship between exchange rate and financial performance.

12. **RIR:** RIR here stands for real interest rate. Interest rate denotes the interest sum which is due each period as a percentage of the sum lent, loaned or invested. The

total interest amount is dependent upon the principal sum that is loaned or lent, the duration, rate of interest. Interest rates can be real or nominal.

The real interest rate (RIR), as opposed to the nominal interest rate, indicates a shift in buying power resulting out of an expenditure or by the debtor giving up something. The nominal interest rate, on the other hand, refers to the interest effectively paid on a debt or purchase. A RIR thus, is a rate of interest which has been modified to account for the impact of inflation. It represents the real cost of money to a borrower after adjustment and the real return to a lending institution. (Brock, 2022)

Thus, RIR = nominal interest rate-inflation rate (real or predicted)

Research work such as Suhadek & Suciany (2020), Tamtelahitu & Mubin (2020) and Rashid and Khalid (2017) found out a weak relationship between interest rate and performance. In contrary to this, research studies such as Khan et al., (2018), Kasman et al., (2011), Qing & Kusairi (2019) reported a significant negative relationship between interest rate and financial performance and Basabeh & Abdelkader (2019) and; Ndlovu et al., (2018) demonstrated a significant positive impact of interest rate on financial performance of firms.

4.14.3. Softwares employed for data analysis

4.14.3.1. DEA calculations

In order to measure the technical efficiency of selected banks using DEA and to analyse the results, the research will employ software called Win4Deap2.1. This software, specialized in calculations involved in DEA, provides the front end for the original DEAP software developed in 1996 by Tim Coelli. In contrary, the Win4Deap doesn't replace the original DEAP software. This software has three principal options:

- The standard CCR and BCC model, which can be employed for the calculations of technical and scale efficiencies.

- The extended model to calculate cost and allocative efficiencies.
- Calculation of total factor productivity indices by Applying Malmquist DEA to panel data.

Win4Deap 2.1 is actually a 32 bit Windows DOS program, which can be used to operate the numerical efficiency calculations' requirements of DEA. In order to implement Win4Deap software, the installation of DEAP.EXE is must, but that's not the scenario in case of DEAP software as it can work pretty well without requiring the instalment of Win4Deap. Unlike DEAP, Win4Deap facilitates the use of a grid and thus, there is no such requirement of spreadsheets to enter data files and data instructions. Thus, data can be stored in any file or folder in case of Win4Deap rather than storing it in just DEAP's. It can be run on any of the Window's version.

This software developed by Coelli is very popular in the literature and has been brought in use by many researchers, for instance, Huss and Cullman (2007), Perrigot and Barros (2008) etc. All the above discussed three models of DEAP software can be used with either an input or output orientation apart from the measurements of cost efficiency which has the option of only an output orientation.

This research study has employed Win4deap2.1 to calculate technical efficiency scores of sample Indian commercial banks for the pre-crisis (i.e. 2001-2007) and the post crisis (i.e. 2010-2017) periods using the CCR model of the program.

4.14.3.2. Calculations involved in regression analysis

To test the relationship between the dependent variable i.e. ROE of sample Indian commercial banks and the independent variables i.e. micro and macro determinants of banks' profitability such as bank age, bank size, Non-performing assets, capital adequacy, market share, net interest margin, bank liquidity, inflation, GDP, exchange rate and real interest rate and to study the impact these micro and macro variables have on profitability of banks, a regression analysis is performed between the dependant and independent variables. GMM (Generalized Methods of Moments) regression method has been utilised to estimate the regression model between dependent and independent variables. As explained in section 4.11, research data can be associated with various endogeneity issues such as non-normality, non-stationarity, correlation, serial-correlation, multicollinearity, panel cross-section dependence, heteroskedasticty etc. and different tests have been suggested to diagnose these issues with the data The benefit of estimating regression models using GMM estimation method is that it automatically takes care of any endogeneity issues with data without having to test the data for the same and taking any other corrective measures.

The regression analysis has been performed using E-Views 11. These regression models are run to estimate the determinants of profitability in the pre and post crisis periods separately to determine whether the banks were more profitable in the pre or the post crisis period. It also gives insights into whether the significant parameters of bank profitability are different or same in the two periods.

E-Views is an unconventional and user friendly object-aligned powerful interface which assists students, organisations, government representative firms, and academic researchers in statistics, forecasting and modelling etc. It is Window's statistical package which is very popular among researchers and is frequently used for econometric investigations of time series data. It is a constituent of IHS, which was initially designed by QMS i.e. Quantitative Micro Software. It is compatible with Windows XP or newer versions of Windows. The latest version of E-Views is E-Views 11 which was released in April, 2019. Agung (2011)

- **E-Views features:** E-Views can be utilised to perform statistical and/or econometric investigations such as analysis, estimation and forecasting involving cross-sectional, time-series and panel data. It makes use of Windows Graphical User Interface i.e. GUI and makes use of a combination of RDB i.e. Relational Database and spreadsheets to perform the statistical software traditional tasks. It is then linked to a programming language.

- **Data format in E-Views:** The data to be used in E-Views analysis is stored in an unregimented and proprietary file format. Numerous data formats such as SPSS, RATS, TSP, Excel, and databank are supported by E-Views for inputs and outputs.

4.15. Relationship between technical efficiency and performance of banks

In this section, the technical efficiency and financial profitability of banks are compared and critically discussed to determine the links between the two and; to evaluate whether that relationship is same or different in the pre and post crisis periods. This will allow the researcher to discuss the implications this relationship has for banks and the banking sector. The relationship between ROE and EFF (technical efficiency) of ICBs will be studied and analysed using the Spearman's Rank-Order Correlation Coefficient method.

According to Clef (2013), Spearman's rank order correlation is a non-parametric category of Pearson's correlation. It is one of the most commonly used and useful tools, which can measure the direction and strength of relationship between two ranked parameters/variables, which are intervals, ordinals or ratios. Contrary to a linear relationship studied by Pearson's correlation, the Spearman's correlation measures the strength of a less-restrictive monotonic relationship between two variables. As the relationship between ROE and the technical efficiency is expected to be monotonic (i.e. if the value of one variable increases, the value of other variable will either increase or decrease), Spearman's correlation coefficient is used to study the direction and strength of that relationship. The strength of monotonic relationship between two variables is determined using the value of Spearman's rank-order correlation coefficient, i.e. p/rho. The value of p lies between -1 to +1, where -1 denotes a strong negative relationship, 0 denotes no relationship and +1 denotes a strong positive relationship between two variables. The Spearman's rank-correlation test works on the following hypothesis:

Null Hypothesis,Ho: There exists correlation between the two ranked variables

Alternative hypothesis, Ha: There exists no correlation between the two ranked variables

To accept $H0$, the calculated rho value should be higher than the critical value of n in the Spearman's significance table given below:

Table 4.1. Spearman's rho table

n\α	0.2	0.1	0.05	0.02	0.01	0.002		n\α	0.2	0.1	0.05	0.02	0.01	0.002
4	1.000	1.000	–	–	–	–		18	0.317	0.401	0.472	0.550	0.600	0.692
5	0.800	0.900	1.000	1.000	–	–		19	0.309	0.391	0.460	0.535	0.584	0.675
6	0.657	0.829	0.886	0.943	1.000	–		20	0.299	0.380	0.447	0.522	0.570	0.662
7	0.571	0.714	0.786	0.893	0.929	1.000		21	0.292	0.370	0.436	0.509	0.556	0.647
8	0.524	0.643	0.738	0.833	0.881	0.952		22	0.284	0.361	0.425	0.497	0.544	0.633
9	0.483	0.600	0.700	0.783	0.833	0.917		23	0.278	0.353	0.416	0.486	0.532	0.621
10	0.455	0.564	0.648	0.745	0.794	0.879		24	0.271	0.344	0.407	0.476	0.521	0.609
11	0.427	0.536	0.618	0.709	0.755	0.845		25	0.265	0.337	0.398	0.466	0.511	0.597
12	0.406	0.503	0.587	0.678	0.727	0.818		26	0.259	0.331	0.390	0.457	0.501	0.586
13	0.385	0.484	0.560	0.648	0.703	0.791		27	0.255	0.324	0.383	0.449	0.492	0.576
14	0.367	0.464	0.538	0.626	0.679	0.771		28	0.250	0.318	0.375	0.441	0.483	0.567
15	0.354	0.446	0.521	0.604	0.654	0.750		29	0.245	0.312	0.368	0.433	0.475	0.558
16	0.341	0.429	0.503	0.582	0.635	0.729		30	0.240	0.306	0.362	0.425	0.467	0.549
17	0.328	0.414	0.488	0.566	0.618	0.711								

Source: Kendall (1970)

The value of p/rho has been calculated by using the following formulae:

In case of non-tied ranks:

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$

Where n is the number of cases and di is the difference between the paired ranks

And for tied ranks:

$$\rho = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2 \sum_i (y_i - \bar{y})^2}}$$

where i denotes the paired score

As the research data on ROE and EFF contains tied ranks, the second formula will be used to calculate the value of p/rho.

4.16. Summary of the chapter

To summarize, this chapter i.e. chapter 4 discussed the research aim, objectives, problem statement, research hypothesis, research paradigm, research philosophy, research design, research population, data collection methods, research approach, data diagnostic tests, analytical model for research and the softwares which have been used for analysis of data. The research thesis follows the functionalist and objectivism research paradigm. The research philosophy to be followed by the research is positivism and critical realism. Further to this, the research work is based on deductive research approach and a descriptive type of research design. The research has been conducted in two time-periods i.e. before and after the crisis. The research population comprises of 26 banks for time period of 17 years i.e. 2001-2017, where 2001-2007 is the pre-crisis period and 2010-2017 is the post-crisis period. The data on banking inputs, outputs, ROE and the independent explanatory variables has been collected from the Reserve bank of India database. The data is tested for normality, stationarity and correlation using different diagnostic tests. The research has been conducted in three main steps: firstly the technical efficiency and ROE of banks are determined (where technical efficiency scores are calculated using the DEA approach and the inputs & outputs are determined using the intermediation approach), secondly the relationship between ROE and its determinants is ascertained using the GMM regression analysis method and; finally the relationship between technical efficiency and ROE of banks is tested using Spearman's rank-order correlation coefficient. In addition to this, t-tests are conducted on the DEA inputs & outputs and; the ROE determinants to gain additional insights on the operating conditions in the two time-periods. DEA efficiency scores of banks have been calculated using the software Win4Deap 2.1 and regression analysis will be run on E-Views 11.

Chapter 5

Descriptive analysis

5.1. Introduction

This chapter presents a summary of the descriptive analysis of the variables used to conduct this research project. The thesis makes use of both the descriptive as well as inferential statistics making a specific use of DEA and regression analysis to provide in depth insights on the technical efficiency and profitability of Indian commercial banks in the pre and post crisis period, impact of internal i.e. capital adequacy (CAPAD), bank age (LAGE), bank size (SIZE), market share (MSHARE), non-performing assets (NPAs), net interest margin (NIM), liquidity (LIQ) and external i.e. Real interest rate (RIR), Exchange rate (LEXR), Inflation (INF) and Gross domestic product (LGDP) factors on the profitability of Indian commercial banks in the pre and post crisis period to assess whether the determinants of profitability in the pre and post crisis period are same or different and finally study the relationship between technical efficiency and profitability of banks. This analysis covers the important event of global financial crisis of 2007-2008. In line with Eichengreen and Gupta (2012), 2001-2007 is considered to be pre-financial crisis period and from 2010 to 2017, the period is known as post-financial crisis period.

The Chapter presents a brief description of the statistics, input and output variables utilised in DEA and dependent and independent variables to be used in the regression analysis. For the regression analysis, the research employs the dimensions i.e. bivariate and multivariate analysis. According To Baltagi (2005), the research data needs to be diagnosed to assess its stability before any regressions are conducted to verify that the specified models' residuals are free of non-normal distribution, heteroskedasticity, serial-correlation and misspecification. This research thesis follows the data diagnosis tests such as normality test, data stationarity tests using LLC (Levin, Lin and Chu) unit root test, IPS (Im, Pesaran &Shin) unit root test, ADF (Augmented Dickey-Fuller) test and PP (Phillips-Perron) test and correlation analysis. As the regression models are estimated using the GMM regression estimation technique, all the endogeneity issues associated with the data are already taken care of by the estimation method. All the diagnosis tests and regressions are conducted using the software E-Views 11. The detailed empirical results of the all the tests are presented in the below sub-sections subsequently.

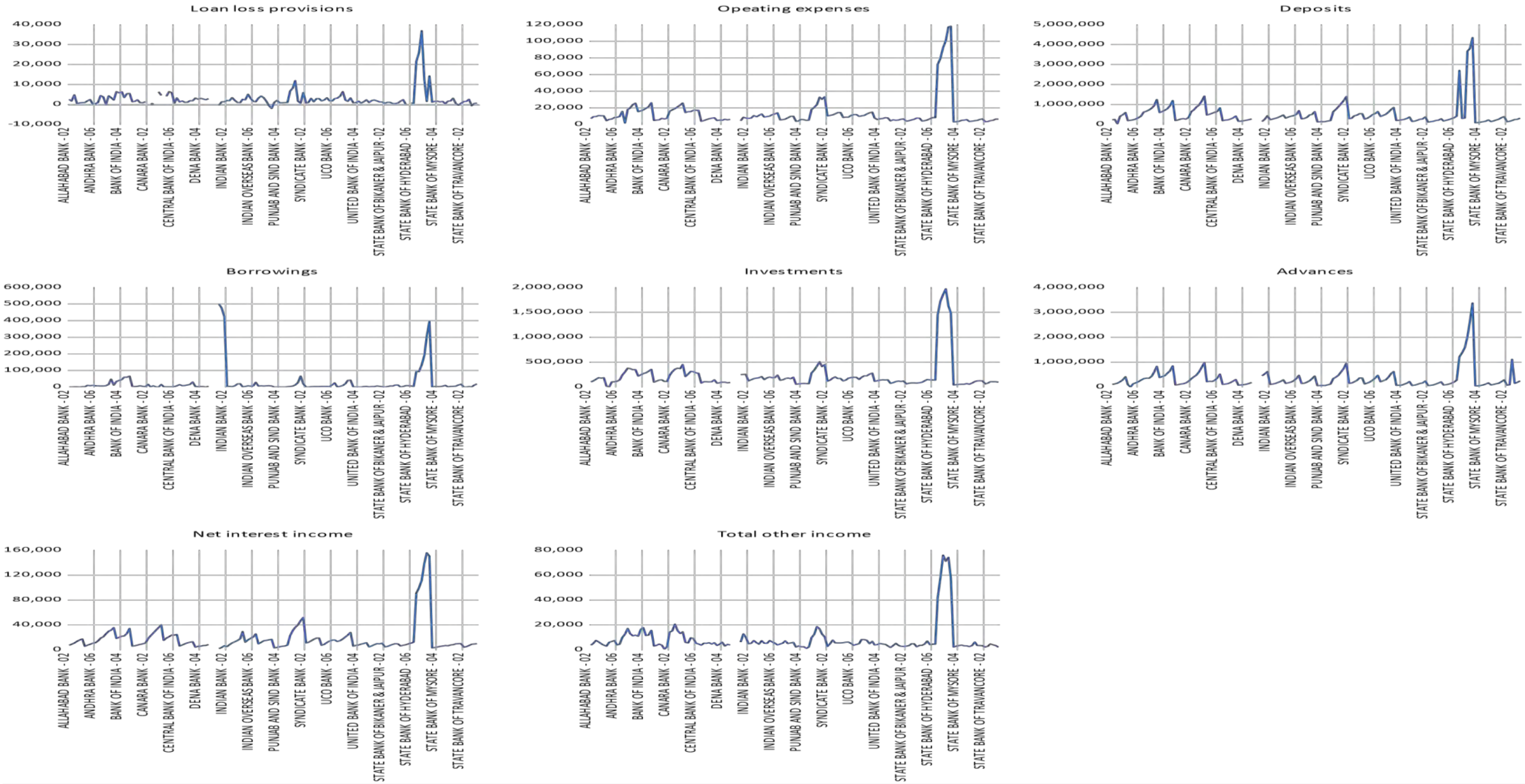
5.2. Descriptive statistics of dependent and independent variables to be used in Regression analysis

This section of the report signifies certain important statistical values of different dependent and independent variables for pre-financial crisis and the post-financial crisis periods in order to analyse the performance of banking sector of India. With the help of descriptive analysis, important and useful insights regarding the nature of the data have been interpreted. As explained in section 4.8.2.1 (chapter 4), ROE (Return on Equity) is the dependent variable and the independent variables are capital adequacy ratio (CAPAD), bank age (LAGE), bank size (SIZE), market share (MSHARE), non-performing assets (NPA), net interest margin (NIM), liquidity (LIQ), inflation (INF), GDP (LGDP), Exchange rate (LEXR) and Real interest rate (RIR). The data for these research variables for the time period 2001-2017 has been collected from Reserve Bank of India database and has been presented in tables 5.1-5.19 in appendices 1 and 2.

5.2.1. Graphical representation of data

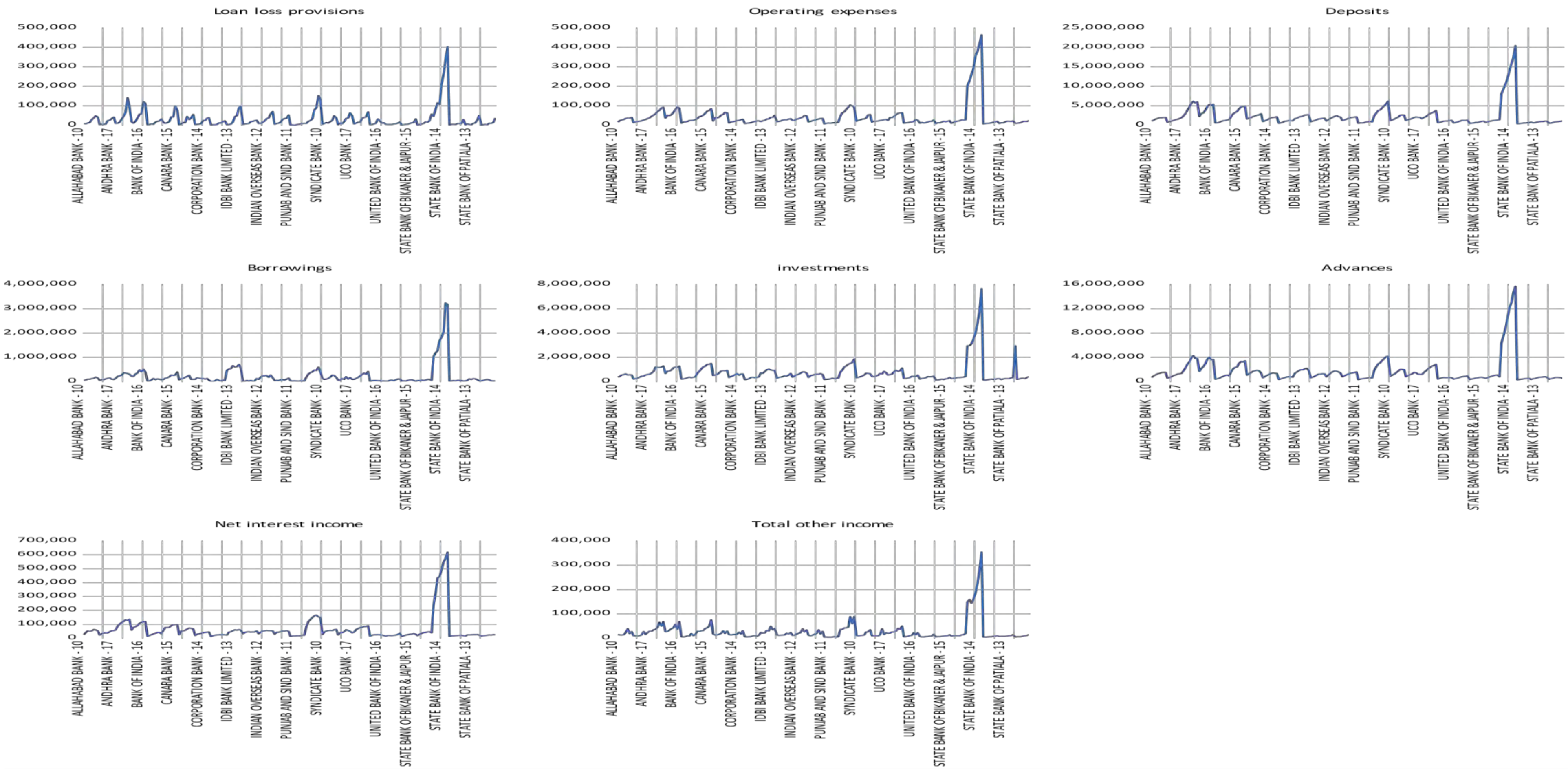
The graphical representation of the growth of each of the input and output variables to be used in calculation of ICBs technical efficiency scores using DEA, the dependent and independent research variables used in regression analysis before and after the financial crisis periods have respectively captured by figures 5.1-5.4.

<u>Figure 5.1. Growth rate of DEA input and output variables before the financial crisis (i.e. 2002-2007)</u>



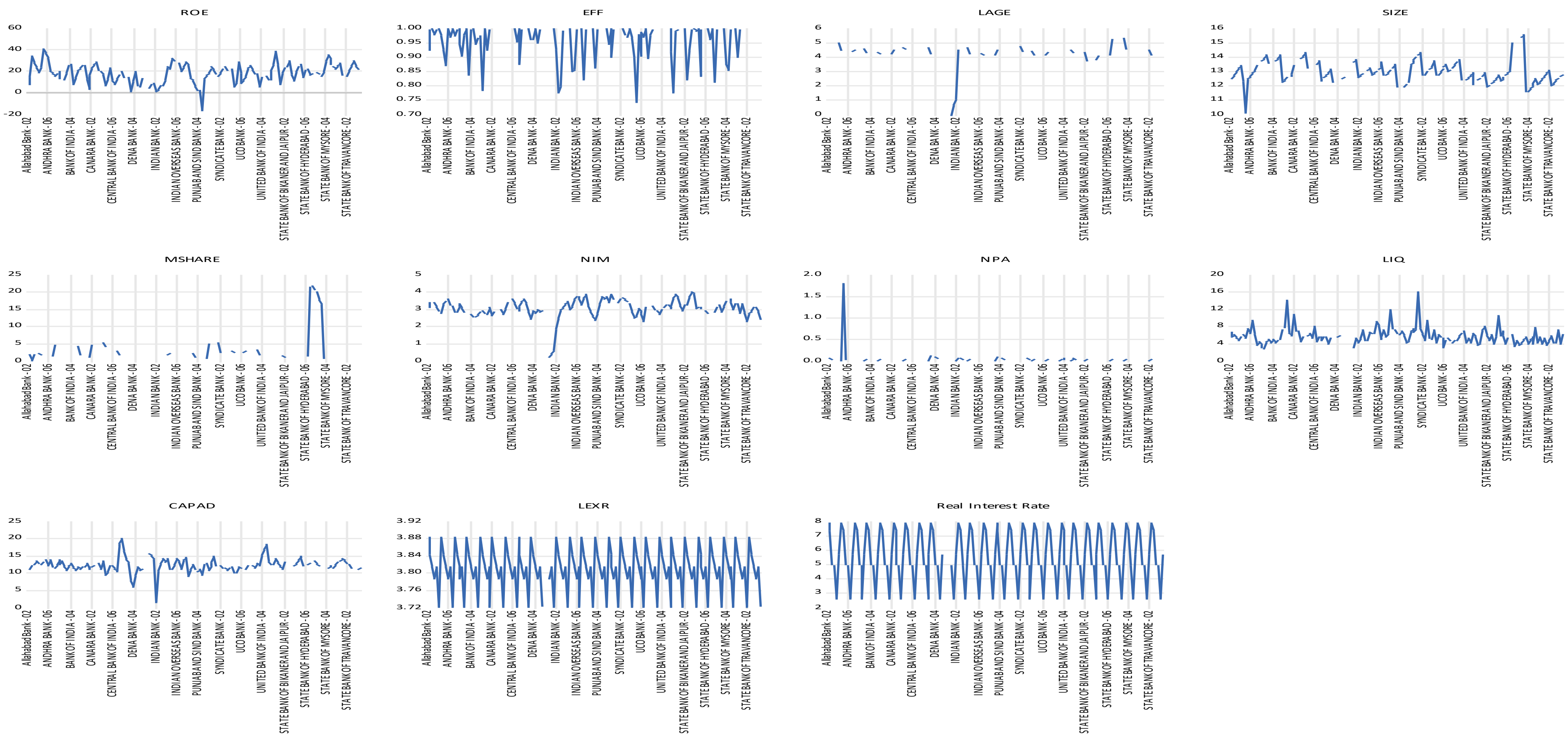
Source: Graphical representation of variables by E-Views 11

Figure 5.2. Growth rate of DEA input and output variables after the financial crisis (i.e. 2010-2017)



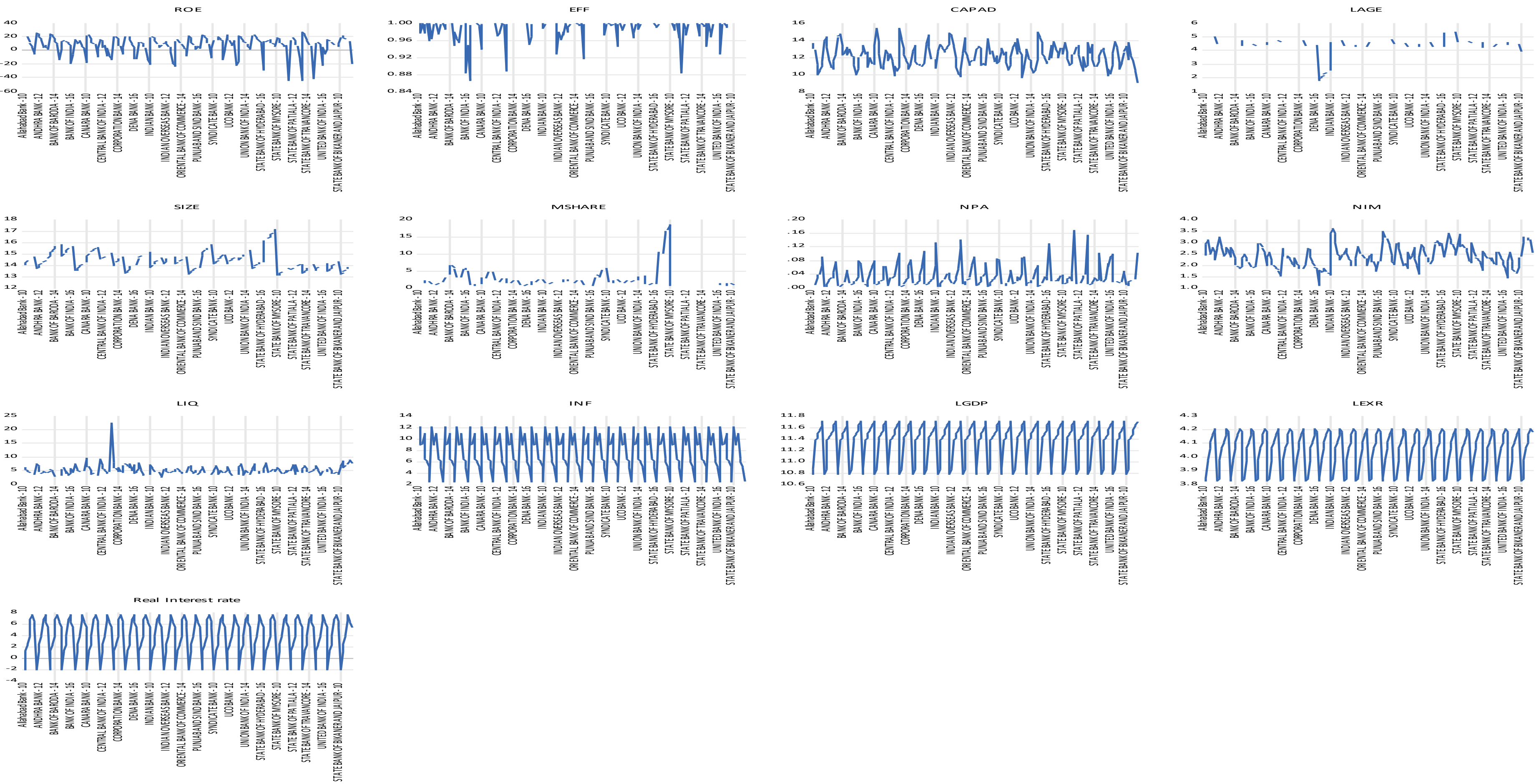
Source: Graphical representation of variables by EViews 11

#-Figure 5.3. Growth rate of dependent and independent variables before the financial crisis (i.e. 2002-2007)



Source: Graphical representation of variables by E-Views 11

Figure 5.4. Growth rate of dependent and independent variables after the financial crisis (i.e. 2010-2017)



Source: Graphical representation of variables by E-Views 11

5.2.2. Descriptive statistics

Tables 5.22-5.25 present the basic statistical description of the DEA input and output variables and the independent research data variables to be used in the regression analysis before and after the financial crisis periods respectively. These statistical tables give an overview of the research data's historical behaviour in terms of their mean, median, maximum value, minimum value, standard deviation, skewness, kurtosis, probability, sum, statistics for Jarque-Bera and so forth.

Table 5.20: Work file statistics before the financial crisis

Workfile Statistics
Date: 10/02/20 Time: 16:20 Name: MR DATA 2002-7 Number of pages: 1 Page: Untitled Workfile structure: Panel - Annual Indices: NAME x DATEID Panel dimension: 26 x 6 Range: 2002 2007 x 26 -- 156 obs
Object Count Data Points series 15 2340 alpha 1 156 coef 1 750 Total 17 3246

Source: Workfile statistics generated by the author using E-Views 11

Table 5.21: Work file statistics after the financial crisis

Workfile Statistics
Date: 10/02/20 Time: 16:22
Name: MR DATA 2010-17 Number of pages: 1

Page: Untitled
Workfile structure: Panel - Annual
Indices: NAME x DATEID
Panel dimension: 26 x 8
Range: 2010 2017 x 26 -- 208 obs

Object	Count	Data Points
series	14	2912
alpha	1	208
coef	1	750
Total	16	3870

Source: Workfile statistics generated by the author using E-Views 11

Tables 5.20 and 5.21 above present some statistics about the work files on research variables before and after the financial crisis respectively and looking at these statistics, it is clear that there are in total of 156 data observations before the financial crisis and 208 observations of data after the crisis, which need to be investigated for panel regression analysis.

Table 5.22. Descriptive statistics of DEA input and output variables before the financial crisis (2002-2007) (in INR)

	LOAN_LOSS_PROVISIONSS	OPEATING_EXPENSES	DEPOSITS	BORROWINGS	INVESTMENTS	ADVANCES	NET_INTEREST_INCOME	TOTALOTHER_INCOME
Mean	2860.877	13295.32	490879.9	26476.5	229349	329305.3	18293.85	8411.919
Median	1736.5	7996.644	311637.1	5377.367	143520.2	204105.6	10942.62	5053
Maximum	36935	118235.2	4355211	500055.4	1970979	3373365	155891.2	76124
Minimum	-1991	1648	31477	1.947	1052	1151	1878.524	522
Std. Dev.	4401.452	18603.26	600749.5	78766.27	317963.5	433764.9	24331.95	12136.24
Skewness	4.896	4.164	4.368	4.715	4.110	4.154	4.00	4.262
Kurtosis	32.627	21.028	24.851	25.235	19.976	24.565	20.181	21.619
JarqueBera	6004.306	2431.83	3415.062	3597.129	2193.737	3293.589	2214.856	2585.734
Probability	0	0	0	0	0	0	0	0
Sum	423409.8	1967707	72650226	3918521	33943651	48737178	2707490	1244964
Sum Sq. Dev.	2.85E+09	5.09E+10	5.31E+13	9.12E+11	1.49E+13	2.77E+13	8.70E+10	2.17E+10
Observations	148	148	148	148	148	148	148	148

Source: Descriptive statistics generated by the author using E-Views 11

Table 5.23. Descriptive statistics of DEA input and output variables after the financial crisis (2010-2017) (in INR)

	LOAN_LOSS_PROVISIONSS	OPEATING_EXPENSES	DEPOSITS	BORROWINGS	INVESTMENTS	ADVANCES	NET_INTEREST_INCOME	TOTALOTHER_INCOME
Mean	30546.71	42978.14	2313821	217372	717740.9	1733581	63858.73	26934.6
Median	14575.18	25571.35	1554886	95100.35	480425.4	1119053	42002.19	14810.65
Maximum	403637.9	464727.7	20447514	3233446	7659896	15710784	618597.4	354609.3
Minimum	611.1	7181.844	388800	9153.381	129271.4	295358.6	11000.22	3942.169
Std. Dev.	48653.16	62837.72	2683549	404620	874620.6	2174479	88617.62	41622.25
Skewness	4.4383	4.551399	3.891861	5.09384	4.583161	4.113629	4.337823	4.78728
Kurtosis	28.30197	25.61894	21.38871	33.54062	29.38685	22.51963	23.35947	30.42646
JarqueBera	6231.194	5152.137	3455.668	8983.157	6762.49	3888.766	4244.715	7313.653
Probability	0	0	0	0	0	0	0	0
Sum	6353716	8939453	4.81E+08	45213379	1.49E+08	3.61E+08	13282617	5602397
Sum Sq. Dev.	4.90E+11	8.17E+11	1.49E+15	3.39E+13	1.58E+14	9.79E+14	1.63E+12	3.59E+11
Observations	208	208	208	208	208	208	208	208

Source: Descriptive statistics generated by the author using E-Views 11

Looking at the results of descriptive statistics of DEA input and output variables presented in tables 5.22 and 5.23, the variables Loan loss provisions, operating expenses, deposits, borrowings, investments, advances, net interest income and total other income have mean values in INR of 2860.877, 13295.32, 490879.90, 26476.50, 229349, 329305.30, 18293.85 and 8411.919 respectively before the financial crisis and; 30546.71, 42978.14, 2313821, 217372, 717740.90, 1733581, 63858.73, 26934.60 respectively after the period of global financial crisis. The DEA input and output variables in the same order have median values in INR of 1736.50, 7996.644, 311637.10, 5377.367, 143520.20, 204105.60, 10942.62 and 5053 respectively before the financial crisis and; 14575.18, 25571.35, 1554886, 95100.35, 480425.40, 1119053, 42002.19, 14810.65 respectively after the financial crisis. The maximum values of these variables in the same order in INR are 36935, 118235.20, 4355211, 500055.40, 1970979, 3373365, 155891.20 and 76124 respectively before the financial crisis and; the maximum values are 403637.90, 464727.70, 20447514, 3233446, 7659896, 15710784, 618597.40, and 354609.30 respectively after the financial crisis. The DEA variables in the same order have minimum values in INR of -1991, 1648, 31477, 1.947, 1052, 1151, 1878.524 and 522 respectively before the crisis and; 611.10, 7181.844, 388800, 9153.381, 129271.40, 295358.60, 11000.22, 3942.169 respectively after the period of global financial crisis.

From table 5.22, with a careful analysis of the spread of the standard deviation series, it can be concluded that before financial crisis, the DEA variables loan loss provisions, operating expenses, net interest income and total other income are less volatile in their essence as compared to other DEA variables with standard deviation values in INR of 4401.452, 18603.26, 24331.95 and 12136.24 respectively. The variable Deposits has demonstrated the highest level (std. deviation value of 600749.50), whereas the variable loan loss provisions has shown the lowest level (std. deviation value of 4401.452) of volatility among all other DEA variables before the period of financial crisis. Similarly, by looking at the statistics presented in table 5.23, it can be analysed that similar trends of volatility have been demonstrated by DEA variables after the financial crisis with deposits being the most volatile variable (std. deviation value of 2683549). Looking at the data of DEA variables presented in tables 5.1-5.16 in appendix 1, a consistent increase in deposits in Indian banking can be observed in Indian banking sector from 2002-2007 and after 2007, a big escalation can be seen in the total deposits figure of the market in 2008. Looking at the total deposits' figure of the market, it can be sensed that there is a significant increase in the deposits of Indian banks during and after the global financial crisis of 2008-2010. According to Eichengreen and Gupta (2013), the reason behind the volatility of deposits' market share of Indian commercial banks can be contributed to the fact that during and after the financial crisis, a significant relocation of public trust and thus, deposits can be noticed from private banks to state owned and public banks.

Further to this, information related to the normal distribution of data series can be generalized from the figures for skewness, kurtosis and Jarque-Bera. The skewness figures represent how symmetric a data series is around its mean and on the other hand, kurtosis statistics of data series depict the curvature of data distribution. Finally the statistics for Jarque-Bera analyse the normal distribution of distinctive data series (Users guide, E-Views 11). The statistics for skewness presented in tables 5.22 and 5.23 illustrate that all the input and output variables used to calculate DEA efficiency of banks have positive values of skewness, both before and after the era of financial crisis. The Kurtosis statistics for all the DEA research variables surpass the value 3, before and after the financial crisis and thus, they have leptokurtic distribution. As all the DEA research variables have non-zero value for skewness and all the Kurtosis values are different from three, the probability values of Jarque-Bera indicate the rejection of null hypothesis, which implies that the distribution of the research variables exhibit non-normality.

The descriptive statistics of research variables to study profitability of Indian commercial banks before and after the financial crisis have been presented in tables 5.24 and 5.25 respectively.

Table 5.24. Descriptive statistics of dependent and independent variables before the financial crisis (2002-2007)

	ROE	EFF	CAPAD	LAGE	SIZE	MSHARE	NPA	NIM	LIQ	INF	LGDP	LEXR	RIR
Mean	18.51	0.969	12.38	4.34	13.01	2.97	0.04	3.06	5.83	4.76	10.39	3.81	5.48
Median	19.15	1.00	12.11	4.43	12.92	1.75	0.02	3.12	5.61	4.31	10.39	3.81	4.90
Maximum	40.31	1.00	20.12	5.30	15.55	21.84	1.79	3.98	16.10	6.39	10.58	3.88	7.90
Minimum	-15.87	0.75	1.70	0	10.11	0.20	0	0.23	2.87	3.77	10.20	3.72	2.60
Std. Dev.	8.45	0.06	1.94	0.62	0.80	3.70	0.15	0.54	1.88	1.02	0.13	0.05	1.74
Skewness	-0.42	-2.01	-0.13	-4.48	0.54	3.82	11.49	-2.20	2.11	0.61	0.17	-o.32	-0.20
Kurtosis	4.02	6.22	10.64	29.53	4.71	18.15	137.09	12.28	10.83	1.66	1.69	2.48	2.13
Jarque-Bera	10.89	164.21	362.98	4888.35	25.60	1787.20	114888.50	653.48	490.93	20.41	11.43	4.19	5.71
Probability	0	0	0	0	0	0	0	0	0	0	0	0.12	0.06
Sum	2757.93	144.46	1842.06	646.90	1938.18	442.26	6.14	456.69	868.77	708.69	1544.72	567.43	8.15.90
Sum Sq. Dev.	10557.93	0.47	557.50	57.29	95.21	2024.08	3.20	43.20	520.70	152.64	2.49	0.37	447.49
Observations	149	149	149	149	149	149	149	149	149	149	149	149	149

Source: Descriptive statistics generated by the author using E-Views 11

Table 5.25. Descriptive statistics of dependent and independent variables after the financial crisis (2010-2017)

	ROE	EFF	CAPAD	LAGE	SIZE	MSHARE	NPA	NIM	LIQ	INF	LGDP	LEXR	RIR
Mean	8.05	0.99	12.15	4.44	14.48	2.37	0.03	2.39	5.09	7.61	11.36	4.05	3.94
Median	9.96	1	12.17	4.52	14.41	1.55	0.02	2.35	4.69	7.62	11.46	4.09	4.60
Maximum	26.88	1	15.38	5.35	17.11	18.40	0.17	3.62	22.52	12.11	11.71	4.21	7.60
Minimum	-44.37	0.87	9	1.79	13.03	0.48	0	1.11	2.46	2.49	10.78	3.82	-2.00
Std. Dev.	12.32	0.02	1.23	0.52	0.77	2.70	0.03	0.46	1.79	3.04	0.33	0.14	3.01
Skewness	-1.68	-3.31	0.19	-2.83	0.82	3.72	1.87	0.25	4.79	-0.12	-0.85	-0.53	-0.67
Kurtosis	6.65	15.27	2.61	14.00	3.83	19.24	6.65	2.61	45.08	1.91	2.18	1.75	2.39
Jarque-Bera	213.09	1685.80	2.54	1327.81	29.10	2765.44	236.72	3.53	16140.6	10.69	30.85	23.41	18.91
Probability	0	0	0.28	0	0	0	0	0.17	0	0.01	0	0	0
Sum	1674.9	206.11	2526.35	922.53	3012.42	493.83	6.83	496.95	1057.96	1583.66	2362.67	841.66	819.00
Sum Sq. Dev.	31411.8	0.10	311.54	56.47	121.67	1513.52	0.19	43.99	660.29	1907.47	21.93	4.08	1879.77
Observations	208	208	208	208	208	208	208	208	208	208	208	208	208

Source: Descriptive statistics generated by the author using E-Views 11

By looking at the descriptive statistics presented in table 5.24 and 5.25, it can be observed that the mean values of variables ROE, EFF, CAPAD, LAGE, SIZE, MSHARE, NPA, NIM, LIQ, INF, LGDP, LEXR and RIR are 18.51, 0.969, 12.38, 4.34, 13.01, 2.97, 0.04, 3.06, 5.83, 4.76, 10.39, 3.81 and 5.48 respectively before the financial crisis and; 8.05, 0.99, 12.15, 4.44, 14.48, 2.37, 0.03, 2.39, 5.09, 7.61, 11.36, 4.05 and 3.94 respectively after the financial crisis. The research variables in the same order have median values of 19.15, 1.00, 12.11, 4.43, 12.92, 1.75, 0.02, 3.12, 5.61, 4.31, 10.39, 10.39, 3.81 and 4.90 respectively before the financial crisis and; 9.96, 1.00, 12.17, 4.52, 14.41, 1.55, 0.02, 2.35, 4.69, 7.62, 11.46, 4.09 and 4.60 respectively after the period of financial crisis. The variables in the same order have maximum values of 40.31, 1.0, 20.12, 5.30, 15.55, 21.84, 1.79, 3.98, 16.10, 6.39, 10.58, 3.88 and 7.90 respectively for the time period 2002-2007 and; 26.88, 1.0, 15.38, 5.35, 17.11, 18.40, 0.17, 3.62, 22.52, 12.11, 11.71, 4.21 and 7.60 respectively for the time period 2010-2017. The minimum value of the research profitability indicator variables in the same order are -15.87, 0.75, 1.70, 0.00, 10.11, 0.20, 0.00, 0.23, 2.87, 3.77, 10.20, 3.72 and 2.60 respectively before the financial crisis and; -44.37, 0.87, 9.0, 1.79, 13.03, 0.48, 0.00, 1.11, 2.46, 2.49, 10.78, 3.82 and -2.00 respectively after the financial crisis.

By looking at the spread of standard deviation values of profitability determinants before the financial crisis presented in table 5.24, it can be analysed that the variables EFF, NPA, NIM, LGDP and LEXR with std. dev. values of 0.06, 0.15, 0.54, 0.13 and 0.05 respectively have exhibited less volatility as compared to rest of the variables. Further to this, the variable ROE with std. dev. value 8.45 has demonstrated the highest volatility whereas LEXR has shown the least amount of volatility before the financial crisis. By looking at the standard deviation values of these variables after the financial crisis presented in table 5.25, it can be observed that the similar variables i.e. EFF, NPA, NIM, LGDP and LEXR with respective std. dev. values of 0.02, 0.03, 0.46, 0.33 and 0.14 are less volatile as compared to the remaining variables after the financial crisis. ROE is the most volatile variable (std. dev. 12.32), whereas EFF (std. dev. 0.02) and NPA (std. dev. 0.03) are the least volatile variables after the financial crisis. The NPA ratio, here, is calculated by dividing Non-performing assets by total advances of the bank. As per Sirohi (2016), some of the factors which contribute towards the volatility of NPAs in banks include banks 'lending policy, credit concentration, supervision, management efficiency, labour issues, loan wave off policies of the government, legal system in the country, competition in the market, state of economy and so forth to name the least. The possible reason behind this can be strict policies of banks in terms of credit grants to individuals and government regulation, especially after the financial shock experienced by the banks during the global financial crisis.

By carefully looking at the skewness statistics from tables 5.24 and 5.25, it can be observed that before the financial crisis the variables ROE, EFF, CAPAD, LAGE, NIM, LEXR and RIR have negative values of skewness and the remaining variables i.e. SIZE, MSHARE, NPA, LIQ, INF and LGDP have positive values of skewness. After the financial crisis the variables ROE, EFF, LAGE, INF, LGDP, LEXR and RIR are negatively skewed and; the remaining variables CAPAD, SIZE, MSHARE, NPA, NIM and LIQ have positive values of skewness. This means that before the financial crisis, the distribution of variables SIZE, MSHARE, NPA, LIQ, INF and LGDP have a long right tail, whereas the variables ROE, EFF, CAPAD, LAGE, NIM, LEXR and RIR have long left tail. On the other hand, after the event of financial crisis, the distribution of variables CAPAD, SIZE MSHARE, NPA, NIM and LIQ have long right tail and the distribution of variables ROE, EFF, LAGE, INF, LGDP, LEXR and RIR have a long left tail.

Apart from the variables INF, LGDP, LEXR and RIR before the financial crisis and variables CAPAD, NIM, INF, LGDP, LEXR and RIR after the financial crisis, rest of the variables surpass the value 3 for Kurtosis statistic and thus, they have leptokurtic distribution. As all the research variables have non-zero value for skewness and all the Kurtosis values are different from three, the probability values of Jarque-Bera are non-significant at 1%, 5% and 10% for all variables (except LEXR and RIR before financial crisis and; CAPAD and NIM, which have significant values of probability at 1%, 5% and 10% after the financial crisis) indicate the rejection of null hypothesis, which implies that the distribution of the research variables exhibit non-normality both, before and after the crisis.

5.3. Results of the diagnostic tests

This section presents and discusses the results of series of diagnostic tests run on the data to assess if the data is normally distributed, is stationary and is free of correlation. The data stationarity is assessed using LLC (Levin, Lin and Chu) unit root test, IPS (Im, Pesaran & Shin W-Stat) unit root test, ADF (Augmented Dickey-Fuller) test and PP (Phillips-Perron) test and a correlation matrix has been generated to assess the degree of correlation between research variables. As the regression models are estimated using the GMM regression estimation method, all the other data endogeneity issues (if there are any) such as autocorrelation, multicollinearity, Hetroskedasticity, panel-cross section dependence, serial-correlation etc. are automatically taken care of. All the diagnosis tests have been conducted using E-Views 11. The detailed empirical results of the all the tests are presented in the below sub-sections subsequently.

5.3.1. **Normality test**

To test whether the data was normally distributed or not, the research study generated histograms and Jarque-Bera probability statistics on the residuals of the panel regression equation. The normal distribution of data is based on the following hypothesis:

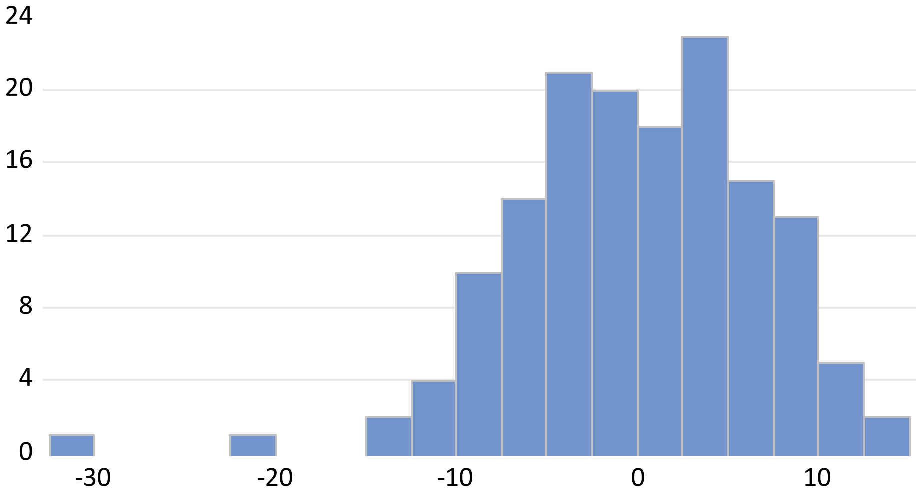
Null Hypothesis, $H0$: The variable isn't normally distributed

Alternative hypothesis, Ha: The variable is normally distributed

If the probability value is less than 5%, then we accept the null hypothesis and if the probability value is more than 5%, the alternative hypothesis of normal distribution of data is accepted.

To run the normality test, the panel regression equation is first estimated between dependent and independent variables and the residuals are then diagonosed for normality using the histograms. The results of the normality test on the data before and after the crisis have been presented below in tables 5.26 and 5.27 respectively.

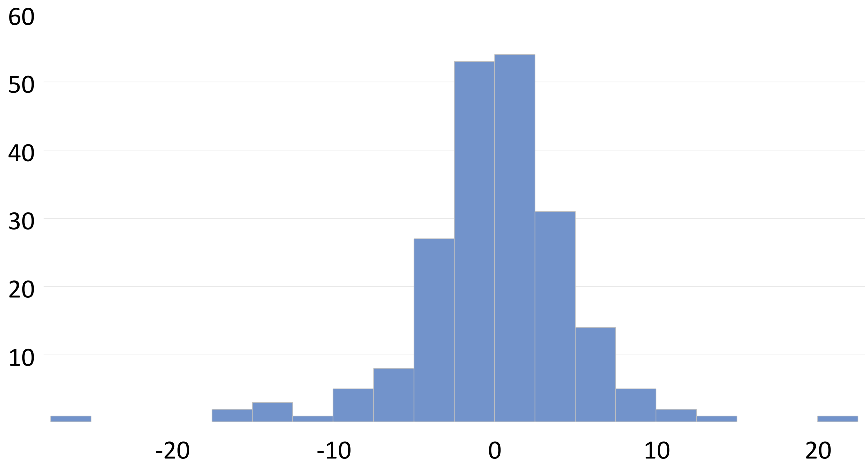
Table 5.26. Results of Normality test before the financial crisis



Series: Standardized Residuals	
Sample 2002 2007	
Observations 149	
Mean	-3.24e-12
Median	0.171807
Maximum	13.62471
Minimum	-32.36571
Std. Dev.	6.794367
Skewness	-0.854920
Kurtosis	5.597325
Jarque-Bera	60.03242
Probability	0.000000

Source: Normality test statistics generated using E-views 11

Table 5.27. Results of Normality test after the financial crisis



Series:Standardized Residuals	
Sample 2010 2017	
Observations 208	
Mean	9.12e-15
Median	0.100118
Maximum	20.50066
Minimum	-25.64724
Std. Dev.	5.039315
Skewness	-0.693813
Kurtosis	7.814073
Jarque-Bera	217.5403
Probability	0.000000

Source: Normality test statistics generated by the author using E-Views 11
0

The results of the normality tests presented in table 5.26 and 5.27 above illustrate that the values of Jarque-Bera probability are 0, both before and after the crisis. On the basis of this, as the p value is below 5%, the null hypothesis of non-normality of data is accepted.

According to Li et al. (2012), it is a misconception that the validity of a linear regression gets violated when the data sample isn't normally distributed. It further states that the validity of a regression model can be better and more accurately checked by establishing whether the errors of a linear regression model are normally distributed.

To add further to this, Shao (2003) adds that the law of large numbers and the central limit theorem states that while dealing with a large data sample, the estimators of a linear regression in Ordinary/Panel Least Square (OLS/PLS) method will still be normally distributed around the true parameter values. This implies that in a large data sample, the linear regression still remains valid even if the variables are not normally distributed.

As the data sample used of this research is quite large with 413 observations in total, the validity of the linear regression doesn't get violated even if the research variables don't have normal distribution of data.

5.3.2. Data stationarity tests

The research study conducted four tests to check the data stationarity, which are:

Levin, Lin and Chu t* (LLC) unit root test, Im, Pesaran & Shin W-Stat unit root test (IPS), Augmented Dickey-Fuller (ADF) Unit root test and Phillips-Perron (PP) unit root test using E-Views 11, taking into account the inclusion of individual intercept. LLC unit root test assumes a common unit root process, whereas IPS, ADF and PP tests consider individual unit root process.

For all these four tests mentioned above to assess the data stationarity, the following hypothesis is tested:

Null hypothesis, $H0$: Panels contain unit root i.e. the data is not stationary

Alternative hypothesis, $H1$: Panel don't contain unit root i.e. the data is stationary

The occurrence of unit root in the data for each research variable is tested by comparing their probability values. If the p value exceeds the 5 percent significance level, then the data contains a unit root and we accept the null hypothesis. If the p value is lower than 5 percent significance level, then we reject null hypothesis and accept the alternative hypothesis. The summary of the results of LLC, IPS, ADF and PP unit root tests before and after the financial crisis are illustrated in tables 5.50 and 5.51 respectively. The individual detailed results of these data stationarity tests for each research variable have been presented in tables 5.28-5.51 in appendix 3.

Looking at the summary of data stationarity tests' results of variables before the financial crisis presented in table 5.52, all the four tests indicate that the research variables EFF, CAPAD, LAGE, NPA and LIQ are stationary, whereas the variables SIZE, INF and LGDP aren't stationary. For the variables ROE, MSHARE and NIM, the tests indicate mixed results, where PP test results indicate ROE to be stationary. LLC and PP tests indicate stationarity and IPS and ADF tests' results confirm that the variables MSHARE and NIM are non-stationary.

Table 5.52. Summary of research variables' unit root test results before the financial crisis

Variable	LLC unit root results		IPS unit root results		ADF unit root test results		PP unit root test results		Significance at (5% level)	Decision
	Statistic	p	Statistic	p	Statistic	p	Statistic	P		
ROE	4.865	1.0	6.519	1.0	17.464	1.0	97.876	0	Significant	Accept H_0
EFF	-10.497	0	-1.697	0.0445	48.040	0.034	58.533	0.003	Not significant	Reject H_0
CAPAD	-15.809	0	-2.852	0.002	85.849	0.001	114.578	0	Not significant	Reject H_0
LAGE	-29.883	0	-782.028	0	460.517	0	442.096	0	Not significant	Reject H_0
SIZE	9.928	1.0	9.558	1.0	6.056	1.0	8.345	1.0	Significant	Accept H_0
MSHARE	-4.579	0	0.292	0.615	52.309	0.384	70.539	0.029	Significant for IPS and ADF and unit root tests	Reject H_0 for LLC and PP tests
NPA	-11.586	0	-2.625	0.004	84.364	0.002	172.077	0	Not significant	Reject H_0
NIM	-8.664	0	0.041	0.516	51.920	0.399	72.385	0.021	Significant for IPS and ADF unit root tests	Reject H_0 for LLC and PP tests
LIQ	-10.724	0	-2.864	0.002	90.565	0	116.791	0	Not significant	Reject H_0
INF	8.387	1.0	5.750	1.0	3.128	1.0	4.368	1.0	Significant	Accept H_0
LGDP	17.172	1.0	11.761	1.0	0.122	1.0	0.008	1.0	Significant	Accept H_0

Source: Data stationarity tests' results generated by the author using E-Views 11

Table 5.53. Summary of research variables' unit root test results after the financial crisis

Variable	LLC unit root results		IPS unit root results		ADF unit root test results		PP unit root test results		Significance at (5% level)	Decision
	Statistic	p	Statistic	p	Statistic	p	Statistic	p		
ROE	4.87	1.0	6.52	1.0	-3.08	0.03	26.53	1.00	Significant	Accept H_0
EFF	-5.62	0	-1.02	0.15	55.32	0	93.46	0	Significant for IPS	Reject H_0 for LLC, ADF and PP tests
CAPAD	-29.40	0	-5.43	0	91.63	0	57.52	0.28	Significant for PP	Reject H_0 for LLC, IPS and ADF tests
LAGE	-29.06	0	-8.90	0	23.00	0	21.75	0	Not significant	Reject H_0
SIZE	-11.54	0	-5.26	0	138.21	0	318.69	0	Not significant	Reject H_0
MSHARE	-3.36	0	1.42	0.92	25.58	1.0	22.96	0.9998	Significant for IPS and ADF and PP unit root tests	Reject H_0 for LLC test
NPA	22.17	1.0	14.16	1.0	2.97	1.0	1.31	1.0	Significant	Accept H_0
NIM	-13.26	0	-3.19	0	106.15	0	56.15	0.32	Significant for PP unit root test	Reject H_0 for LLC, IPS and ADF tests
LIQ	-13.81	0	-3.06	0	98.61	0	86.22	0	Not significant	Reject H_0
INF	-2.02	0.02	2.97	1.00	12.98	1.0	4.60	1.0	Significant for IPS, ADF and PP unit root tests	Reject H_0 for LLC test
LGDP	-41.21	0	-13.95	0	268.30	0	165.60	0	Not significant	Reject H_0
LEXR	-30.89	0	-9.24	0	199.84	0	111.58	0	Not significant	Reject H_0
RIR	-3.66	0	1.11	0.87	27.18	1.0	241.47	0	Significant for IPS and ADF unit root tests	Reject H_0 for LLC and PP tests

Source: Data stationarity tests' results generated by the author using E-Views 11

In the same manner, the summary of data stationarity tests' results of variables after the period of financial crisis presented in table 5.53 indicate that all the four tests consistently confirm that the variables LAGE, SIZE, LIQ, LGDP and LEXR are stationary, whereas the variables ROE, NPA are non-stationary. The tests have given mixed results for the variables ROE, EFF, CAPAD, MSHARE, NIM, INF and RIR. LLC test results confirm that the variables i.e. EFF, CAPAD, MSHARE, NIM, INF and RIR are stationary for the time-period 2010-2017. ADF test results indicate ROE to be stationary in the post-crisis period. According to Baltagi (2005), the non-stationarity of the data can result in misleading results in the regression model estimations and can be resolved by taking data variables in their first differences.

5.3.3. Correlation analysis

To check whether the research variables are correlated and to analyse the extent of that correlation, the study conducted correlation analysis between the profitability measure i.e. ROE and the independent explanatory variables i.e. CAPAD, LAGE, SIZE, MSHARE, NPA, NIM, LIQ, INF, LGDP, LEXR and RIR before and after the financial crisis. According to Cooper and Schindler (2009), if the value of the correlation coefficient exceeds 0.80, it indicates the problem of multicollinearity and thus, should be corrected. On the other hand, Mashotra (2007) considers the value of correlation coefficient up to 0.75 fine and Hair et al. (2006) suggests that any value of correlation coefficient below 0.90 won't necessarily cause any serious multicollinearity issues.

5.3.3.1. Correlation analysis between ROE and explanatory variables

The results obtained for correlation analysis between dependent and independent research variables, for the time periods before and after the financial crisis, have been presented in tables 5.54 and 5.55 respectively.

Table 5.54. Correlation matrix to analyse correlation between research variables before the financial crisis

	ROE	CAPAD	LAGE	SIZE	MSHARE	NPA	NIM	LIQ	INF	LGDP	LEXR	RIR
ROE	1	0.27	0.10	-0.10	0	0.15	0.38	0.12	-0.25	-0.15	0.03	0.08
CAPAD	0.27	1	-0.11	0.02	0.01	-0.02	0.12	-0.09	-0.08	0.06	-0.12	-0.13
LAGE	0.10	-0.11	1	0.14	0.37	0.02	0.61	0.09	-0.05	-0.06	0.05	0.06
SIZE	-0.10	0.02	0.14	1	0.77	-0.34	-0.20	-0.04	0.30	0.35	-0.32	-0.23
MSHARE	0	0.01	0.37	0.77	1	-0.03	-0.04	-0.09	-0.03	-0.04	0.03	0.03
NPA	0.15	-0.02	0.02	-0.34	-0.03	1	0.01	-0.03	-0.16	-0.20	0.16	0.19
NIM	0.38	0.12	0.61	-0.20	-0.04	0.01	1	0.16	-0.21	-0.10	0.06	-0.08
LIQ	0.12	-0.09	0.09	-0.04	-0.09	-0.03	0.16	1	0.02	0.01	-0.04	0.06
INF	-0.25	-0.08	-0.05	0.30	-0.03	-0.16	-0.21	0.02	1	0.87	-0.65	-0.42
LGDP	-0.15	0.06	-0.06	0.35	-0.04	-0.20	-0.10	0.01	0.87	1	-0.89	-0.65
LEXR	0.03	-0.12	0.05	-0.32	0.03	0.16	0.06	-0.04	-0.65	-0.89	1.00	0.40
RIR	0.08	-0.13	0.06	-0.23	0.03	0.19	-0.08	0.06	-0.42	-0.65	0.40	1.00

Source: Correlation analysis results generated by the author using E-Views 11

By looking at the correlation matrix presented in table 5.54 for the correlation analysis between research variables before the financial crisis, it can be observed that ROE is strongly and positively correlated to CAPAD (0.27), NPA (0.15), NIM (0.38), and LIQ (0.12) and; is strongly and negatively correlated to INF (-0.25) and LGDP (-0.15). A weak positive correlation of ROE has been observed with LAGE (0.10), MSHARE (0.003), LEXR (0.03) and RIR (0.08) and; a weak negative correlation of ROE can be seen with SIZE (-0.097) before the period of financial crisis.

Table 5.55. Correlation matrix to analyse correlation between research variables after the financial crisis

	ROE	CAPAD	LAGE	SIZE	MSHARE	NPA	NIM	LIQ	INF	LGDP	LEXR	RIR
ROE	1	0.54	0.06	-0.15	-0.02	-0.90	0.46	0.12	0.70	-0.63	-0.65	-0.52
CAPAD	0.54	1	0	-0.08	0.04	-0.49	0.32	0.12	0.52	-0.61	-0.67	-0.66
LAGE	0.06	0	1	0.20	0.33	0	0.30	-0.04	-0.06	0.06	0.06	0.06
SIZE	-0.15	-0.08	0.20	1	0.85	0.14	-0.12	-0.22	-0.27	0.31	0.32	0.30
MSHARE	-0.02	0.04	0.33	0.85	1	0.01	0.03	-0.10	-0.16	0.14	0.16	0.16
NPA	-0.90	-0.49	0	0.14	0.01	1	-0.40	-0.07	-0.76	0.63	0.64	0.47
NIM	0.46	0.32	0.30	-0.12	0.03	-0.39	1	0.11	0.30	-0.27	-0.32	-0.20
LIQ	0.12	0.12	-0.04	-0.22	-0.09	-0.07	0.11	1	0.14	-0.37	-0.36	-0.35
INF	0.70	0.52	-0.06	-0.27	-0.16	-0.76	0.30	0.14	1	-0.77	-0.79	-0.76
LGDP	-0.62	-0.61	0.06	0.31	0.14	0.63	-0.27	-0.37	-0.77	1	0.97	0.89
LEXR	-0.65	-0.67	0.06	0.32	0.16	0.64	-0.32	-0.36	-0.79	0.97	1.00	0.92
RIR	-0.52	-0.66	0.06	0.30	0.16	0.47	-0.20	-0.35	-0.76	0.89	0.92	1.00

Source: Correlation analysis results generated by the author using E-Views 11

Similarly, by looking at the correlation analysis between variables after the financial crisis presented in table 5.55, ROE has been observed to be strongly and positively correlated to CAPAD (0.54), NIM (0.46), LIQ (0.12) and INF (0.70) and; strongly and negatively correlated to INF (-0.63), SIZE (-0.15), NPA (-0.90), INF (-0.63), LEXR (-0.65) and RIR (-0.52). A weak positive correlation of ROE has been observed with LAGE (0.06) and a weak negative correlation with MSHARE (-0.02) after the financial crisis.

5.3.3.2. Correlation analysis among independent explanatory variables

This section presents, discusses and analyses the results of correlation analysis between the independent research variables to be employed in the regression analysis.

By looking at the results of correlation analysis presented in tables 5.54 and 5.55, it can be noticed that the correlation between most of the explanatory variables is low. Before financial crisis, a strong positive correlation has been observed between the variables SIZE and MSHARE (0.77), LAGE and NIM (0.61), LEXR and RIR (0.40) and; INF and LGDP (0.87) and a strong negative correlation has been observed between LEXR and SIZE (-0.32), LEXR and INF (-0.65), LEXR and LGDP (-0.89), RIR and SIZE (-0.23), RIR and INF (-0.42) and; RIR and LGDP (-0.65). After the event of global financial crisis, strong correlation can be seen between CAPAD and INF (0.52), CAPAD and LGDP (-0.61), SIZE and MSHARE (0.85), NPA and LGDP (0.63), INF and LGDP (-0.77), LEXR and CAPAD (-0.67), LEXR and SIZE (0.32), LEXR and NPA (0.64), LEXR and NIM (-0.32), LEXR and LIQ (-0.36), LEXR and INF (-0.79), LEXR and LGDP (0.97), LEXR and RIR (0.92), RIR and CAPAD (-0.66), RIR and SIZE (0.30), RIR and NPA (0.47), RIR and LIQ (-0.35), RIR and INF (-0.76) and; RIR and LGDP (0.89)

According to Cooper and Schindler (2009), a high value of correlation coefficient indicates the problem of multicollinearity and thus, should be corrected for. According to Frost (2019), the need to fix the issue of multicollinearity between research variables depends on its severity. He further states that, if the issue of multicollinearity exists between some of the variables, model estimations can be done without using those variables.

5.3.5. Summary of diagnostic tests

This section of the chapter discusses and summarizes the results of different diagnostic tests run on the data to assess its suitability for estimation of regression models for the determination of relationship between dependent variable (ROE) and the independent explanatory variables (CAPAD, LAGE, SIZE, MSHARE, NPA, NIM, LIQ, INF, LGDP, LEXR and RIR) before and after the financial crisis. The section also discusses the different steps which will be taken to address any issues in the data demonstrated by different diagnostic tests.

To test whether the research variables come from a normal data distribution of data, histograms of residuals of the estimated panel regression models were generated and the associated Jarque-Bera probability values were assessed and it was discovered that the variables don't come from a normal data set, both before and after the crisis.

According to Li et al. (2012), it is a misconception that the validity of a linear regression gets violated when the data sample isn't normally distributed. The data stationarity was tested by running the LLC, IPS, ADF and PP unit root tests. All the four tests indicate that the research variables EFF, CAPAD, LAGE, NPA and LIQ are stationary both before and after the crisis. LEXR is found to be stationary after the crisis. The non-stationary variables before crisis are SIZE, INF and LGDP and after the crisis are ROE and NPA.

Before the financial crisis for the variables ROE, MSHARE and NIM, the tests indicate mixed results, where PP test results indicate ROE to be stationary, LLC and PP tests indicate stationarity for MSHARE and NIM and; IPS and ADF tests' results confirm that these variables (MSHARE and NIM) are non-stationary. After the period of financial crisis, all the four tests consistently confirm that the variables LAGE, SIZE, LIQ and LGDP are stationary, whereas the variable NPA is non-stationary. The tests have given mixed results for the variables ROE, EFF, CAPAD, MSHARE, NIM, INF and RIR. LLC test results confirm that the variables i.e. EFF, CAPAD, MSHARE, NIM and RIR are stationary for the time-period 2010-2017. The ADF test results confirm ROE to be stationary after the crisis.

According to Baltagi (2005), the non-stationarity of the data can result in misleading results in the regression model estimations and thus, should be addressed for before any analysis is being conducted. However, according to Moyi (2017), if N (no. of cross sections)>T (No. of time-periods), then GMM regression models can be estimated without having to worry much about the issue of non-stationarity in data. As for both the research time period samples in this research thesis, N>T (i.e. before crisis, N=26, T=6 and after crisis, N=26, T=8), the regression models can be estimated without having to dealing with the issue of non-stationarity of data. According to Baltagi (2005), the non-stationarity of the data can be resolved by taking data variables in their first differences.

The correlation analysis demonstrates that the variables LAGE, SIZE, MSHARE, INF, LGDP, LEXR and RIR have strong correlation with the rest of the explanatory variables. To resolve these endogeneity issues in the data sample, regression models will be estimated by using the GMM (Generalized Methods of Moments) technique and by dropping the variables LAGE, SIZE, MSHARE, INF, LGDP, LEXR and RIR due to the high correlation of these variables with the rest of the variables. The residuals of the estimated model using the explanatory variables CAPAD, LIQ, NIM and NPA will again be tested to determine whether the model is free from the endogeneity issues or not. However, many researchers in the literatures have emphasized the importance of bank size, interest rate and exchange rate on their performance. For instance, Aldwan (2015), Redmond and Bohnsack., (2007), Kasimodou et al., 2006) etc. studied and proved the significance of bank size on their performance. Similarly, interest rate (Kasman et al., 2011, Hossain, 2010, Peng et al., 2003, and exchange rate (Negrbo, 2012, Kiganda, 2014, Magud et al., 2014, Kasman et al., 2011, Lambe, 2015) have been found out to be significant determinants of banks' performance. Keeping in mind, the huge significance of bank size, interest rate and exchange rate in banks' performance, two different types of models have been estimated in the research project to study the impact of micro and macro determinants on profitability of commercial banks, one with dropping the variables LAGE, SIZE, MSHARE, LGDP, INF, LEXR and RIR and the other model comprising for variables CAPAD, SIZE, NPA, NIM, LIQ, LEXR and RIR. The endogeneity issues associated with the variables SIZE, LEXR and RIR have been taken care of by converting these variables into first lags. Further details and explanation for the same have been presented in chapter 7.

5.4. Summary of the chapter

To summarize, this chapter presented the descriptive statistics about the dependent and independent research variables. The chapter also presented and discussed the results of different diagnostic tests on the data to make sure that the data is fit to run the research models such as normality test, data stationarity tests using LLC, IPS, ADF and PP unit root tests and correlation analysis. All the diagnosis tests and regressions are conducted using the software E-Views 11.0. The tests indicate that the research explanatory variables are associated with the issues of non-normality, non-stationarity and high correlation among themselves, both before and after the financial crisis. To resolve these issues along with other possible endogeneity problems in the data (such as heteroskedasticty and multicollinearity) in the data sample, regression models have been estimated by using the GMM (Generalized Methods of Moments) technique and by dropping he variables LAGE, SIZE, MSHARE, INF and LGDP due to the high correlation of these variables with the rest of the variables. However, due to the huge significance of variables SIZE, LEXR and RIR, separate models have also been estimated using these variables in addition to the other explanatory variables used in the original model.

Chapter 6

Technical efficiency of Indian Commercial Banks (ICBs)

6.1. Introduction

This chapter of the thesis discusses and analyses the technical efficiency of Indian Commercial Banks, before and after the financial crisis. Over the course of time, the business environment in which the banks are operating has become more competitive and contemporary, which calls for the banks to perform efficiently in order to maintain a sustainable position in the market. It has been argued by the literature that if a firm faces intense competition, then they perform efficiently (Bhaumik and Dimova, 2004).

The financial sector of India has been operating in a closed and regulated manner, which has experienced a number of changes since the time it has been operating since the 1990s. Until 1992, banks of India were under the state ownership, after which the banking sector started to face immense competition because of new private banks started to enter the market. On an overall basis, this has impacted the efficiency of the banks. During the sixteen year period used in this research work (i.e. 2002-2017), there were a number of reforms that were introduced such as branch de-licensing, entry deregulation, deregulation of interest rates and allowing the Indian banks to raise their equity in the capital market up to the level of 49%. These policies collectively have contributed towards increasing the competition in the financial sector of India (Sahoo, Sengupta & Mandal, 2007). This has pressurized the banking sector of India in terms of their performance and productivity. Automated Teller Machines (ATM), mobile banking, internet banking, and other innovative products and services are the result of the competition. The following sections discuss the technical efficiency of Indian banking sector in general as well as the individual efficiency scores of sample ICBs.

The research time-period sample has been divided into two parts: research sample 2002-2007 i.e. before the financial crisis and 2010-2017 i.e. after the financial crisis. In line with Eichengreen and Gupta (2012), the time period 2007-2009 has been considered as the global financial crisis period. Conducting the research in these two time-periods separately will provide the readers with insights into how the performance of the Indian banking sector has got effected by the crisis.

6.2. Mean technical efficiency scores of Indian Commercial Banks

The descriptive statistics of mean technical efficiency scores of Indian commercial banking sector, represented by EFF (discussed in tables 5.24 and 5.25), before and after the financial crisis have been presented in Table 6.1 below. The efficiency scores have been calculated using the CRS model of DEA with the help of software Win4Deap version 2.1. To calculate the technical efficiency, data on four inputs (Loan loss provisions, operating expenses, deposits and borrowings) and four outputs (investments, advances, net interest income and total other income) for 26 sample banks for the time period 2001-2017 was used. This data was collected from Reserve Bank of India database. The inputs and outputs used in the DEA model have been determined using the intermediation approach. Technical efficiency of ICBs lies between 0-1, where o represents fully non-efficient and 1 represents fully efficient.

Table 6.1. Descriptive statistics of technical efficiency of ICBs before and after the financial crisis

EFF	Before crisis (2002-2007)	After crisis (2010-2017)
Mean	0.99	0.97
Median	1	1.00
Maximum	1	1.00
Minimum	0.87	0.75
Std. Dev.	0.02	0.06
Skewness	-3.31	-2.01
Kurtosis	15.27	6.22
Jarque-Bera	1685.80	164.21
Probability	0	0
Sum	206.11	144.46
Sum Sq. Dev.	0.10	0.47
Observations	208	149

(Source: Descitptive statistics generated by the author using E-Views 11.0)

It can be analysed from the results presented in Table 6.1 above that the mean, median, maximum and minimum values of EFF of ICBs before the financial crisis are 0.99, 1, 1 and 0.87 respectively. Similarly, after the financial crisis, ICBs have mean, median, maximum and minimum values of 0.97, 1, 1 and 0.75 for technical efficiency respectively. The values of standard deviation indicate that there are more fluctuations in technical efficiency of ICBs after the financial crisis than for the time-period before the financial crisis.

Table 6.2 below represents the yearly mean technical efficiency scores of commercial banking sector of India for the time-period 2002-2017.

Table 6.2. Mean efficiency scores of Indian commercial banks for the time-period 2002- 2017

Year	EFF	Year	EFF
2001-2002	0.972	2009-2010	0.981
2002-2003	0.907	2010-2011	0.993
2003-2004	0.958	2011-2012	0.993
2004-2005	0.987	2012-2013	0.997
2005-2006	0.992	2013-2014	0.997
2006-2007	0.993	2014-2015	0.998
2007-2008	0.997	2015-2016	0.985
2008-2009	0.99	2016-2017	0.981

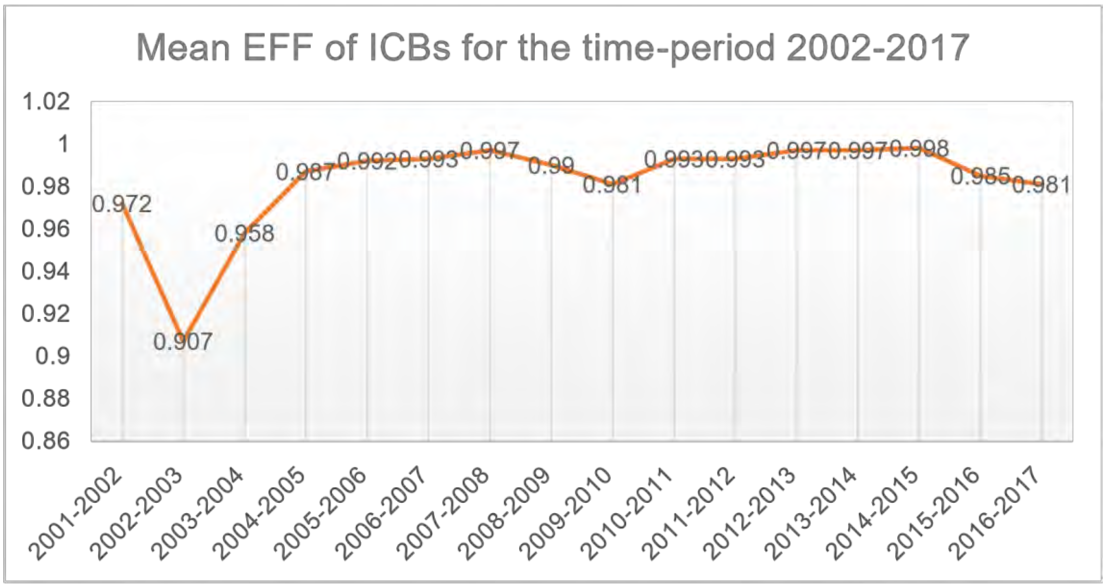
(Source: **Mean technical efficiency scores calculated by the author using Win4Deap 2.1**

From the results presented in Table 6.2, it can be observed that the sample 26 commercial banks in India have an average technical efficiency score of 98% for the time period 2002-2017, which indicates technical inefficiency level of only 2%. This means that the commercial banks in India are efficient in minimizing the inputs, yet producing the same number of outputs. But having said so, the banks haven't been fully efficient in doing so in any of the years and there is still room for improvement. Further to this, the technical efficiency of Indian commercial banks, in general, has been stable and above 90% in all years for the time-period 2002-2017. These results of efficiency are similar to the ones obtained by Nandkumar & Singh (2014), which reported the efficiency of Indian banks to be above 90% in all years for the time-period 2006-2010, Dwivedi & Charyulu (2011) reporting efficiency score of above 95% for Indian banks for the time period 2005-2010, and; Singh & Thaker (2020), where an average efficiency score of 85% was reported for Indian banks for the research time-period 2008-2012. The possible reason behind a stable technical efficiency score for ICBs can be their ability in keeping the inputs to possible minimum, while producing the same/better number of outputs. It can be clearly seen from the data presented in tables 5.1-5.16, that the annual increase in the inputs for ICBs is consistent and poise and; no major jumps can be observed in the value of any variable in any of the years.

Having said so, the banks haven't been fully efficient in doing so in any of the years and there is still room for improvement. The recorded period, where lowest level of technical efficiency and sharp decline, is observed is 2002-2003, where the estimated score for technical efficiency fell from 97.2% in the previous year to 90.7%. With the careful analysis of the data on DEA inputs and outputs presented in tables 5.15.16 in appendix 1, the possible reason behind the decrease of technical efficiency of ICBs in the year 2002-2003 can be the fall in deposits, as apart from deposits, a steady increase can be observed in all rest of the input and output variables. As per updates on economic developments for India for the year 2002-2003 published on Reserve Bank of India website, the year 2002-2003 can be characterised as the year of industrial revolution. The farm industry's growth was inhibited due to draught conditions and this, in turn caused downfall in GDP of India as compared to previous year. There was significant increment in non-food items and mineral oil. To support the industrial growth, the scheduled commercial banks shifted its operations towards advances and credit facilities to customers by dropping the interest rates (both lending and borrowing rates) from 7.25%-8.75% to 5.25%-7.00% for one year deposits. The low interest rates can be one of the prime factors behind lower bank deposits in the year 2002-2003.

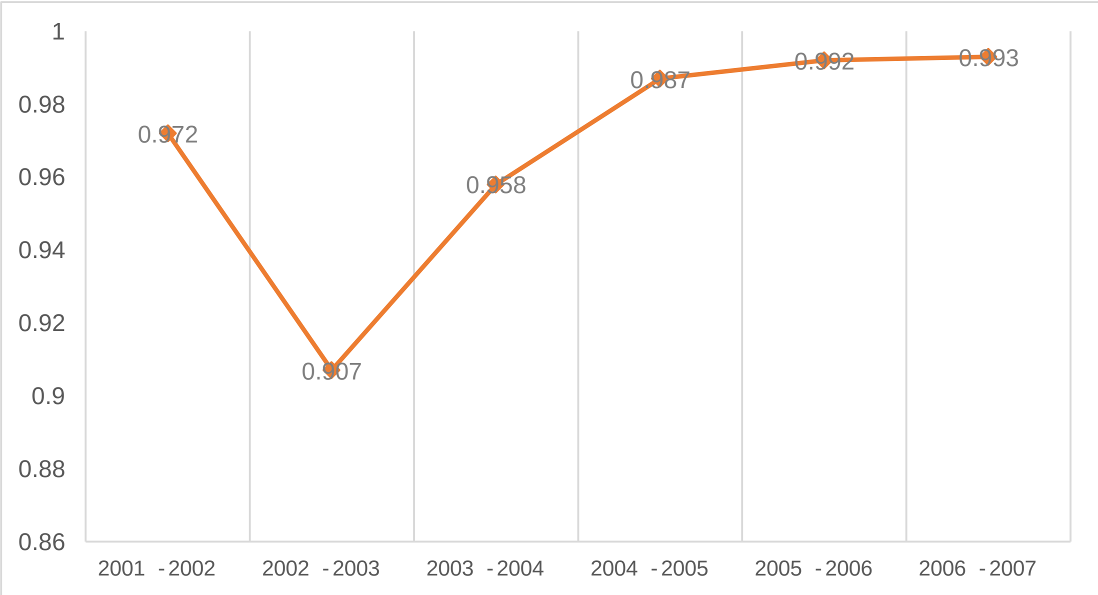
The efficiency score raised again the following year i.e. 2003-2004 to 95.8%. From 2004-2008, the technical efficiency has mostly been stable and around 99% in all years. A slight dip in technical efficiency can again be observed in the year 2007-2008, where the score fell down to 98% from 99% in 2007-2008. Though this decrease in efficiency score isn't significant, it is predicted that this slight decrease might have occurred because of the impact of the global financial crisis in 2007-2008. The technical efficiency of ICBs for the time periods 2002-2017, before and after the crisis have also been illustrated by graphs 6.1, 6.2 and 6.3 respectively.

Figure 6.1. Mean efficiency scores of Indian commercial banks for the time period 2002-2017



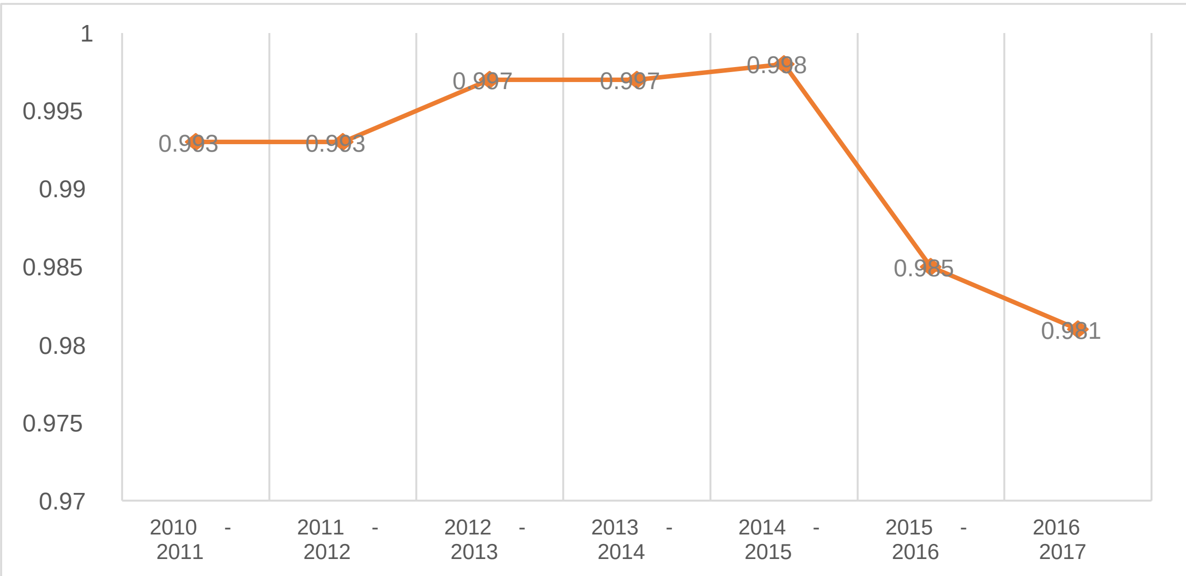
Source: Generated by the author using Microsoft Excel

Figure 6.2. Mean efficiency scores of Indian Commercial banks before the financial crisis



Source: Generated by the author using Microsoft Excel

Figure 6.3. Mean efficiency scores of Indian Commercial banks after the financial crisis



Source: Generated by the author using Microsoft Excel

6.3. Mean technical efficiency scores of individual commercial banks of India

This section discusses the mean technical efficiency scores of individual commercial banks of India for the time period 2002-2017, before and after the financial crisis and have been presented in Table 6.3 The same has been graphically represented by figures 6.4, 6.5 and 6.6 respectively. These efficiency scores have been calculated using CRS version of DEA model. The model was run on Win4Deap version 2.1 software.

Looking at these estimations of technical efficiency of individual sample 26 banks in India presented in Table 6.3, it can be concluded that none of the commercial banks has attained a score of 1 for the time period 2002-2017 and thus, is not fully technically efficient. Canara bank and IDBI banks have the highest technical efficiency score of 99.9%, which means that the score of technical inefficiency for these two banks for the time period 2002-2017 is 0.1%. On the other hand, UCO Bank has the lowest technical efficiency score of i.e. approximately 96.1%, which indicates technical inefficiency of 3.9% for the given time-period.

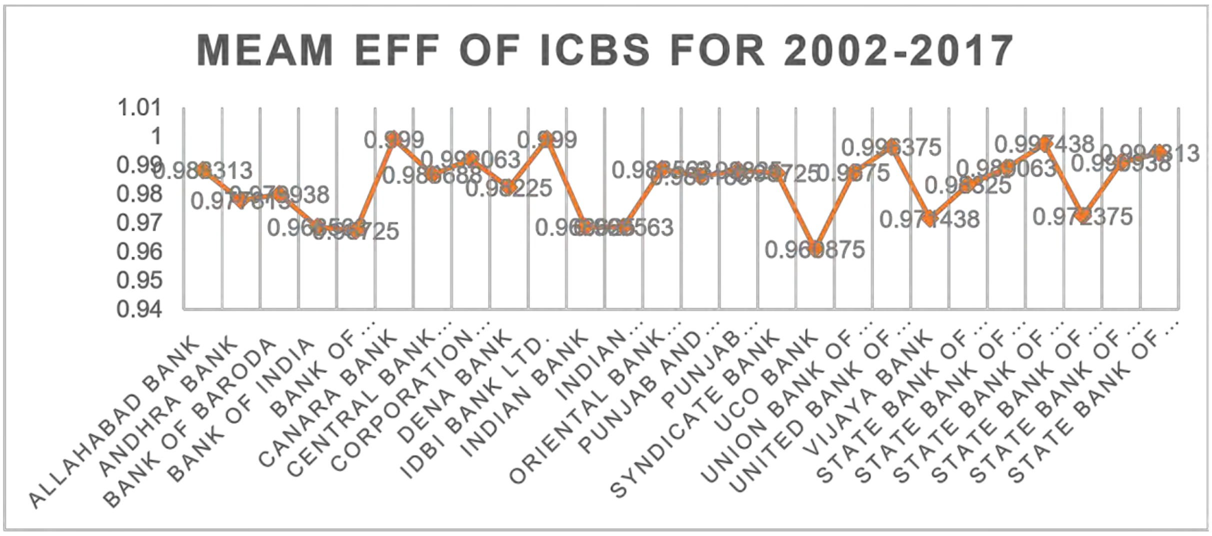
Similarly, before the financial crisis, four banks i.e. Canara Bank, IDBI Bank, United Bank of India and State Bank of Travancore have the highest technical efficiency score of 1. Thus, these banks are fully efficient in utilizing their inputs to produce the maximum outputs. On the other hand, UCO bank has the lowest technical efficiency score of 91.3% before the crisis, which in turn, represents technical inefficiency of 8.7%. Finally, by looking at the technical efficiency scores after the financial crisis, the banks Canara Bank, Corporation Bank and Indian banks are fully efficient with a score of 1 (100%), whereas UCO bank has the lowest technical efficiency of 96.1% (implies technical inefficiency of 3.9%). It can further be concluded that Canara bank has scored the highest score whereas UCO bank has scored the lowest score for technical efficiency for all the three sample research time periods i.e. full sample (2002-2017), before crisis (2002-2007) and after crisis (2010-2017).

Table 6.3. Mean technical efficiency scores of individual ICBs

Name of the Bank	2002-2017	Before Crisis	After Crisis
Allahabad Bank	0.988	0.984	0.989
Andhra Bank	0.978	0.956	0.992
Bank of Baroda	0.980	0.966	0.989
Bank of India	0.969	0.959	0.968
Bank of Maharashtra	0.967	0.947	0.974
Canara bank	0.999	1	1
Central Bank of India	0.987	0.992	0.979
Corporation Bank	0.992	0.979	1
Dena Bank	0.982	0.978	0.99
IDBI Bank ltd.	0.999	1	0.998
Indian Bank	0.969	0.916	1
Indian Overseas Bank	0.969	0.952	0.974
Oriental Bank of Commerce	0.989	0.970	0.999
Punjab and Sind Bank	0.986	0.977	0.986
Punjab National Bank	0.988	0.974	0.9882
Syndicate Bank	0.987	0.984	0.987
UCO Bank	0.961	0.913	0.961
Union Bank of India	0.9875	0.979	0.988
United Bank of India	0.996	1	0.996
Vijaya Bank	0.971	0.947	0.971
State Bank of Bikaner and Jaipur	0.983	0.955	0.983
State Bank of Hyderabad	0.989	0.972	0.989
State Bank of India	0.997	0.993	0.997
State Bank of Mysore	0.972	0.955	0.972
State Bank of Patiala	0.991	0.983	0.991
State Bank of Travancore	0.994	1	0.994

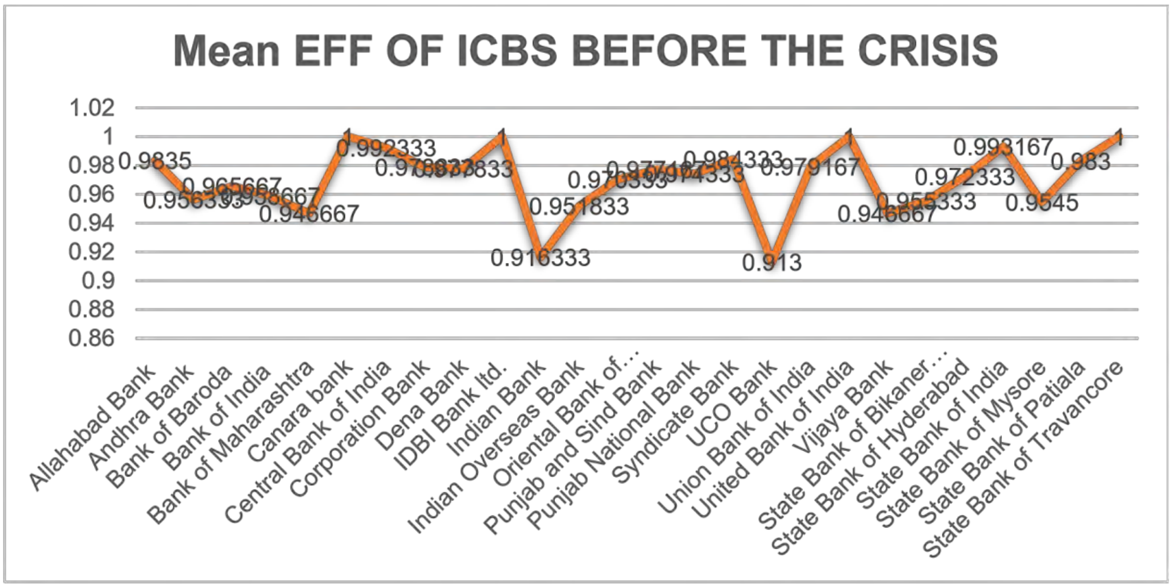
Source: Mean efficiency scores of individual banks calculated by the author using Win4Deap 2.1

Figure 6.4. Mean technical efficiency scores of individual banks from 2002-2017



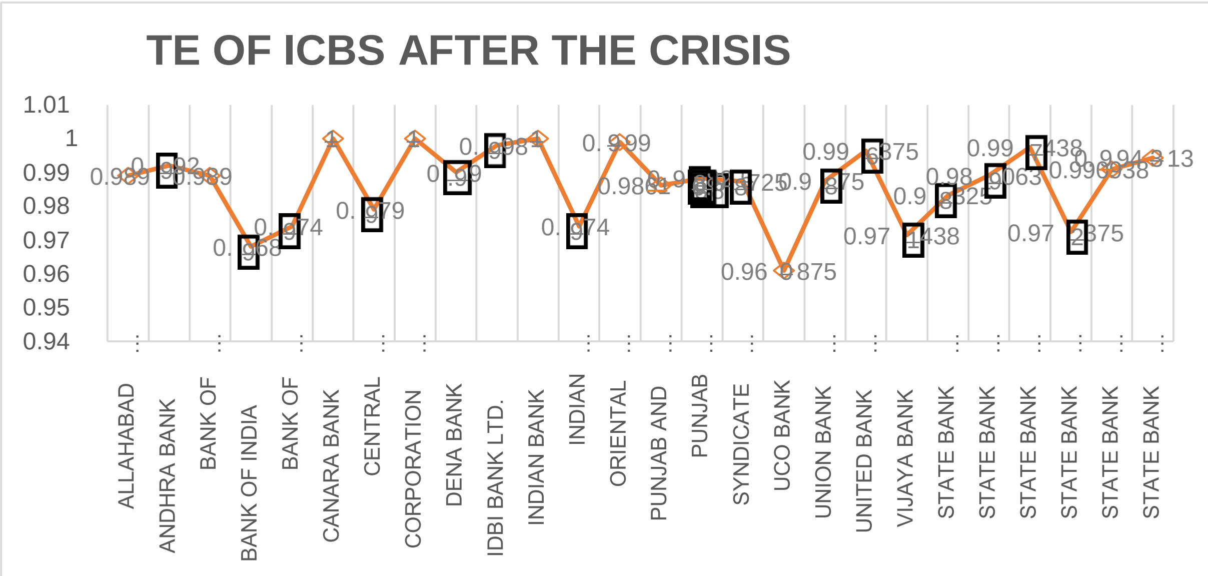
Source: Generated by the author using Microsoft Excel

Figure 6.5. Mean technical efficiency scores of individual banks before the crisis



Source: Generated by the author using Microsoft Excel

Figure 6.6. Mean technical efficiency scores of individual banks after the crisis



Source: Generated by the author using Microsoft Excel

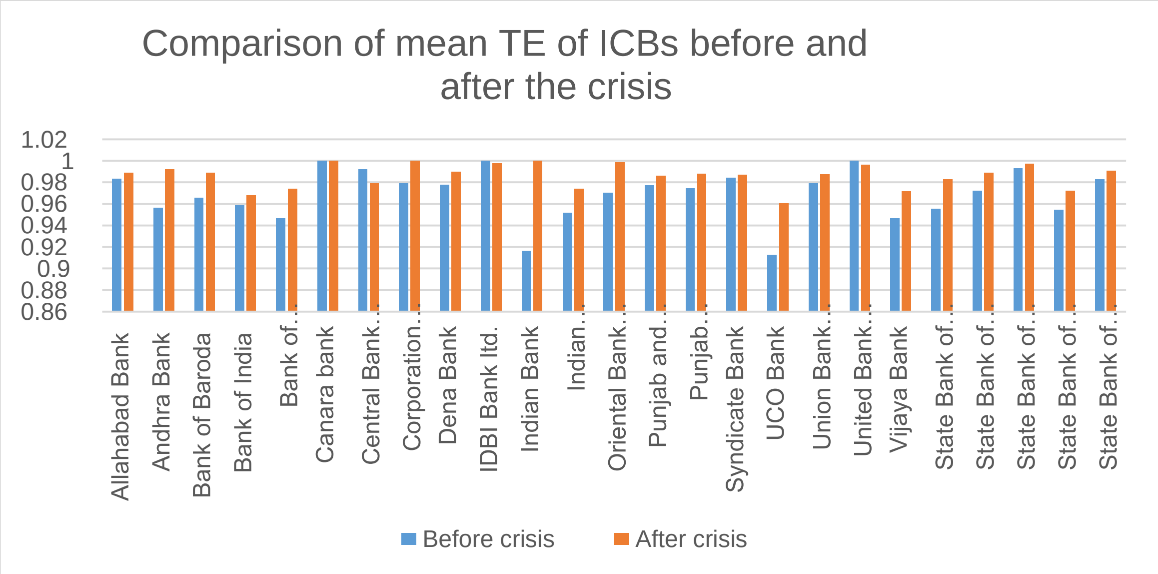
6.4. Impact of financial crisis on the efficiency of Indian commercial banks

This section of the chapter tends to analyse the impact of financial crisis on the technical efficiency of Indian commercial banks and assess how the efficiency scores have changed after the crisis as compared to the efficiency of banks before the crisis.

It can be analysed from the values of technical efficiency scores of Indian commercial banking sector presented in table 6.2 that the means of technical efficiency before and after the crisis are respectively 0.9682 and 0.9906 respectively, which in turn implies that before the crisis the ICBs are 96.82% efficient and after the crisis, their technical efficiency increases to 99.06% The impact of the global financial crisis on the individual efficiency scores of Indian commercial banks has been illustrated by figure 6.7, which shows a comparison between the technical efficiency scores of Indian commercial banks before and after the crisis.

With the careful analysis of the mean technical efficiency scores of ICBs presented in Tables 6.2 and 6.3 and comparison of mean technical efficiency of ICBs before and after the crisis presented by figure 6.7, it can be concluded that mean technical efficiency of Indian commercial banking sector in general as well as individual technical efficiency of most of the commercial banks of India (except IDBI Bank ltd. and United Bank of India) has improved after the event of global financial crisis. The data analysis further suggests that in contrary to an expected negative impact of global financial crisis on the technical efficiency of ICBs, the technical efficiency of the Indian commercial banking sector in general as well as the individual technical efficiency scores of most of the commercial banks in India have improved after the event of the financial crisis. The possible reason behind this can be strict policies, government regulation regulating the Indian banking industry which allowed public to maintain their trust and the Indian banks to continue normally with their operations despite the unfavourable global market conditions. The same is also evident from the data presented in tables 5.22 and 5.23 (presented in chapter 5), where an increase can be observed in the mean values of deposits, investments, advances, net interest income and total other income after the crisis.

Figure 6.7. Comparison of mean technical efficiency of individual ICBs before and after the crisis



Source: Generated by the author using Microsoft Excel

The major positive impact of financial crisis can be observed in the case of Indian Bank where the efficiency score has increased by 8.37%, from 91.63% before the crisis to 100% after the crisis. The efficiency scores of Canara bank, Central bank of India, and IBBI Bank ltd. have observed slight decrease in efficiency after the crisis, whereas no impact can be observed on the efficiency of Canara bank. If we have to generalize the results, then the event of global financial crisis is positively related to the technical efficiency of Indian commercial banks.

The only banks which have demonstrated a negative impact of crisis on their technical efficiency are IDBI bank and United Bank of India. The possible reason behind this can be their inability to manage their operating expenses as big jump can be seen for their operating expenses after the crisis. For example, for IDBI bank, the mean of their operating expenses before and after the crisis are approximately 777 million INR and 38816 million INR respectively.

These findings are in line with the findings of Sinha & Khan (2014), which reported that the global financial turmoil couldn't effect the performance of Indian banking sector and it continued performing efficiently in contrary to the negative impact of the crisis on most of the businesses around the world and the possible reason for the same was suggested as the strong base, timely stringent measures and a good governance structure managed by the central bank of India i.e. Reserve Bank of India (RBI).

Similar findings were reported by Deb (2019), which found out that there was no or little impact of financial crisis on the performance of Indian banks and the steady performance of Indian banks achieved during the crisis was attributed to the strong policies and measures in place to combat such situations.The results are also in agreement with the results obtained by Sufian (2009), where the Malaysian banks exhibited higher technical efficiency in the post-crisis period as compared to precrisis period.

On the other hand, a negative impact of financial crisis was reported on the performance of Indonesian banks by Sufian & Habibullah (2010). Maredza & Ikhide (2013) concluded the event of financial crisis as the main determinants of efficiency of banks in South Africa for the time-period 2000-2010 and recorded a significant decrease of 16.96% in the efficiency of banks after the event of global financial crisis. Similar results were obtained by Mabwe & Web (2010), where a significant decline was recorded in profitability, liquidity and credit quality of top five banks in South Africa after the global financial crisis for the time period 2007-2009, but as the banking system in South Africa was well capitalised, the banks in South Africa remained stable during and after the crisis despite the decrease in profitability, credit quality and liquidity.

Singh et al. (2017) examined the impact of global financial crisis on the efficiency of 49 Arab banks employing DEA and a decline of 1.28% was observed during the financial crisis i.e. 2007-2010, but it increased significantly by 20.19% after the crisis during the time period 2011-2014 and the reason of this decline and then increase afterwards was attributed to interest expense in the research.

To further understand the impact of financial crisis on technical efficiency of ICBs, t-tests were conducted on DEA variables as well as the independent explanatory variables to understand the impact of operating conditions on the above observed and analysed trends in efficiency, before and after the crisis. The results of the same have been presented and discussed in the following sections.

6.5. Results of t-tests on DEA input and output variables

This section discusses the results of t-tests on the DEA input and output variables to get insights on the role these variables have in the above observed trends in the technical efficiency scores of ICBs. As analysed and concluded in section 5.3.1 above, the data on the research variables come from a non-normal data distribution set, it is non-paramagnetic in nature. For non-paramagnetic data, t-tests for independent samples and one-way ANOVA tests are not suitable and valid. So this research thesis has employed Mann-Whitney U-test to compare the differences between two sets of input and output variables, one sample before the crisis and the one after the crisis.

The test is based on the following hypothesis:

Null Hypothesis, $H0$: There exists no significance difference in the variable before and after the crisis

Alternative hypothesis, Ha: There exists significance difference in the variable before and after the crisis

The hypothesis is tested at significance level of 5%. If p value is above 5%, we accept the null hypothesis and the alternative hypothesis of significant difference between the data variables in the two research time –periods is accepted for values of p below 5%.

The results of the Mann-Whitney U test are presented in Table 6.4 below.

Table 6.4. Results of Mann-Whitney U-test for DEA input and output variables

Variable	Group	N	Mean	Adjusted H (Test statistic)	p-value	Decision
Loan loss provisions	Pre-crisis	149	2836.70	197.685	6.68E-45	Reject $H_{0,}$ Loan loss provisions are significantly higher in the post crisis period
	Post-crisis	209	30502			
Operating expenses	Pre-crisis	154	13273.50	171.938	2.79E-39	Reject H_0 , , operating expenses are significantly higher in the post crisis period
	Post-crisis	209	42811			
Deposits	Pre-crisis	154	492130.56	219.701	1.05E-49	Reject $H_{0,}$, deposits are significantly higher in the post crisis period
	Post-crisis	209	2307351			
Borrowings	Pre-crisis	154	28483.45	217.127	3.83E-49	Reject H_0 , borrowings are significantly higher in the post crisis period
	Post-crisis	209	218258			
Investments	Pre-crisis	154	229720.93	175.47	4.73E-40	Reject $H_{0,}$,investments are significantly higher in the post crisis period
	Post-crisis	209	716927			
Advances	Pre-crisis	154	329679.59	220.128	8.48E-50	Reject $H_{0,}$, advances are significantly higher in the post crisis period
	Post-crisis	209	1728853			
Net Interest Income	Pre-crisis	154	18175.70	179.087	7.67E-41	Reject $H_{0,}$, net interest income is significantly higher in the post crisis period
	Post-crisis	209	63595			
Total other income	Pre-crisis	154	8477.96	144.922	2.23E-33	Reject $H_{0,}$, total other income is significantly higher in the post crisis period
	Post-crisis	209	26886			

Source: Mann-Whitney test statistics generated by the author using the Kruskal-Wallis test spreadsheet

As it can be seen from the results of Mann-Whitney U -test presented in Table 6.4 above, the p value is below 5% for all the input (loan loss provisions, operating expenses, deposits, borrowings) and output (investments, advances, net interest income and total other income) variables, on the basis of which the null hypothesis is rejected and it can be concluded that there exists significant difference between the values of variables before and after the crisis. Also by looking at the mean values of all the variables, it can be said that the values of all input and output variables are significantly higher in the post-crisis period. This, in turn, implies that the increase in inputs corresponded to increase in outputs for the Indian banking sector.

6.6. Summary of the chapter

To conclude, this chapter discussed and interpreted the results of technical efficiency scores of ICBin detail with possible reasons and evidence to support the findings. The chapter starts with an analysis of the technical efficiency of Indian banking industry and it has been found that Indian banks in general have been stable in terms of technical efficiency with a score of above 90% in all the years of the research time-period and the main reason behind that is their ability to control their inputs. Having said that, there is still room for improvement as the technical efficiency score for the Indian commercial banking sector has not been 100% in any of the years. Further to this, the event of global financial crisis had a positive impact on the efficiency of Indian banking sector in general as well as most of the individual banks due to strict government policies and regulations, especially after the crisis. The only banks, which experienced negative effect of the crisis on their efficiency are IDBI and the United Bank of India and the possible reason for the same has been analysed as their inability to manage their operational expenses. Mann-Whitney U-tests were conducted on the DEA input and output variables to get a clearer picture on the technical efficiency of banks. All the input and outputs variables to be used in the DEA showed a significant increase after the crisis which demonstrates that increase in inputs corresponded to increase in outputs, thus, implying sound efficiency scores for ICBs.

Chapter 7

Profitability of Indian commercial banks

7.1. Introduction

This chapter in the research thesis is about the discussion and interpretation of the results obtained from the findings of the analysis conducted to investigate the profitability of Indian commercial banks (ICBs), the determinants of profitability of ICBs, the impact of financial crisis of 2007-2009 on the profitability and relationship of profitability with different explanatory variables. As discussed in chapters 4 and 5, efficiency and profitability are two measures of performance of any firm and to get a full picture of the performance of commercial banks of India, the research thesis has evaluated both the efficiency and profitability of banks for the time period 2001-2017. As described in section 4.13 in chapter 4, following the lines of Beck et al. (2013), Lee & Kim (2013) and Olson & Zoubi (2011), ROE has been considered as the measure of bank profitability. ROE has been considered as a measure of profitability and thus, the performance. The research time-period sample has been divided into two parts: research sample 2002-2007 i.e. before the financial crisis and 2010-2017 i.e. after the financial crisis. In line with Eichengreen and Gupta (2012), the time period 2007-2009 has been considered as the global financial crisis period. Conducting the research in these two time-periods separately will provide the readers with insights into how the performance of the Indian banking sector has got effected by the crisis.

After the analysis and interpretation of profitability of ICBs, regression models were conducted between ROE and explanatory variables to understand the relationship ROE has with different micro and macro-economic variables and finally, Mann-Whitney U-tests were conducted on dependent and independent variables to get a clearer picture of operating conditions in the pre and post-crisis periods and understand the reasons responsible for the impact of financial crisis on profitability scores as well as the changing relationship of ROE with explanatory variables in two research samples.

7.2. Profitability of ICBs

This section discusses the performance of Indian banks for the time period 2002-2017, before crisis and after the crisis. ROE (Return on Equity) has been considered as a measure of profitability and thus, the performance. Mean ROE has been calculated and analysed for thee Indian banking sector in general as well as individual ICBs. The data on ROE for the sample banks for the time-period 2001-2017 have been collected from Reserve Bank of India database. This section discusses the ROE of Indian banking sector in general as well as for individual sample commercial banks of India in three research time-period samples i.e. full sample (2002-2017), before crisis (2002-2007) and after crisis (2010-2017). This will also enable the researcher to analyse the impact of financial crisis on the profitability of Indian banks.

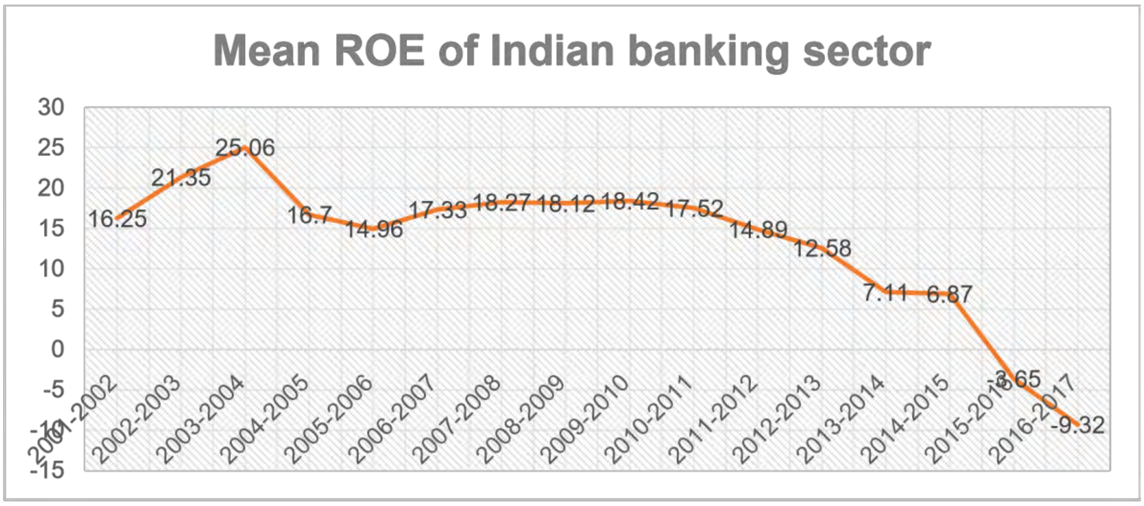
The mean ROE results for the Indian banking sector has been presented in Table 7.1 below and the same has been graphically represented by figure 7.1. The individual mean ROE results for the sample ICBs have been presented in Table 7.2 and graphical representation of the same for full sample, before crisis and after crisis can be seen in graphs 7.2, 7.3 and 7.4 respectively.

Table 7.1. Mean ROE of Indian commercial banks for the time-period 2002-2017

Year	Mean ROE	Year	Mean ROE
2001-2002	16.25	**2009-2010**	18.42
2002-2003	21.35	**2010-2011**	17.52
2003-2004	25.06	**2011-2012**	14.89
2004-2005	16.70	**2012-2013**	12.58
2005-2006	14.96	**2013-2014**	7.11
2006-2007	17.33	**2014-2015**	6.87
2007-2008	18.27	**2015-2016**	-3.65
2008-2009	18.12	**2016-2017**	-9.32

Source: Mean ROE results calculated by the author using the ROE data from Reserve Bank of India database

Figure 7.1. Mean ROE of Indian banks for the time period 2002-2017



Source: Generated by the author using Microsoft Excel

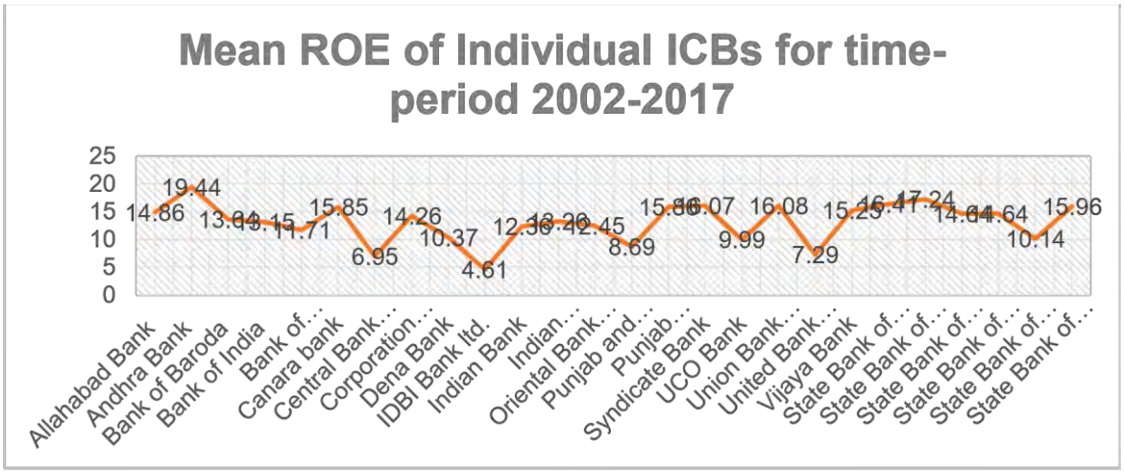
As it can be seen from Table 7.1 and figure 7.1 above, a continuous and steady increase in ROE of banks can be observed from 2001 up until the financial year 2008-2009. A continuous decline can be observed in the ROE value after the year 2009-2010. The reason of the same can be attributed to the financial crisis of 2007-2009, which had a negative impact on the performance of most of the businesses around the world. Further to this, the Indian banking sector recorded highest and lowest values of ROE in the years 2003-2004 (25.06) and 2016-2017 (-9.32) respectively

Table 7.2. Mean ROE of individual commercial banks of India

Name of the Bank	2002-2017	Before Crisis	After Crisis
Allahabad Bank	14.86	21.34	9.46
Andhra Bank	19.44	28.5	12.9
Bank of Baroda	13.64	15.27	11.67
Bank of India	13.15	19.21	5.72
Bank of Maharashtra	11.71	17.67	5.66
Canara bank	15.85	22.48	10.68
Central Bank of India	6.95	12.8	1.73
Corporation Bank	14.26	16.54	11.36
Dena Bank	10.37	9.76	8.03
IDBI Bank ltd.	4.61	7.63	2.39
Indian Bank	12.36	9.28	12.42
Indian Overseas Bank	13.26	27.78	-0.48
Oriental Bank of Commerce	12.45	20.44	7.08
Punjab and Sind Bank	8.69	3.69	9.29
Punjab National Bank	15.86	19.94	11.65
Syndicate Bank	16.07	21.69	10.74
UCO Bank	9.99	14.14	5.51
Union Bank of India	16.08	20.01	11.71
United Bank of India	7.29	12.75	2.64
Vijaya Bank	15.25	23.02	9.99
State Bank of Bikaner and Jaipur	16.41	20.94	12.1
State Bank of Hyderabad	17.24	23.05	11.94
State Bank of India	14.64	17.94	11.6
State Bank of Mysore	14.64	28.98	3.86
State Bank of Patiala	10.14	19.5	2.55
State Bank of Travancore	15.96	24.03	7.15

Source: Mean ROE results calculated by the author using the ROE data from Reserve Bank of India database

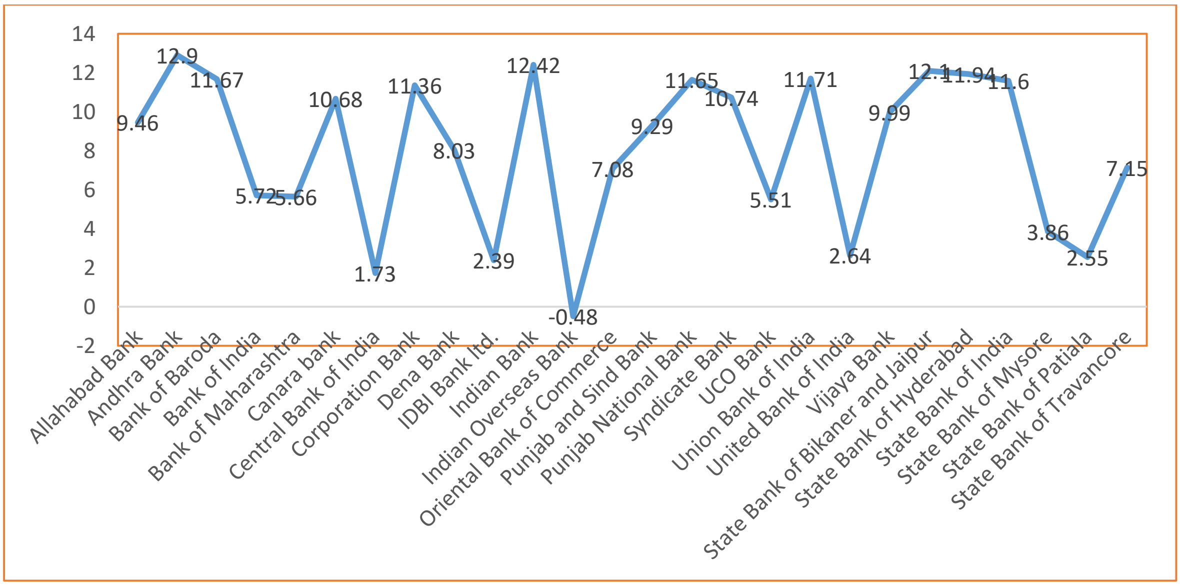
Figure 7.2. Mean ROE of Individual ICBs for the time-period 2002-2017



Source: Generated by the author using Microsoft Excel

From the ROE results of individual ICBs for the time-period 2002-2017 presented in Table 7.2 and figure 7.2 above, it can be observed that Andhra bank has the highest profitability with ROE value of 19.44, whereas IDBI bank has the lowest ROE i.e. 4.61 for the time-period 2002-2017.

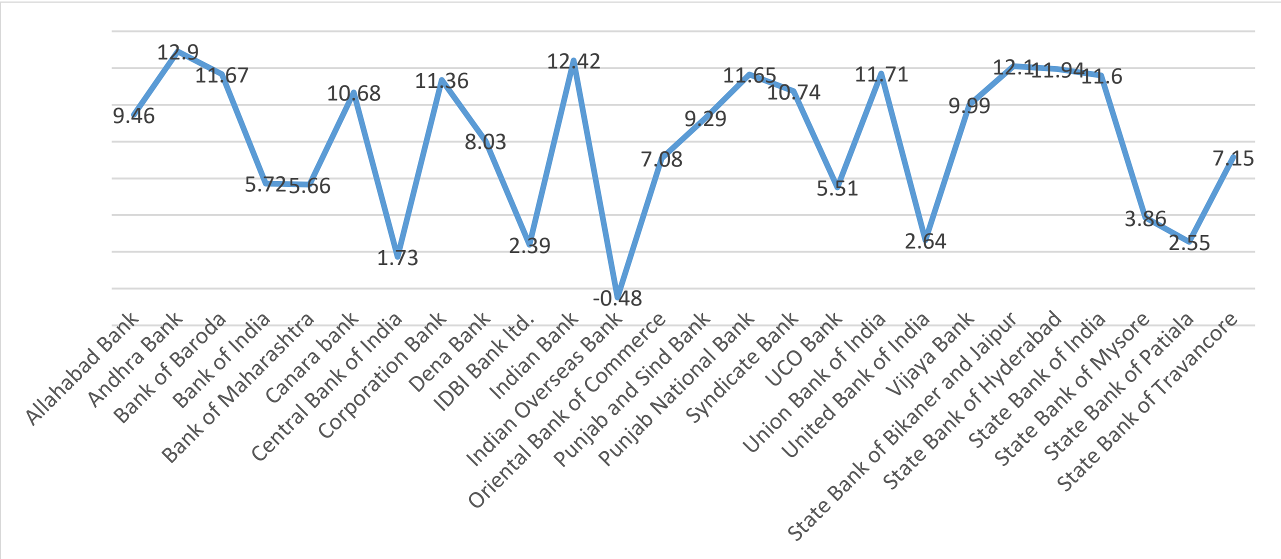
Figure 7.3. Mean ROE of individual ICBs before the crisis (2002-2007)



Source: Generated by the author using Microsoft Excel

For ROE results in the pre-crisis period presented in Table 7.2 and figure 7.3 above, it can be concluded that before crisis, Andhra bank has the highest ROE value of 28.50 and the lowest ROE of 3.69 has been recorded for Punjab and Sind Bank.

Figure 7.4. Mean ROE of individual ICBs after the crisis (2010-2017)



Source: Generated by the author using Microsoft Excel

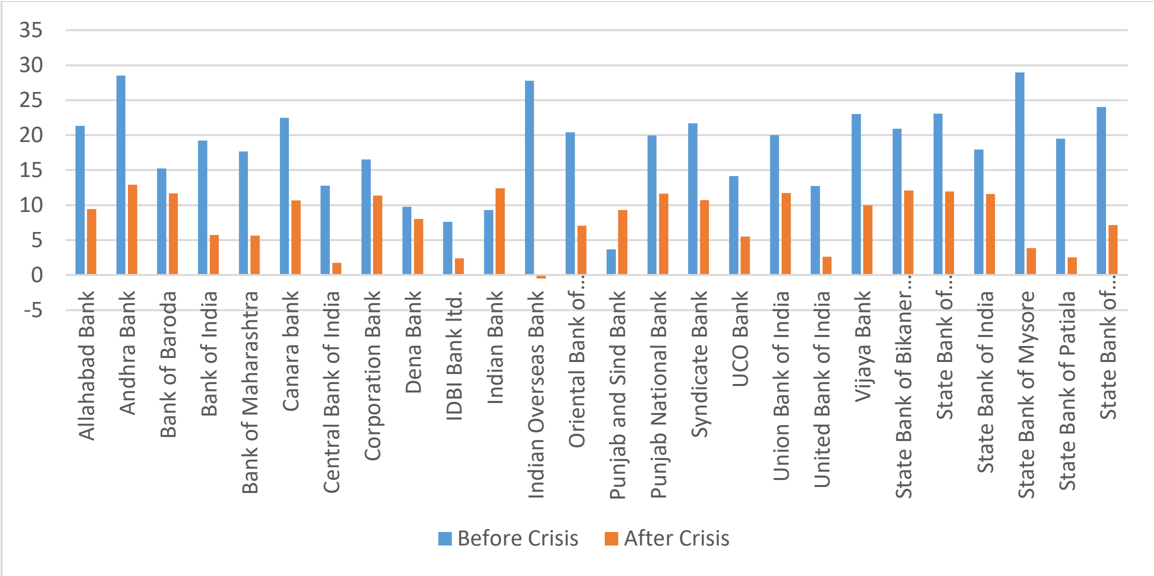
Finally, by looking at the results presented in Table 7.2 and figure 7.4 above, it can be seen that after the crisis, the highest value of ROE has been observed for Andhra bank (12.90) and Indian overseas bank had the lowest ROE value of (-) 0.48.

The analysis of ROE results of individual banks presented in Table 7.2 further reveals that Andhra bank had the highest profitability for all three research time-period samples i.e. 2002-2017 (19.44), pre-crisis (28.50) and post-crisis (12.90). The banks with lowest value of ROE in the full sample, pre-crisis and post-crisis periods are IDBI bank (4.61), Punjab & Sind Bank (3.69) and Indian overseas bank (-0.48) respectively. The reason behind this can be mainly attributed to the capital adequacy of banks, where Andhra bank has reported higher value of capital adequacy ratio than Punjab & Sind bank and Indian overseas bank in the pre-crisis and post-crisis periods respectively (table 5.17 in appendix 2).

7.3. Impact of financial crisis on the profitability of ICBs

The impact of financial crisis on the profitability of ICBs can be demonstrated by the figure 7.5 below, which compares the mean ROE values of individual banks before and after the crisis.

Figure 7.5. Comparison of mean ROE of individual ICBs before and after the crisis



Source: Generated by the author using Microsoft Excel

With a careful analysis of figures 7.1 and 7.5 above, it can be observed that the ROE of Indian banking sector as well as the most of the individual ICBs (except Indian bank and, Punjab & Sind bank) has declined after the financial crisis. On the basis of this, it can be concluded that the event of global financial crisis had negative impact on the performance of Indian banking sector in general as well the individual banks.

Finally, by looking at tables 7.1 and 7.2 and figures 7.1 and 7.5, it can be concluded that the event of global financial crisis had negative impact on the profitability of Indian banking sector in general as well as the profitability of individual commercial banks of India. This finding is further confirmed by the results of the Mann-Whitney U-test presented in table 7.3, which shows that the ROE of Indian banks were significantly lower in the pre-crisis period. The reason behind this can be the significant decline in the values of liquidity, capital adequacy and net interest margin of banks after the crisis (See table 7.3 below).

Most of the studies in the literature agree with these findings of negative impact of financial crisis on the profitability of banks such as Sufian and Habibullah (2010) for Indonesian banks, Dietrich & Wanzenried (2011) for 372 commercial banks in Switzerland for the time-period 1999-2009, Acharya, Agarwal & Kulkarni (2012), Eichengreen & Gupta (2012) and Dalaien (2016). According to Eichengreen and Gupta (2012), initially the Indian banks were viewed as non-effected from the global event of financial crisis because of the huge public ownership and conventional management. To the contrary, the bank analysts noticed a rapid rise in the borrowing/lending rates between banks, lowered deposits and credits and thus, lowered returns as an outcome since mid 2008s.

7.4. Results of Mann-Whitney U-test to assess the research variables before and after the crisis

This section of the thesis discusses and analyses the results of the Mann-Whitney U-test run on the research dependent and explanatory independent variables to assess whether there are statistically significant changes in the values of the variables before and after the event of global financial crisis of 2007-2009. The results will also provide important additional insights on the operating conditions in the two time-periods. The test and the analysis has been carried out for EFF, the dependent variable ROE and the independent explanatory variables and tests the null hypothesis that there are no significant changes in the means of two groups of each variable (i.e. before and after the crisis). The summary of the test results has been presented in table 7.3 below. The test has been conducted using the Kruskal-Wallis test spreadsheet.

The following null hypothesis is tested in t-tests at a significance level of 5%:

Null Hypothesis, $H0$: There exists no significance difference in the variable before and after the crisis

Alternative hypothesis, Ha: There exists significance difference in the variable before and after the crisis

Table 7.3. Summary of the results of Mann-Whitney U-test for dependent and independent variables

Variable	Group	N	Mean	Adjusted H (Test statistic)	p-value	Decision
ROE	Pre-crisis	150	18.5749	76.986	1.72E-18	Reject $H_{0,}$ ROE is significantly lower in the post crisis period
	Post-crisis	208	8.052381			
EFF	Pre-crisis	151	0.968641	14.894	0.000114	Reject $H_{0,}$ EFF is significantly higher in the post crisis period
	Post-crisis	208	0.990909			
CAPAD	Pre-crisis	152	12.32261438	9.748	0.001795	Reject $H_{0,}$, CAPAD is significantly lower in the post crisis period
	Post-crisis	208	12.14591346			
NPA	Pre-crisis	151	0.0421395	9.336	0.002247	Reject $H_{0,}$, NPA is significantly lower in the post crisis period
	Post-crisis	208	0.03285974			
NIM	Pre-crisis	152	3.070797	140.858	1.73E-32	Reject $H_{0,}$, NIM is significantly lower in the post crisis period
	Post-crisis	208	2.389169			
LIQ	Pre-crisis	152	5.836827	34.032	5.42E-9	Reject $H_{0,}$ LIQ is significantly lower in the post crisis period
	Post-crisis	208	5.08634			
INF	Pre-crisis	6	4.734837	3.267	0.071	Accept $H_{0,}$ INF is higher in the post crisis period, but the difference isn't significant
	Post-crisis	8	7.61375			
GDP	Pre-crisis	6	31952.233	9.6	0.001946	Reject $H_{0,}$, GDP is significantly higher in the post crisis period
	Post-crisis	8	89917.21			
LEXR	Pre-crisis	6	3.81	**	3.95E1	Accept $H_{0,}$ LEXR is higher in the post crisis period, but the difference isn't significant
	Post-crisis	8	4.05			
RIR	Pre-crisis	6	5.48	**	-1.93E1	Accept $H_{0,}$ RIR is higher in the pre-crisis period, but the difference isn't significant
	Post-crisis	8	3.94			

Source: Mann-Whitney test statistics generated by the author using the Kruskal-Wallis test spreadsheet

Based on the results of the Mann-Whitney U-test presented in table 7.3 above, it can be concluded that ROE, CAPAD, NPA, NIM and LIQ of ICBs have significantly declined after the crisis, whereas a significant increase can be observed in the values of EFF and GDP after the crisis. The value of INF and LEXR increased and RIR decreased after the crisis, however the difference isn't significant as the $p>0.05$.

The results obtained from the Mann-Whitney U-test presented above in table 7.3 are opposite to the regulations suggested by the Basel III framework for the better management and soundness of the banking system after the event of global financial crisis (which suggested banks to have better capital adequacy and liquidity position after the crisis). The reason for the same as given by Gopakumar (2019) is that the Reserve Bank of India (RBI) hasn't implemented the framework in the Indian Banking sector yet. Also by looking at the figures presented in the table 5.64, it can be observed that the Indian banking sector has already been regulating and supervising the capital (above 12%) and liquidity (above 5%) requirements suggested by the Basel III framework.

These results also indicate that there was a positive impact of crisis on the technical efficiency of ICBs, but the crisis negatively effected the ROE of commercial banks of India. The lower values of CAPAD, NIM and LIQ after the crisis also partially explain the decline in the value of ROE after the crisis, however, better conclusions and judgements can be drawn after analysing the determinants of ROE before and after the crisis via the estimation of regression models.

7.5. Regression model estimation to establish the determinants of profitability of ICBs

This step in the empirical analysis is based on the estimation of regression model between the dependent variable ROE and the independent explanatory (micro and macro-economic) variables, before and after the crisis. This will give insights into the determinants of profitability of banks and how profitability (ROE) of banks is related to different micro and macro variables. The original sample of variables to be researched, comprised of CAPAD (capital adequacy), LAGE (bank age), SIZE (bank size), MSHARE (market share), NPA (non-performing assets), NIM (net interest margin), LIQ (liquidity), INF (inflation), LGDP (Gross Domestic Product), LEXR (exchange rate) and RIR (real interest rate).

CAPAD is a micro-economic, bank specific factor and is calculated using the formula: tier 1 capital+tier II capital)/risk weighted assets. The age of a bank i.e. LAGE in a given year is calculated by computing the difference between the given year and the year of its establishment. SIZE of a bank has been calculated by taking log of a bank's total assets. MSHARE of a bank has been calculated in terms of the bank's deposits' share in total deposits of the market. NPA is a ratio and has been calculated by dividing the non-performing assets of the bank with the total advances offered by the bank to its customers. NIM is a ratio and has been calculated by dividing net interest income to total assets of a banks. LIQ again is a ratio, which represents the liquidity position of a banks and has been calculated by multiplying the two ratios, which are cash/deposits and deposits/total liabilities. Finally, INF, LGDP, LEXR and RIR are macroeconomic and country-specific factors. LGDP has been commuted by taking log of GDP. LEXR represents annual mean exchange rate and has been calculated by taking log of exchange rate and RIR represents Real Interest Rate.

The data on all these variables for the time period 2002-2017 for the sample 26 commercial banks of India has been collected from the Reserve Bank of India database. The financial year represents time period from 1 April to 31 March. For example, the data for the year 2002 runs from April 1, 2001-March 31, 2002. To study the impact of the financial crisis on ROE and its determinants, regression models will be run for the two time-periods i.e. before and after the crisis. In line with Eichengreen and Gupta (2012), 2002-2007 has been considered to be pre-financial crisis period and 2010-2017 has been considered as the post-crisis period.

As explained and summarized in section 5.3.5 above, different diagnostic tests were conducted to assess the suitability of data for regression analysis indicate that the data variables exhibit non-normality and some of the variables are associated with the issue of non-stationarity. The tests further confirm that the residuals and errors terms are associated with issues of correlation, both before and after the financial crisis. To resolve these issues along with other endogeneity issues in the data sample (such as heteroskedasticity and multicollinearity), regression models will be estimated by using the GMM (Generalized Methods of Moments) technique and by dropping the variables LAGE, SIZE, MSHARE, INF, LGDP, LEXR and RIR due to the high correlation of these variables with the rest of the variables.

However, many researchers in the literatures have emphasized the importance of bank size, interest rate and exchange rate on their performance. For instance, Aldwan (2015), Redmond and Bohnsack (2007), Kasimodou et al., 2006) etc. studied and proved the significance of bank size on their performance. Similarly, interest rate (Kasman et al., 2011, Hossain, 2010, Peng et al., 2003, and exchange rate (Negrbo, 2012, Kiganda, 2014, Magud et al., 2014, Kasman et al., 2011, Lambe, 2015) have been found out to be significant determinants of banks' performance. Keeping in mind, the huge significance of bank size, interest rate and exchange rate in banks' performance, two different types of models have been estimated in the research project to study the impact of micro and macro determinants on profitability of commercial banks, one with dropping the variables LAGE, SIZE, MSHARE, LGDP, INF, LEXR and RIR and the other model comprising of variables CAPAD, SIZE, NPA, NIM, LIQ, LEXR and RIR. In line with Baltagi (2005), the endogeneity issues associated with the variables SIZE, LEXR and RIR have been taken care of by converting these variables into first lags. The residuals of the estimated model will again be tested to determine that the estimated models are free from the endogeneity issues.

7.5.1. Impact of CAPAD, LIQ, NPA and NIM on profitability of ICBs

To determine the impact of independent variables CAPAD, LIQ, NPA and NIM on ROE of banks, ROE is considered as a function of these variables as follows:

ROE = f(CAPAD, LIQ, NPA, NIM)

ROE is regressed against CAPAD, LIQ, NPA and NIM using the GMM (Generalized Methods of Moments) estimation technique in E-Views 11.0 to test the following equation:

ROE = C(1) ROE(-1)) + C(2) CAPAD + C(3) LIQ + C(4) NPA + C(5) NIM...............................7.1

The results of the GMM regression estimation between ROE and the above mentioned explanatory independent variables, before and after the financial crisis, have been presented in tables 7.4 and 7.6 respectively. The estimation of equation 7.1 for the time period 2002-2007 (i.e. before the financial crisis) has resulted in the following equation 7.2:

ROE = 0.0582 ROE(-1) + 3.315 CAPAD + 3.735 LIQ+ 48.043 NPA+ 11.274 NIM 7.2

p-value	0.8094	0.1980	0.0591	0.1239	0.0901

Similarly, the estimation of equation 7.1 for the time period 2010-2017 (i.e. after the financial crisis) has resulted in the following equation 7.3:

ROE = -0.052 ROE(-1)) + 1.246 CAPAD - 0.559 LIQ - 252.980 NPA + 9.704 NIM 7.3

p-value	0.2878	0.0076	0.0017	0.00	0.0001

Table 7.4. Results of GMM regression model estimation between ROE and CAPAD, LIQ, NIM and NPA before the financial crisis

Dependent Variable: ROE				
Method: Panel Generalized Method of Moments				
Transformation: First Differences				
Date: 11/24/20 Time: 14:49				
Sample (adjusted): 2004 2007				
Periods included: 4				
Cross-sections included: 26				
Total panel (unbalanced) observations: 101				
White period instrument weighting matrix				
White period standard errors & covariance (d.f. corrected)				
Instrument specification: @DYN(ROE,-2)				
Constant added to instrument list				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROE(-1)	0.058	0.241	0.242	0.809
CAPAD	3.315	2.558	1.296	0.198
LIQ	3.735	1.956	1.910	0.059
NPA	48.043	30.949	1.552	0.124
NIM	11.274	6.584	1.712	0.090
Effects Specification				
Cross-section fixed (first differences)				
Root MSE	12.979		Mean dependent var	-0.909
S.D. dependent var	7.703		S.E. of regression	13.313
Sum squared resid	17015.19		J-statistic	8.917
Instrument rank	10		Prob(J-statistic)	0.112

Source: GMM regression model estimated by the author using E-Views 11.0

The null hypothesis that the over-identifying restrictions are valid is accepted as probability of the J-statistic is > 0.05. As this is a dynamic panel, the second order serial correlation in the residuals is tested using Arellano-Bond serial correlation test and the results for the same have been presented in table 7.5 below.

Table 7.5. Arellano-Bond Serial-Correlation Test results for the regression model between ROE and; CAPAD, LIQ, NIM and NPA before the financial crisis

Arellano-Bond Serial Correlation Test				
Sample: 2002 2007				
Included observations: 101				
Test order	m-Statistic	rho	SE(rho)	Prob.
AR(1)	-1.830	-3761.604	2055.542	0.067
AR(2)	-1.607	-2795.177	1739.572	0.108

Source: Arellano-Bond serial correlation test results generated by the author using E-Views 11.0

From Table 7.4, it can be analysed that the value of m-statistics for AR(1) and AR(2) are -1.830 and -1.607 respectively. The probability values indicate that while AR(1) is statistically significant at 10%, AR(2) is statistically insignificant. These values of AR(1) and AR(2) imply that the error terms in the given estimated regression model are free from the issue of serial-correlation.

After the analysis of the results of the regression model presented in table 7.4, it can be seen that before the financial crisis, the probability values for variables CAPAD, LIQ, NPA and NIM in the given model are 0.198, 0.059, 0.124 and 0.090 respectively. Looking at these values of p, it can be concluded that LIQ and NIM are significant at significance level of 10%, whereas CAPAD and NPA are insignificant. The values of the coefficient C in the given model for these variables in the same order are 3.734, 3.315, 48.043 and 11.274 respectively. Considering the values for probability and the coefficient C, the null hypothesis is rejected for the variables LIQ and NIM and; is accepted for CAPAD and NPA and it can be concluded that LIQ and NIM are significantly and positively related to ROE, whereas CAPAD and NPA have an insignificant positive relationship with ROE before the financial crisis. This relationship is further confirmed by looking at the values of correlation coefficient of ROE with these variables from table 5.54 in chapter 5 above.

The values of correlation coefficient of ROE with CAPAD, LIQ, NPA and NIM are 0.266, 0.117, 0.152 and 0.380 respectively. The value of the coefficient C measures the contribution of each research variable to the model. The values of coefficients in the given model imply that if all the other independent variables are kept to be zero, a unit increase in CAPAD will increase ROE by 3.735, a unit increase in LIQ will increase ROE by 3.315, a unit increase in NPA will increase ROE by 48.043 and finally a unit increase in NIM will increase ROE by 11.274 for the time-period before the financial crisis.

Table 7.6. Results of GMM regression model estimation between ROE and CAPAD, LIQ, NIM and NPA after the financial crisis

Dependent Variable: ROE				
Method: Panel Generalized Method of Moments				
Transformation: First Differences				
Sample (adjusted): 2012 2017				
Periods included: 6				
Cross-sections included: 26				
Total panel (balanced) observations: 156				
White period instrument weighting matrix				
White period standard errors & covariance (d.f. corrected)				
Instrument specification: @DYN(ROE,-2)				
Constant added to instrument list				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ROE(-1)	-0.052	0.048	-1.067	0.288
CAPAD	1.247	0.460	2.708	0.008
LIQ	-0.559	0.175	-3.199	0.002
NPA	-252.980	16.218	-15.598	0
NIM	9.705	2.405	4.035	0
Effects Specification				
Cross-section fixed (first differences)				
Root MSE	6.367	**Mean dependent var**		-4.473
S.D. dependent var	10.196	**S.E. of regression**		6.471
Sum squared resid	6322.759	**J-statistic**		18.809
Instrument rank	21	**Prob(J-statistic)**		0.279

Source: GMM regression model estimated by the author using E-Views 11.0

The null hypothesis that the over-identifying restrictions are valid is accepted as probability of the J-statistic is > 0.05. As this is a dynamic panel, the second order serial correlation in the residuals is tested using Arellano-Bond serial correlation test and the results for the same have been presented in table 7.7 below.

Table 7.7. Arellano-Bond Serial-Correlation Test results for the regression model between ROE and; CAPAD, LIQ, NIM and NPA after the financial crisis

Arellano-Bond Serial Correlation Test				
Sample: 2010 2017				
Included observations: 156				
Test order	**m-Statistic**	**Rho**	**SE(rho)**	**Prob.**
AR(1)	-3.242	1773.226	546.867	0.001
AR(2)	1.284	345.147	268.814	0.199

Source: Arellano-Bond serial correlation test results generated by the author using E-Views 11.0

By looking at the results presented in Table 7.7 it can be analysed that the value of m-statistics for AR(1) is -3.242, which is statistically significant with a probability value of 0.001. The value of AR(2) is 1.284 which is statistically insiginificant with a probability value of 0.119. Based on these results, it can be drawn that the error terms in panel regression estimations for the research data after the financial crisis are also free from the issue of serial-correlation.

By analysing the results of regression model between ROE and explanatory variables after the financial crisis presented in Table 7.6 above, it can be seen that the probability values for variables CAPAD, LIQ, NPA and NIM in the given model are 0.008, 0.001, 0 and 0 respectively. Looking at these values of p, it can be concluded that all the independent variables in the given model i.e. CAPAD, LIQ, NPA and NIM are significant a significance level of 5%. The values of the coefficient C in the given model for these variables in the same order are 1.247, -0.559, -252.980 and 9.705 respectively. Considering the values for probability and the coefficient C, the null hypothesis is rejected for all the independent variables in the model and it can be concluded that CAPAD and NIM are significantly and positively related to ROE, whereas LIQ and NPA have a significant negative relationship with ROE after the event of the global financial crisis. This relationship is further confirmed by looking at the values of correlation coefficient of ROE with these variables from table 5.54 in chapter 5 above. The values of correlation coefficient of ROE with CAPAD, LIQ, NPA and NIM after the crisis are 0.535, 0.121, -0.897 and 0.463 respectively.

The values of coefficients in the given model imply that if all the other independent variables are kept to be zero, a unit increase in CAPAD will increase ROE by 1.247, a unit increase in LIQ will decrease ROE by 0.559, a unit increase in NPA will decrease ROE by 252.980 and finally a unit increase in NIM will increase ROE by 9.705 for the time-period after the financial crisis.

The above resultant regression models presented in tables 7.4 and 7.6 reveal that the regression estimation outputs before the crisis are different to those obtained for the sample time-period after the crisis. While CAPAD and NPA are insignificant in the regression model before the crisis, they become significant after the crisis. Further to this, NPA and LIQ are found to be positively related to ROE before the crisis, whereas they are found to have negative impact on the ROE of ICBs after the crisis. Thus, the relationship of ROE with the independent variables varies in different stages of a business cycle.

CAPAD in the research thesis is found to have a positive relationship with ROE, both before (insignificant) and after (significant) the crisis. The findings are in agreement with the findings of Gupta & Mahakud (2020), Ramlall (2009), Berger (1995), Athanasoglou et al. (2005), Athanasoglou et al. (2006), Goaied & Bennaceur (2008), Dietrich & Wanzenried (2011), Wahidudin et al. (2013), Ayaydin & Karakaya (2014), Jabbar (2014), Saeed (2014) and; Batten & Vo (2019), where a positive relationship between bank profitability and capital adequacy has been reported. Other examples of research studies to report a positive relationship between capital adequacy and bank performance are Tochkov & Nenousky (2009), Ani, Ugwunta & Imo (2012), Adeusi, Kolapo & Aluko (2014), Grigorian & Manole (2002), Naceur et al. (2009), Das & Ghosh (2009), Sufian and Noor (2009), Chortareas, Garza-Garcia & Girardone (2009), Yildrim & Philippatos (2002), Wapmuk (2016), Barth et al. (2013b), Pessarossi and Weill (2014), Pasiouras (2008), Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques (2001), Rime (2001), Jeitschko and Jeung (2005), Kaparakis et al. (1990), Elyasani et al. (1994), Girardone et al., (2004), Berger (1995), Alexiou and Sofoklis (2009), Haron (2004), Kosmidou (2008), Demirguc-Kunt & Huizinga (1999), Goddard et al. (2004), Sufian & Chong (2008), Pasiouras & Kosmidou (2007), Alunbas et al. (2007), Hafez (2018), which state that banks, which are well capitalised have lower risks of bankruptcy and thus, have high credit worthiness, which in turn reduces their cost of funding and ultimately, enhances their profitability and efficiency.

According to Gupta & Mahakud (2020), stronger position of a bank in terms of its capital adequacy demonstrates its financial strength and offers protection to depositors, which in turn encourages its profitability and strength and thus, its overall stability. According to Berger (1995), banks with strong capital position require less funding from outside, which in turn leads to lower cost of capital and bankruptcy and thus, results in higher profitability. Ramlall (2009) offers further support to these findings by stating that banks with a strong capital position are capable of extending further loans to their clients, which results in higher interest income and thus, higher profits. According to Claeys & Vander Vennet (2003), well capitalised banks are motivated to enhance their risky assets ’by loans and securities. Also as higher capital is associated with better incentives for shareholders for the monitoring of operations and strategies of managers, it impacts the performance of managers and thus, the banks indirectly.

In contrary to the findings of this research thesis, studies such as Guru et al. (2002),

Ali et al. (2011), Chronopoulos et al. (2012), Goddard, Molyneux & Wilson (2004), Ayaydin & Karakaya (2014), Oladeji, Ikpefan & Olokoyo (2015) and; Ugwuanyi & Ewah (2015) have reported a negative relationship between bank performace and its capital adequacy position by stating that higher capital reduces a bank’s position of financial leverage which in turn, effects the risk and thus have an adverse effect on its overall profitability. No significant relationship between bank performance and capital adequacy has been reported by Gupta, Doshit and Chinubhai (2008) and Casu & Molyneux (2003). The possible reason behind this can be the strict requirements of capital in case of Indian banking sector as banks are required to keep a minimum of 25-30% of their capital as reserved funds. According to Christine Lagarde, the director of International Monetory Fund (IMF), the Indian banking sector is well capitalised. As most of the banks are well capitalised, no significant impact of capital is observed on efficiency of banks in India.

The liquidity position of a bank (LIQ) has been found to have a significant positive effect on the profitability of ICBs before the crisis and a significant negative effect on ROE of ICBs after the crisis. The findings of a significant relationship between bank liquidity and its profitability confirm the findings of Lukorito et al. (2014), Sufian (2012), Dang (2011) and Ibe (2013). As per Lukorito et al. (2014), banks with higher levels of liquidity are able to settle their short-term liabilities as well as operational expenses smoothly, which in turn, facilitates better service delivery to their customers and thus, results in better performance. A weak positive relationship between bank liquidity and its profitability has been discovered by Lartey et al. (2013) for Ghana Banks for the time period 2005-2010 and; Munteanu (2013) for commercial banks in Eastern and central Europe for the time-period 20032010. On the other hand, Nimer et al. (2013) has discovered a significant negative impact of liquidity on the profitability of Jordanian banks for the time-period 2005-2011. Accoridng to Nimer et al. (2013), banks with high liquidity suffer from the loss occurred due to holding too many liquid assets rather than earning benefits from investing them in profitable ventures. In contrary to the findings of this research, Ongore & Kusa (2013) and; Mohanty & Mehrotra (2018), demonstrated an insignificant impact of bank liquidity and its profitability.

It can be noted that the relationship between LIQ and ROE before the financial crisis is different to that, after the crisis. The reason for the same can be given by the results of Mann-Whitney U-test presented in table 7.3, where it can be observed that there has been a significant decline in the liquidity of ICBs after the crisis. The finding of significant positive relationship of ROE with LIQ before the crisis and significant negative relationship after the crisis gets support from the findings of Mayank and Mishra (2013), Shahchera (2012) and; Bordeleau & Graham (2010), which suggest a non-linear relationship between liquidity and profitability of Indian banks, where liquidity is positively related to profitability of banks to a certain level and above that level, there comes a point where holding any more liquid assets start effecting the profitability of banks negatively due to the opportunity cost associated with holding comparatively less-earning assets on the balance sheet of banks. As the liquidity of sample ICBs reduces significantly after the crisis, it justifies the positive impact of LIQ on ROE after the event of global financial crisis.

The next independent variable to study in the regression model estimation is nonperforming assets i.e. NPA. The GMM regression estimations reveal an insignificant positive impact of NPA on ROE before the crisis and a significant negative effect of NPA on ROE after the crisis. The Mann-Whitney U-test results presented in table 7.3 above reveal that there is a significant decline in the value of NPAs after the crisis. According to Sengupta & Vardhan (2017), immediately after the global financial crisis in 2008, the governments of countries across the world started taking measures to deal with the negative aftermath consequences of crisis which included imposing strict measures and regulations and that can be one of the possible reasons behind a significant decline in the value of NPAs in the Indian Banking Industry in the post-crisis period. Sengupta & Vardhan (2017) further state that like many other countries around the world, India too faced a drastic decline in the economic growth, enormous depreciation in the currency value, high rate of inflation, and a long-continuous period of financial contraction which forced the Reserve Bank of India to raise interest rates to deal with the recession and high inflation rates. This is also evident from the results of Mann-Whitney U-test results presented in table 7.3, where a non-significant increase can be observed in the inflation rate in the Indian economy in the post-crisis period. The GDP of India improved significantly after the crisis. The concerned economic slowdown prompted the Indian government to encourage banks to lend more to the infrastructure industry to deal with the slowing economy and as a consequence, the leverage position of Indian banks heightened further while the economic downturn carried on worsening further (Sengupta & Vardhan, 2017).

As the value of NPAs has reduced significantly after the crisis in the Indian banking industry, so similar to relationship between ROE and NPAs before the crisis, no significant impact of NPAs on the profitability of Indian banks will be expected in the post-crisis period as well. However, due to the severe economic slowdown caused by the global financial crisis, the increased interest rates and the heightened leverage position of Indian banks, NPAs effected the profitability of Indian banks even more negatively than it would have done otherwise. The findings of this research work of a significant impact of NPA on the performance of ICBs are consistent with studies such as Pastor (1992), Sufian & Habibullah (2009), Sufian (2009), Manthos (2009), Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017), Mehta & Malhotra (2014), Ibrahim & Thangavelu (2014), Alam, Haq & Kader (2015), Alagarsamy & Ganapathy (2017) and Sengupta & Vardhan (2017), which have also reported NPAs as one of the main determinants of performance of banks. Most of the studies in the literature support the research finding of a significant and negative relationship between bank performance and non-performing assets of the banks and thus, are consistent with the findings of this research thesis.

The findings of this research thesis on a significant and negative relationship between efficiency and NPAs of banks are supported by previous researches such as Pastor (1992) for Mexican banks, Sufian & Habibullah (2009) and Sufian (2009) for banks in Singapore, Manthos (2009) for Greek banks, Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017) and; Mehta & Malhotra (2014) for banks in India. According to Daru (2016), high NPAs demotivate investors, creditors and depositors. It effects the funds recycling negatively, which in turn effects the credit deployment negatively. When loans become nonrecoverable, it not only has negative impact on credit availability in the future, but also has bad effect on banks' financial soundness. As per Mittal & Suneja (2017), NPAs negatively impact the performance of banks due to their undermining and negative influence on liquidity position, future funding, risk and productivity etc.

Finally, the Net Interest Margin (NIM) has been found to have a significant positive effect on the profitability of ICBs, both before and after the crisis. As it can be seen from the results of Mann-Whitney U-test presented in table 7.3 above, there has been significant decline in the value of NIM of banks after the crisis. This decrease in NIM might have happened due to heightened value of INF (Abugamea, 2018) and the post-effect of the financial crisis. Despite the decrease in its value, NIM is effecting the profitability of banks positively, even after the crisis. From the results of the regression models and the values of coefficient, C for the two models presented in tables 7.4 and 7.6, it can be concluded that a unit increase in the value of NIM increases the ROE of banks by 11.274 units and 9.705 units, before and after the crisis respectively. The findings of this research thesis with regards to positive effect of NIM on profitability of banks are in agreement with and extend support to previous studies in the literature such as Silaban (2017) for Indonesian banks for the time-period 2012-2016, Almilia & Herdiningtyas (2005), Wasiuzzaman & Gunasegavan (2013) for banks in Malaysia for the time-period 2005-2009, Doliente (2003), Wasiuzzaman & Tarmizi (2010), Gul et.al (2011) for commercial banks of Pakistan for the time-period 2005-2009, Park & Weber (2006) for Korean Banks for the time-period 1992-2002.

According to Almilia & Herdiningtyas (2005), greater is the value of NIM, higher is the value of interest income on the earning assets of the bank, which in turn, depicts a better performance. Wasiuzzaman & Tarmizi (2010) state that wise investment qwdecisions made by the banks reduce the credit risk, which in turn, improves the revenues earned by lending operations and thus, contributes positively towards the overall profitability of banks.

After a careful observation of the results of GMM regression analysis presented in tables 5.65 and 5.66, it can be seen that NPA has the highest value of the coefficient C, both before and after the crisis, which indicates that the main determinant of profitability of ICBs are its non-performing assets. This findings of this research work are consistent with and get support from previous studies such as Pastor (1992), Sufian & Habibullah (2009), Sufian (2009), Manthos (2009), Daru (2016), Siraj & Pillai (2013), Rai (2012), Bihari (2012), Vikram & Gayathri (2018), Mittal & Suneja (2017), Mehta & Malhotra (2014), Ibrahim & Thangavelu (2014), Alam, Haq & Kader (2015), Alagarsamy & Ganapathy (2017) and Sengupta & Vardhan (2017), which have also reported NPAs as one of the main determinants of performance of banks.

7.5.2. Impact of CAPAD, LIQ, NPA, NIM, SIZE, LEXR and RIR on profitability of ICBs

As explained in sections 5.3.5. and 7.5 above, considering the significance of microeconomic variable bank size and macroeconomic variables interest rate and exchange rate, separate models have been estimated by adding these variables to originally estimated models comprising capital adequacy, liquidity, net interest margin and non-performing assets. However, as summarized in section 5.3.5 in chapter 5 above, the variables SIZE, LEXR and RIR are associated with high correlation with other independent variables and low degree of correlation with the dependent variable ROE, models have been estimated by converting them into first lags and using GMM estimation method and the results of the same have been presented in tables 7.8 and 7.10. The resultant estimation models have also been tested for serial correlation using Arellano-Bond serial correlation and the results of the same have been presented in tables 7.9 and 7.11.

To determine the impact of independent variables CAPAD, LIQ, NPA, NIM, SIZE, LEXR and RIR on ROE of banks, ROE is considered as a function of these variables as follows:

ROE = f(CAPAD, LIQ, NPA, NIM, SIZE, LEXR, RIR)

ROE is regressed against CAPAD, LIQ, NPA, NIM, SIZE, LEXR and RIR using the GMM (Generalized Methods of Moments) estimation technique in E-Views 11.0 to test the following equation:

ROE = C(1) ROE(-1)) + C(2) CAPAD + C(3) LIQ + C(4) NPA + C(5) NIM+C(6) SIZE+(C7)LEXR+(C8)RIR..7.4

The estimation of equation 7.4 for the time period 2002-2007 (i.e. before the financial crisis) has resulted in the following equation 7.5:

ROE = -0.042 ROE(-1)+2.904 CAPAD+1.374 LIQ+ -128.502 NPA+9.198 NIM + 86.477 SIZE+668.759 LEXR+14.630 RIR……………………………………………………………..............................7.5

p-value 0.917 0.678 0.591 0.1239 0.774 0.282 0.377 0.345

Similarly, the estimation of equation 7.4 for the time period 2010-2017 (i.e. after the financial crisis) has resulted in the following equation 7.6:

ROE = 0.102 ROE(-1)+0.017 CAPAD+(-1.211) LIQ+ -215.262 NPA+4.908 NIM + 3.837 SIZE+(-21.913) LEXR+0.625 RIR……………………………………………………………..............................7.6

p-value 0.050 0.017 0.204 0.00 0.241 3.837 0.292 0.057

Table 7.8. Results of GMM regression model estimation between ROE and; CAPAD, LIQ, NIM, NPA, SIZE, LEXR and RIR before the financial crisis

Dependent Variable: ROE
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 07/06/22 Time: 22:42
Sample (adjusted): 2004 2007
Periods included: 4
Cross-sections included: 26
Total panel (unbalanced) observations: 98
White period (period correlation) instrument weighting matrix
White period (cross-section cluster) standard errors & covariance (d.f. corrected)
Standard error and t-statistic probabilities adjusted for clustering
Instrument specification: @DYN(ROE,-2)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ROE(-1)	-0.042	0.399	-0.106	0.917
SIZE	86.477	78.644	1.100	0.282
NPA	-128.502	443.362	-0.289	0.774
CAPAD	2.904	6.911	0.420	0.678
NIM	9.198	15.375	0.598	0.555
LIQ	1.374	2.521	0.545	0.591
RIR	14.630	15.183	0.964	0.345
LEXR	668.759	743.118	0.900	0.377
Effects Specification				
Cross-section fixed (first differences)				

Root MSE	43.868	**Mean dependent var**	-1.311
S.D. dependent var	7.488	**S.E. of regression**	45.777
Sum squared resid	188595.0	**J-statistic**	5.818
Instrument rank	10	**Prob(J-statistic)**	0.055

Source: GMM regression model estimated by the author using E-Views 11.0

After the analysis of the results of the regression model estimation presented in table 7.8 above, the null hypothesis that the over-identifying restrictions are valid is accepted as probability of the J-statistic is > 0.05. As this is a dynamic panel, the second order serial correlation in the residuals is tested using Arellano-Bond serial correlation test and the results for the same have been presented in table 7.9 below.

From Table 7.9, it can be analysed that the value of m-statistics and probability, p-value for AR(2) are 0.866 and 0.387 respectively. The probability values indicate AR(2) is statistically insignificant as p>0.05 and this, in turn, implies that the error terms in the given estimated regression model are free from the issue of serial-correlation.

Table 7.9. Results of Arellano-bond serial correlation test of regression model of ROE with CAPAD, LIQ, NIM, NPA, SIZE, LEXR and RIR before the financial crisis

Arellano-Bond Serial Correlation Test Date: 07/06/22 Time: 22.42 Sample: 2002 2007 Included observations: 98

Test order	**m-Statistic**	**rho**	**SE(rho)**	**Prob.**
AR(2)	0.866	11067.220	12785.576	0.387

Source: Arellano-Bond Serial correlation test statistics generated using E-Views 11.0

After the analysis of the results of the regression model presented in table 7.8 above, it can be seen that before the financial crisis, the probability values for all the variables in the model are greater than 0.05 and thus, all coefficients for all the variables are non-significant. However, as the model is free from serial-correlation as can be seen from table 7.9 above, the model is overall acceptable.

The values of the coefficient C in the given model for SIZE, NPA, CAPAD, NIM, LIQ, RIR AND LEXR are 86.477, -128.502, 2.904, 9.198, 1.374, 1.630 and 668.759 respectively. Based on these value of coefficients, it can be concluded that after adding the variables SIZE, LEXR and RIR to the originally estimated model for the time-period before the crisis, presented in table 7.4 above, all the variables become non-significant, where SIZE, CAPAD, NIM, LIQ, RIR and LEXR have non-significant positive relationship with ROE, whereas NPA has non-significant negative relationship with ROE.

Table 7.10. Results of GMM regression model estimation between ROE and; CAPAD, LIQ, NIM, NPA, SIZE, LEXR and RIR after the financial crisis

Dependent Variable: ROE Method: Panel Generalized Method of Moments Transformation: First Differences Date: 07/06/22 Time: 23:09 Sample (adjusted): 2012 2017 Periods included: 6 Cross-sections included: 26 Total panel (balanced) observations: 156 White period (period correlation) instrument weighting matrix White period (cross-section cluster) standard errors & covariance (d.f. corrected) Standard error and t-statistic probabilities adjusted for clustering Instrument specification: @DYN(ROE,-2) Constant added to instrument list				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ROE(-1)	0.102	0.050	2.064	0.050
SIZE	3.837	9.288	0.413	0.683
NPA	-215.262	25.825	-8.335	0.00
CAPAD	1.963	0.764	2.570	0.017
NIM	4.908	4.091	1.20	0.241
LIQ	-1.211	0.928	-1.305	0.204
RIR	0.625	0.313	1.995	0.057
LEXR	-21.913	20.352	-1.077	0.292
Effects Specification				
Cross-section fixed (first differences)				

Root MSE	7.302	**Mean dependent var**	-4.473
S.D. dependent var	10.196	**S.E. of regression**	7.496
Sum squared resid	8317.107	**J-statistic**	18.509
Instrument rank	21	**Prob(J-statistic)**	0.139

Source: GMM regression model estimated by the author using E-Views 11.0

After the analysis of the results of the regression model estimation between ROE and; SIZE, NPA, CAPAD, NIM, LIQ, RIR and LEXR after the crisis presented in table 7.10 above, the null hypothesis that the over-identifying restrictions are valid is accepted as probability of the J-statistic is > 0.05. As this is a dynamic panel, the second order serial correlation in the residuals is tested using Arellano-Bond serial correlation test and the results for the same have been presented in table 7.11 below.

From the Arellano-Bond Serial Correlation test results presented in table 7.11 below, it is clear that the value of m-statistics and probability, p-value for AR(2) are 1.464 and 0.143 respectively. The probability values indicate AR(2) is statistically insignificant as p>0.05 and this, in turn, implies that the error terms in the given estimated regression model are free from the issue of serial-correlation.

Table 7.11. Results of Arellano-bond serial correlation test of regression model of ROE with CAPAD, LIQ, NIM, NPA, SIZE, LEXR and RIR before the financial crisis

Arellano-Bond Serial Correlation Test Date: 07/06/22 Time: 23:09 Sample: 2010 2017 Included observations: 156

Test order	m-Statistic	Rho	SE(rho)	Prob.
AR(2)	1.464	655.695	447.779	0.143

Source: Arellano-Bond Serial correlation test statistics generated using E-Views 11.0

By analysing the GMM regression estimation results for the given model after the financial crisis presented in table 7.10 above, it is clear that the p-values for variables SIZE, NPA, CAPAD, NIM, LIQ, RIR and LEXR are 0.683, 0, 0.017, 0.241, 0.204, 0.057 and 0.292 respectively and the values of coefficients for these variables in the same order are 3.837, -215.262, 1.963, 4.908, -1.211, 0.625 and -21.913 respectively. By looking at these values of probability and coefficients, it is clear that after the financial crisis, the resultant regression model depicts that NPA has significant negative, whereas CAPAD has significant positive relationship with ROE. Apart from these two variables, p-values are greater than 0.05 for rest of the variables (i.e. SIZE, NIM, LIQ, RIR and LEXR) and thus, these variables have non-significant relationship with ROE. Further to this, the values of coefficient in the given model demonstrate that SIZE, NIM and RIR have non-significant positive relationship, whereas LIQ and LEXR have non-significant negative relationship with ROE.

The regression model estimation results presented in tables 7.8 and 7.10 for time-periods before and after the crisis also reveal that the regression estimation outputs before the crisis are different to those obtained for the sample time-period after the crisis. While all the variables in the model have non-significant relationship with

ROE before the crisis, CAPAD and NPA have significant relationship with ROE after the crisis.

The impact of CAPAD, NIM, NPA and LIQ on profitability of banks has already been discussed in great detail in section 7.5.1 and this, section focuses on impact of SIZE, LEXR and RIR on profitability of banks. All these three variables have been found out to have non-significant relationship with ROE both before and after the crisis. While SIZE and RIR have non-significant positive relationship with ROE both before and after the crisis, the relationship between LEXR and ROE is non-significant positive before the crisis and non-significant negative after the crisis.

Most of the studies in the literature based on the determinants of profitability of banks have examined bank size (log of total assets) as an important indicator of bank profitability. The findings of no significant relationship between bank size and its profitability in the given research project extend support to previous studies in the literature such as Ghosh (2015), Ćurak et al. (2012), Tan & Floros (2012), Delis et al. (2012) and Althanasoglou et al. (2008), which concluded a no relationship between profitability and size of a bank and thus, suggested that a bank's size is not important to its profitability. These findings are also in contradiction with findings of numerous research papers which have concluded a significant impact of bank size on its profitability. Petria et al. (2015) studied the performance of banks in 27 countries in the Europe for the time-period 2004 to 2011 and demonstrated a significant positive relationship between a bank's profitability and its size, which in turn implies that banks with higher number of totals assets are able to earn higher profits and the reason for this was given as the economies of scale benefitted by the banks from their higher size. Other examples of studies in the literature which have proposed the positive effect of bank size on its profitability are Lee & Kim (2013), Flamini et al. (2009), Shehzad et al. (2013), Houston et al. (2010), Chronopoulos et al. (2015) and so forth. Research studies, for instance, Altunbas & Marques (2008), Lin & Zhang (2009), Barry et al. (2011), Haan & Poghosyan (2012) found a negative relationship between a bank's profitability and its size.

The finding of no significant impact of exchange rate on profitability of banks is in agreement with the results of previous research studies such as Manyok (2016), Kiganda (2014) and Suhadek & Suciany (2020), which have demonstrated a non-significant/weak relationship between exchange rate and financial performance of banks. However, the findings of the given research project differ from previous research studies such as Keshtgar et al., (2020), Chauque & Rayappan (2018) and Mbithi (2009), which concluded a significant negative impact of exchange rate fluctuations on financial performance and research studies, for instance, Khan et al., (2018), Nguyen & Do (2020), Qing & Kusairi (2019) and Kasman et al., (2011) where a significant positive relationship between exchange rate and financial performance was found out.

Finally, real interest rate (RIR) was also found out to have a non-significant relationship with banks' ROE, both before and after the event of global financial crisis. This is clear from correlation analysis results presented in tables 5.54 and 5.55 (in chapter 5) as well as results of regression analysis presented in tables 7.8 and 7.10 above. The findings of a weak relationship between interest rate and performance are in agreement with previous research work such as Suhadek & Suciany (2020), Tamtelahitu & Mubin (2020) and Rashid and Khalid (2017). However, these findings are contrary to previous research studies such as Khan et al., (2018), Kasman et al., (2011), Qing & Kusairi (2019), where a significant negative relationship has been reported between interest rate and financial performance and Basabeh & Abdelkader (2019) and; Ndlovu et al., (2018) which have demonstrated a significant positive impact of interest rate on financial performance of firms.

7.6. Summary of the chapter

To summarise, this chapter studied and analysed the financial profitability of ICBs and; it was discovered that the profitability of Indian banking sector was spontaneously and continuously going up from 2001 till 2008 and started declining from 2009 onwards, the reason for which has been attributed to the negative effect of the global financial crisis. The highest value of ROE was recorded in the year 2003-2004, whereas the lowest value of ROE was found to be in the year 2016-2017. The profitability of Indian banking sector in general as well as most of the individual commercial banks of India has been found to be adversely effected by the event of the global financial crisis. After this, Mann-Whitney U-test was run on the research dependent and explanatory independent variables to assess whether there are statistically significant changes in the values of the variables before and after the event of global financial crisis of 2007-2009. Based on the results obtained from the Mann-Whitney U-test, it can be concluded that ROE, CAPAD, NPA, NIM and LIQ of ICBs have significantly declined after the crisis, whereas a significant increase can be observed in the values of EFF and GDP after the crisis. The value of INF and LEXR increased and RIR decreased after the crisis.

Finally, regression models were run on dependent (ROE) and independent variables (CAPAD, NIM, NPA, LIQ, SIZE, LEXR and RIR) to determine the relationship between them using GMM regression estimation technique. As SIZE, LEXR and RIR were associated with the issue of non-stationarity, high correlation with remaining independent variables and low degree of correlation with the dependent variable ROE, these variables were dropped from the original model. However, many research studies have highlighted the huge significance of these variables in the performance of firms, separate models were estimated by adding these variables to the original model and the correlation issues were taken care of by converting the variables into first lags and estimating the models using the GMM regression estimation technique (which takes care of endogeneity issues associated with data.

The results of the original regression model estimations reveal that CAPAD is found to be related positively to ROE; LIQ has a non-linear relationship with the profitability of Indian banks, where LIQ effects the ROE positively to a certain level as it has been observed in the post-crisis period, but above that level (as in the pre-crisis period), it starts effecting the bank performance negatively due to the opportunity cost caused by holding too many liquid assets rather than investing them in higher earning ventures; NIM effects the profitability of ICBs positively both before and after the crisis and; NPA has been found to have insignificant positive impact on ROE before the crisis, but the economic downturn, increased leverage and heightened interest rates in the aftermath crisis period caused the NPAs to effect the profitability of Indian banks negatively. Finally, among all the four research independent variables, NPA has been found to be the main determinant of profitability of commercial banks of India.

After adding the variables SIZE, LEXR and RIR to the originally estimated models, all the variables were found to be non-significant relationship with ROE before the crisis. After the crisis, CAPAD was found to have significant positive and NPA significant negative relationship with ROE and rest of the variables (i.e. NIM, LIQ, LEXR, RIR and SIZE) were found out to have non-significant impact on ROE of banks.

Chapter 8

Relationship between technical efficiency and profitability of Indian Commercial Banks

8.1. Introduction

This chapter of the thesis aims to investigate and analyse the relationship between technical efficiency and profitability of ICBs. Although a common assumption is that a high efficiency will lead to an enhanced performance, but researchers have mixed opinions on the relationship between the two. Profitability and efficiency are two indicators of a firm's performance and different research studies in the literature have used one or the other indicator of performance in their analysis. Profitability is the estimation of the degree to which a firm earns profit or financial gains from the different production factors and portrays the relationship between incomings (revenue) and outgoings (expenses). On the other hand, efficiency focuses on the extent of the efficacious utilization of production factors and refers to the use of minimum possible inputs to produce the given outputs or using the given inputs to produce the maximum possible outputs.

To get a clear picture on the performance of ICBs for the given time period, this research study measured both the profitability as well as technical efficiency of banks. ROE has been considered as an indicator of profitability and technical efficiency of banks has been measured using the CCR version of DEA (Data Envelopment Analysis). The inputs and outputs used to measure technical efficiency of banks have been determined using the intermediation approach. Under the intermediation approach, loan loss provisions, operating expenses, deposits and borrowings are taken as inputs and; investments, advances, net interest income and total other income are taken as outputs of the banking activity. The chapter analyses and assesses whether the technical efficient banks are also profitable and vice-versa. The section further studies whether the relationship between technical efficiency and profitability of ICBs remains the same or differs in two research time-period samples i.e. before and after the financial crisis.

8.2. Relationship between technical efficiency and profitability of ICBs

As explained in section 4.15 of chapter 4, the relationship between ROE and EFF (technical efficiency) of ICBs has been studied and analysed using the Spearman's Rank-Order Correlation. The strength of monotonic relationship between two variables is determined using the value of Spearman's rank-order correlation coefficient, i.e. p/rho. The value of p lies between -1 to +1, where -1 denotes a strong negative relationship, 0 denotes no relationship and +1 denotes a strong positive relationship between two variables. The Spearman's rank order correlation test works on the following hypothesis:

Null Hypothesis, $H0$: There exists correlation between two ranked variables

Alternative hypothesis, Ha: There exists no correlation between the two ranked variables

To accept $H0$, the calculated rho value should be higher than the critical value of n in the Spearman's significance table.

The detailed calculations for the calculation of pho, for the data sample before and after the crisis have been presented in tables 8.1 and 8.2 respectively in appendix 5 and the summary of the same has been presented in Table 8.3 below.

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Table 8.3. Summary of the results of Spearman's Rank-Order Correlation

Time-period	rho
Before crisis	-0.0942
After Crisis	0.175321

Source: Calculated by the author using Microsoft Excel

The analysis of results presented in Table 8.3 above demonstrates that before financial crisis, the value of Spearman's rank-order correlation coefficient is -0.0942 which illustrates a weak negative relationship, whereas the value of the same goes up to 0.1753 after the crisis and indicates a weak positive relationship between ROE and technical efficiency of commercial banks of India (EFF). After comparing these values to the critical values of Spearman's rho table presented in table 4.1 (in chapter 4), it can be concluded that the calculated values of rho both before and after the financial crisis are below the critical value of 0.362, which rejects the null hypothesis. On the basis of these results, it can be concluded that there exists no significant relationship between ROE and EFF of ICBs, both before and after the event of global financial crisis. This in turn, implies that higher efficiency of banks doesn't always indicate a higher profitability and vice-versa.

The relationship between ROE and technical efficiency (i.e. EFF) is further confirmed by the results of Man-Whitney U-test for dependent and independent variables of the regression model presented in table 7.3 in section 7.4 of chapter 7 above and the same has also been presented below.

Table 7.3. Summary of the results of Mann-Whitney U-test for dependent and independent variables

Variable	Group	N	Mean	Adjusted H (Test statistic)	p-value	Decision
ROE	Pre-crisis	150	18.5749	76.986	1.72E-18	Reject H_0, ROE is significantly lower in the post crisis period
	Post-crisis	208	8.052381			
EFF	Pre-crisis	151	0.968641	14.894	0.000114	Reject H_0, EFF is significantly higher in the post crisis period
	Post-crisis	208	0.990909			
CAPAD	Pre-crisis	152	12.3226143 8	9.748	0.001795	Reject H_0, , CAPAD is significantly lower in the post crisis period
	Post-crisis	208	12.1459134 6			
NPA	Pre-crisis	151	0.0421395	9.336	0.002247	Reject H_0, , NPA is significantly lower in the post crisis period
	Post-crisis	208	0.03285974			
NIM	Pre-crisis	152	3.070797	140.858	1.73E-32	Reject H_0, , NIM is significantly lower in the post crisis period
	Post-crisis	208	2.38916 9			
LIQ	Pre-crisis	152	5.836827	34.032	5.42E-9	Reject H_0, LIQ is significantly lower in the post crisis period
	Post-crisis	208	5.08634			
INF	Pre-crisis	6	4.734837	3.267	0.071	Accept H_0, INF is higher in the post crisis period, but the difference isn't significant
	Post-crisis	8	7.61375			
GDP	Pre-crisis	6	31952.233	9.6	0.001946	Reject H_0, , GDP is significantly higher in the post crisis period
	Post-crisis	8	89917.21			
LEXR	Pre-crisis	6	3.81	**	3.95E1	Accept H_0, LEXR is higher in the post crisis period, but the difference isn't significant
	Post-crisis	8	4.05			
RIR	Pre-crisis	6	5.48	**	-1.93E1	Accept H_0, RIR is higher in the pre-crisis period, but the difference isn't significant
	Post-crisis	8	3.94			

Source: Mann-Whitney test statistics generated by the author using the Kruskal-Wallis test spreadsheet

The results of Mann-Whitney U-test results indicate a statistically significant increase in the value of EFF, whereas a statistical decline in the value of ROE, after the crisis. This, in turn, implies that less efficient banks can also be more profitable than the fully efficient banks and vice-versa.

The finding of no relationship between technical efficiency and profitability of banks can further be confirmed by the results of the two presented and discussed in sections 6.2 (chapter 6) and 7.2 (chapter 7) and; tables 6.1, 6.2, 7.1 and 7.2. In section 6.3, it was discovered and concluded that Canara bank had the highest technical efficiency, whereas UCO bank recorded the lowest score for technical efficiency for the research time-period samples 2002-2017, pre-crisis and post-crisis. On the other hand, in section 7.2, it was found that Andhra bank had the highest value of ROE for all three time-period samples and; IDBI bank, Punjab & Sind Bank and Indian Overseas Bank had the lowest values of profitability for the full sample, pre-crisis and post-crisis periods respectively. This proves that banks with highest technical efficiency are not always the ones with the highest profitability. From tables 6.1 & 6.2 (chapter 6) for technical efficiency and tables 7.1 & 7.2 (chapter 7) for ROE results, it can be observed that the technical efficiency of Indian banking sector in general as well the individual commercial banks of India improved after the crisis, whereas the profitability of the banking sector of India in general as well as the individual commercial banks of India declined after the global financial crisis of 2007-2009. This further proves that there exists no relationship between technical efficiency and financial profitability of ICBs.

According to Keramidou et al., (2013), the heterogeneity between efficiency and profitability can be caused by many differences within industries. The study further states that despite being technically inefficient, firms can still be performing superiorly financially via methods such as gaining competitive advantage in narrow market segments, illegal practices of cost economies (e.g. tax invasion), achieving low cost via use of family labour, different types of flexibility, vertical integration of the business (which enables them to lower their transition cost or to gain market power, competition and so forth), economies of scale advantage due to large size etc. At the same time, a fully efficient bank can still be earning less profits due to factors such as location, size and so forth.

Palečková (2016) tested the relationship between profitability and efficiency for the Czech Commercial Banking sector for the time period 2004-2014, where ROA (Return on Assets) and ROE (Return on Equity) were used as indicators of profitability and efficiency of banks were measured using the slack-based, Variable Returns to Scale (VRS) DEA model and; in line with the findings of this research study, the research paper also confirmed that there exists no relationship between profitability and efficiency of Czech commercial banks. Similar results were also confirmed by Keramidou et al. (2013) for the Greek meat producing companies for the time period 1994-2007, which stated that the companies with the maximum efficiency of production aren't always capable of generating maximum profits and long term survival of firms require the adoption of profit-enhancement strategies and; Shieh (2012) for 68 international hotels in Taiwan for the time period 1997-2006.

Košak & Zajc (2006) studied the profitability (measured by ROA and ROE) and efficiency of new member countries of the European Union (EU) and demonstrated a positive relationship between the two performance parameters. Tahtamouni et al. (2020) studied the relationship of ROA and ROE with Pure technical efficiency (PTE) and Relative Technical Efficiency (RTE) of 13 commercial banks of Jordan for the time period 2010-2017 and demonstrated a positive relationship. Similar findings were confirmed by Kosmidou et al. (2008) for commercial banks of the UK (United Kingdom) by demonstrating a positive relationship between profitability and efficiency in management of expenses, Afsharian et al. (2011) for European publicly traded banks and Sharma (2018) for finding a significant relationship between operational efficiency and market performance of Indian banks. On the other hand, a negative relationship between efficiency and profitability (ROA) were confirmed by studies such as Palečková (2015) for banking industry of Czech Republic and; Kosmidou (2008), Pasiouras et al. (2006) for banks in Australia, Greece and Malaysia.

As there exists no relationship between technical efficiency and profitability of banks (both calculated using the financial variables), it doesn't make any sense to evaluate the determinants of technical efficiency and ROE of banks using the same micro and macro variables. Due to this, only the regression models to study the determinants of ROE have been estimated as presented and discussed in section 7.4 in chapter 7.

8.3. Summary of the chapter

To conclude, this chapter analysed the relationship between profitability and technical efficiency for commercial banks of India. Although a common assumption is that a high efficiency will lead to an enhanced performance, but researchers have mixed opinions on the relationship between the two. The relationship between technical efficiency and profitability have been investigated using Spearman rank-order correlation. The analysis reveals that there is no relationship between profitability (ROE) and technical efficiency (EFF) of ICBs, both before and after the crisis. The finding of no relationship between technical efficiency and profitability is further confirmed by the results of Mann-Whitney U-test, the mean values of technical efficiency and profitability for the Indian banking sector as a whole as well as for individual banks. As there exists no relationship between technical efficiency and profitability of banks (both calculated using the financial variables), it doesn't make any sense to evaluate the determinants of technical efficiency and ROE of banks using the same micro and macro variables.

Chapter 9

Conclusion

9.1. Introduction

The aim of undertaking this research project is to evaluate the profitability and technical efficiency of sample Indian commercial banks, in the pre and post-crisis periods, between the time period sample 2001-2017 and investigate whether there exists any relationship between the two parameters of performance and assess the impact of explanatory internal (capital adequacy, bank age, bank size, market share, net interest margin and non-performing assets) and external (inflation, GDP, exchange rate and real interest rate) variables on the profitability of Indian commercial banks for the two research time-period samples. In the context of a developing economy such as India, the literature and research on the given subject area is restricted and indecisive.

This chapter of the research project discusses the significance this research with regards to the apprehension of the discipline by the reconciliation of the main research findings, analysis and the different arguments relevant to the topic discussed in different chapters all through the research project. It further manifests the main limitations of the research and illustrates how the current horizon of the research can be stretched by providing recommendations and references for any future research work to be conducted on this topic.

9.2. Research problem

For the development and the smooth running of the overall economy of any country, the efficient working of financial institutions in that country is crucial. The banking industry is very competitive and to achieve a sustainable competitive advantage, it is vital to attain high performance standards at all times. To ensure the efficient working of these financial institutions, it is crucial to monitor and evaluate their performance in a timely manner.

According to Alharthi (2016), different methods have been used by researchers in the literature to determine the performance of banks such as profitability ratios (i.e. ROE, ROA,NIM), efficiency measurements (Technical efficiency, Pure technical efficiency, scale efficiency, allocative efficiency, profit efficiency, cost efficiency), bank stability (z-score, capital ratios) etc. According to Arslan and Ergec (2010), the traditional methods used for performance evaluation and management such as ratio analysis come with flaws. In terms of MacDonald and Koch (2006), the evaluation of economic entities merely on the basis of financial statements is not very wise and is difficult as the probability of the manipulation of those statements by the managers for the disguise of potential problems is quite high. Prior (2006) further adds that the traditional performance evaluations methods can evaluate only one activity of a firm at a time which makes it difficult for the analysers to gain an overall perspective of the performance. According to Daley and Matthews (2009), the ratio analysis can be useful only to calculate the efficiency values, but the identification of the reasons responsible for causing inefficiencies still remains a task.

To overcome these limitations of traditional performance assessment methods, a rising trend can be observed towards the adoption of frontier methods (specifically DEA) for performance evaluation. The reason for the popularity of these new methods was given by Berger et al. (1993), which stated that the scale and scope economies used in traditional methods account for less that 5 percent of the total cost while on the other hand; efficiency contributes more than 20 percent of the total costs of the banks. The extensive use of DEA for the evaluation and improvement of performance can be seen across various different manufacturing and service industries, such as: schools (Grosskopf and Moutray, 2001); hospitals (Prior, 2006); production companies (Liang et al., 2013); banks (Isik and Hassan, 2002) etc.

In developing economies such as India, most of the research studies focus on overall performance and profitability of banks and little emphasis is given to efficiency and effectiveness (Raphael (2013). The existing literature on banks' performance and its determinants focuses on banks from developed economies and less attention is being given to banks from emerging economies (Pastor, 2002, Varias & Sofianopoulou, 2012). Also, the studies on performance determinants of banks in India had methodological shortcomings e.g. small sample sizes, short time period data etc. (Debashish & Mishra, 2005). This research thesis addresses these limitations by studying technical efficiency as well as profitability of 26 commercial banks of India to gain a better overview of their performance, over the time period of 17 years (from 2001 to 2017), employing a two-step analysis , where the efficiency and ROE and; the relationship between the two performance indicators has been analysed in the first step and the determinants of sample banks' performance are determined in the second step using Regression analysis (Raphael, 2013, Leigh et al., 2005, Wanke, Barros, Macanda, 2015). The research also evaluates the impact of financial crisis on the efficiency, profitability and the relation profitability has with its determinants.

9.3. Research findings

The aim of this research is to evaluate technical efficiency and performance of Indian commercial banks before and after the crisis of 2008-2009 and then to examine the relative value of these concepts from the point of view of stakeholders.

As mentioned in section 1.5 in chapter 1, to fulfil this aim, the research sought to achieve the following five main research objectives. These research objectives along with the findings of each objective are mentioned below:

i. To extensively review the available literature on evaluation and determinants of banks' technical efficiency and performance in developed and emerging economies.

To achieve objective i, the literature review chapter i.e. chapter 2, extensively reviewed the different techniques which can be used to measure the performance of organizations, specifically banks. After the extensive review of the literature, some of the discovered and reviewed main methods which have been and are employed by researchers, scholars and technicians include ratio analysis, profitability, Balance Scorecard approach, and efficiency measures using parametric and non-parametric techniques. Though financial ratios specifically have been viewed as one of the easiest, simplest and a user friendly method for the computation and analysis of organisational efficiency, yet they have proved to be inadequate in the measurement of efficiency of banks as they are unable in handling the multiple banks' input and output variables. Academicians and scholars' shift towards the frontier methods can be clearly felt to overcome these limitations of ratio analysis. There are two types of frontier methods i.e. parametric and non-parametric. Parametric methods are considered to be more useful while dealing with large sample sizes, whereas nonparametric methods are considered more useful for small sample data sizes

The chapter analysed different research studies in the literature based on the profitability and efficiency of banks based in different countries. The chapter also studied the research work based on the relationship between efficiency and profitability of firms and it was discovered that different research studies have different views based on that. While some studies suggest a strong link between the two indicators of performance, other research papers suggest that efficiency and profitability are two completely different parameters of performance and there exists no relationship between the two.

The chapter also examined the research studies based on the determinants of bank profitability and efficiency in different countries, from which it can be concluded that the factors which have impact on the performance and efficiency of banks are not same in all the countries and vary from one country to another. Though, the empirical research suggests that there are various micro and macro factors, which impact the performance of banks, but these factors are specific to a country and the experience of banks in one country cannot be extrapolated to banks in another country. From the review of the literature, it has also been analysed that research studies have used one or the other method to analyse the performance of banks. The use of one performance dimension to explain the other has also been observed in the literature.

Different theories relevant to the relationship of performance with different micro and macro variables have been discussed in chapter 3 i.e. theoretical framework. The theories and models in the literature help to understand and provide justification for the relationship of a firm's performance with different micro and macro variables. As mentioned in section 1.3 of chapter 1, previous research work on the topic of efficiency and profitability evaluation in the literature has some limitations in terms of sampling. In developing economies such as India, most of the research studies focus on overall performance and profitability of banks and little emphasis is given to efficiency and effectiveness. Also, the existing literature on banks' performance and its determinants focuses on banks from developed economies and less attention is being given to banks from emerging economies. The studies on performance determinants of banks in India has methodological shortcomings e.g. small sample sizes, short time-period etc. This research thesis has addressed these limitations by studying efficiency as well as profitability of 26 commercial banks of India to gain a better overview of their performance, over the time period of 17 years (from 2001 to 2017), employing a two-step analysis , where the technical efficiency and ROE and; the relationship between the two performance indicators has been studied in the first step and the determinants of sample banks' performance are determined in the second step using Regression analysis. The research thesis further evaluates the impact of financial crisis on the technical efficiency, profitability and the relationship profitability has with technical efficiency its determinants.

ii. To measure the technical efficiency of Indian commercial banks and compare and contrast them in the pre and post crisis periods.

To achieve this objective, section 6.2 in chapter 6 is based on the measurement of technical efficiency scores of sample commercial banks of India using the non-parametric frontier method DEA. As mentioned in section 4.12.1 of chapter 4, the inputs and outputs employed in DEA to measure technical efficiency scores of sample ICBs are determined using the intermediation approach. Loan loss provisions, operating expenses, deposits and borrowings are considered as inputs of the banking activity and; investments, advances, net interest income and total other income have been utilised as outputs of the banking activity. The data on these inputs and outputs for sample 26 commercial banks of India for the time period 2001-2017 has been collected from the Central Bank of India i.e. Reserve Bank of India database. The efficiency scores employing DEA technique have been calculated with the help of the software Win4Deap 2.1.

The research thesis evaluated and analysed the mean efficiency scores of the Indian commercial banks in general as well as the mean efficiency scores of the sample banks individually. To study the impact of the global financial crisis of 2007-2009 on the technical efficiency of Indian commercial banks, the efficiency of sample banks have been studied in two research time-periods i.e. pre and post crisis periods. The analysis of the technical efficiency of the commercial banking sector in India depicts that it has been found that Indian banks in general have been stable in terms of technical efficiency with a score of above 90% in all the years of the research time-period and the main reason behind that is their ability to control their inputs. Having said that, there is still room for improvement as the technical efficiency score for the Indian commercial banking sector has not been 100% in any of the years. The analysis also reveals Canara Bank to score the highest while UCO bank to score the lowest in terms of technical efficiency for the full time-period sample i.e. 2001-2017, before as well as after the crisis.

The data analysis further suggests that in contrary to an expected negative impact of global financial crisis on the technical efficiency of ICBs, the efficiency of the Indian commercial banking sector in general as well as the individual efficiency scores of most of the commercial banks in India has improved after the event of the financial crisis. The possible reason behind this can be strict policies, government regulation regulating the Indian banking industry which allowed public to maintain their trust and the Indian banks to continue normally with their operations despite the unfavourable global market conditions. IDBI bank and United Bank of India are the only banks to have observed negative impact of the crisis on their technical efficiency scores and the possible reason behind this can be their inability to manage their operating expenses as big jump can be seen for their operating expenses after the crisis.

iii. To empirically evaluate the performance of Indian commercial banks, and compare and contrast them in the pre and post crisis periods.

This objective has been achieved in section 7.2 of chapter 7, where the profitability of ICBs has been evaluated and analysed in detail along with possible reasons and justifications of the findings. As explained in section 4.13 of chapter 4, profitability of banks measured by ROE (Return on Equity) has been considered as an indicator of banks' performance. The evaluation, analysis and interpretation of profitability results reveals that there has been constant increase in the ROE value of ICBs until 2008-2009. From 2009-2010 onwards, the profitability of banks started falling down continuously and the reason behind this has been attributed to the aftermath effects of the global financial crisis of 2007-2009. Andhra bank was found to record the highest value of ROE for the full sample (2001-2017), before as well as after the crisis periods. The banks with the lowest value of ROE in the full research time-period sample, before crisis and after crisis periods are IDBI bank, Punjab and Sind bank and Indian overseas bank respectively. The possible factor behind this ranking can be the capital adequacy ratio, where Andhra bank reported the higher value of capital adequacy ratio than the other two banks in the mentioned research time-periods.

In agreement with most of the research studies in the literature, the analysis further demonstrates a negative impact of global financial crisis on the profitability of commercial banking sector of India in general, as well as the individual profitability of most of the commercial banks of India. The possible reasons behind the profitability of banks getting negatively affected due to the financial crisis are the lowered deposits/credits, increased borrowing/lending among banks and reduced returns earned by the banks as a consequence, after the crisis.

To determine the impact of explanatory independent variables (CAPAD, LAGE, SIZE, MSHARE, SIZE, LIQ, NIM, NPA, INF, LGDP, LEXR and RIR) on the profitability of ICBs, regression model estimations were carried out between the dependent and independent variables using the GMM regression analysis technique in section 5.5 of chapter 7. As explained in section 5.3.5, the variables LAGE, SIZE, MSHARE, INF, LGDP, LEXR, SIZE and RIR were dropped from the sample due to endogeneity issues associated with them. However, considering the huge significance of variables SIZE, LEXR and RIR in performance of banks as highlighted by numerous researchers in literature, two different types of models have been estimated in the research project to study the impact of micro and macro determinants on profitability of commercial banks, one with dropping the variables LAGE, SIZE, MSHARE, LGDP, INF, LEXR and RIR and the other model comprising of variables CAPAD, SIZE, NPA, NIM, LIQ, LEXR and RIR. In line with Baltagi (2005), the endogeneity issues associated with the variables SIZE, LEXR and RIR have been taken care of by converting these variables into first lags. The results of the regression model estimations reveal that CAPAD is found to be related positively to ROE; LIQ has a nonlinear relationship with the profitability of Indian banks, where LIQ effects ROE positively to a certain level as it has been observed in the post-crisis period, but above that level (as in the pre-crisis period), it starts effecting the bank performance negatively due to the opportunity cost caused by holding too many liquid assets rather than investing them in higher earning ventures; NIM effects the profitability of ICBs positively both before and after the crisis and; NPA has been found to have insignificant positive impact on ROE before the crisis, but the economic downturn, increased leverage and heightened interest rates in the aftermath crisis period caused the NPAs to effect the profitability of Indian banks negatively. Finally in the second regression model, the variables SIZE, LEXR and RIR were found to have a non-significant relationship with ROE both before and after the crisis.

iv. To examine the relationship between technical efficiency and performance of Indian commercial banks.

To achieve this objective, the analysis of the relationship between technical efficiency and profitability of Indian commercial banks has been presented and interpreted in chapter 8 of the thesis. The relationship between technical efficiency and profitability of banks has been tested by calculating the Spearman's Rank-Order Correlation Coefficient. The analysis and interpretation of results imply that there exists no relationship between technical efficiency of Indian commercial banks, both before and after the period of the global financial crisis.

The finding of no relationship between technical efficiency and profitability of banks is further confirmed by the results of the Mann-Whitney U-test presented in section 7.4 in chapter 7 (where different impacts of financial crisis can be observed on the technical efficiency and profitability of banks) and the ranking of banks presented in sections 6.3 and 7.2 on the basis of technical efficiency scores and profitability respectively (which shows that the most technically efficient banks don't score the highest in terms of profitability) in chapters 6 and 7 above.

vi. To provide recommendations on the basis of empirical findings to bank managers and regulators for improvements in the Indian banking sector.

Based on the results obtained from the evaluation and analysis of technical efficiency and profitability of commercial banks of India, the following recommendations are made to bank managers, regulators and policy makers, which can help in the improvement of efficiency and performance of banks in India:

First recommendation of the study is the measurement and examination of performance of banks on a regular basis so as to improve the ability to predict events well in advance as the performance of firms tend to change over time due to unforeseen changes in the micro and macro environment in which the banks operate.

As predicted in the limitations section of this thesis, the evaluation of performance of banks shouldn't be done solely on the basis of financial figures. Performance review of banks should be both quantitative as well as qualitative.

Regulation and management of banks' policies and strategies should be done on proactive rather than reactive basis so that bank managers, regulators and policy makers have ample time for the regulation and reviewing of policies, strategies and frameworks for the banks.

As the research findings have concluded non-performing assets as one of the main determinants of performance of Indian commercial banks, stricter policies should be designed and implemented by the bank regulators and policy makers in terms of identification, management and minimization of non-performing assets in the Indian banking sector. Some examples of areas which can be considered by the bank regulators and policy makers in India which can help in the strengthening of NPAs' management framework are: the part of collateral in the identification process of NPAs, criterion to exit NPAs, identification and implementation of the qualitative elements which can be employed for the classification of exposures as non-performing, rights to implement prudential backstops for dealing with scenarios where the supervisory perspective finds the NPAs accounting provision inadequate, supervisory instructions on the sensible estimation of collateral to assist NPAs, realistic estimation of time and cost required to liquidate collaterals that may assist NPAs, designing regulatory actions to deal with accounting effect of accruing interest associated with NPAs, criterion to write off bank loans and so forth.

As the data analysis has demonstrated positive impact of capital adequacy and liquidity ratios on the profitability of banks, stricter application of policies related to the maintenance of minimum capital and liquidity level requirements by banks at all times should be in place.

As the research findings have demonstrated no relationship between technical efficiency and profitability, it implies that increasing revenues via reduction of costs may not be a viable option for the banks. The business may already have achieved the maximum efficiency via maximum possible reduction of costs associated with inputs through means such as negotiation of the best possible prices for the materials, labour force, facilities etc. At the same time, if the business is operating in a highly competitive environment, saturated market or a very depressed economy, any further increase in sales or increasing prices may not be a feasible strategy to increase revenues. So the banks are recommended to focus more on building their brand image via providing the best products and services to their customers, which in turn, can enable them to command higher prices and thus, raise their profitability.

9.4. Overview of research hypothesis

This section of the chapter assesses the research hypothesis presented in section 4.9 in chapter 4 and presents a conclusion on the same in light of the empirical findings of the research. The decision on the research hypothesis is presented in the following table i.e. table 9.1.

Table 9.1. Summary of research hypothesis

No.	Hypothesis	Decision
H1	On the basis of DEA approach, the efficiency scores among different banks are similar.	**Accepted** Most of the banks had stable technical efficiency scores of 90 percent and above.
H2	Efficient and inefficient banks in India cannot be characterized by any common features.	**Accepted** It is hard to categorize a bank as efficient and non-efficient on the basis of certain features.
H3	The event of global financial crisis had negative impact on the technical efficiency scores and profitability of banks in India.	**Accepted for profitability** A decline was observed in case of profitability of banks after the crisis. **Not accepted for technical efficiency** The possible reason behind the contrary positive impact of financial crisis on technical efficiency of ICBs can be strict policies, government regulation regulating the Indian banking industry which allowed public to maintain their trust and the Indian banks to continue normally with their operations despite the unfavourable global market conditions. The same is also evident from the data presented in tables 5.22 and 5.23, where an increase can be observed in the mean values of deposits, investments, advances, net interest income and total other income after the crisis.
H4	There exists no relationship between technical efficiency and financial profitability of banks.	**Accepted** The results of the Spearman's Rank Order Correlation Coefficient analysis reveal no relationship between technical efficiency and profitability of commercial banks of India, both before and after the crisis.

H5	There exists no relationship between bank's profitability and microeconomic variables (CAPAD, LAGE, SIZE, MSHARE, NIM, NPA, LIQ) for commercial banks in India.	**Not accepted** for CAPAD, LIQ, NPA and NIM Well capitalised banks have lower risks of bankruptcy and thus, have high credit worthiness, which in turn reduces their cost of funding and ultimately, enhances their profitability. Banks with higher levels of liquidity are able to settle their short-term liabilities as well as operational expenses smoothly, which in turn, facilitates better service delivery to their customers and thus, results in better performance. High NPAs demotivate investors, creditors and depositors. It effects the funds recycling negatively, which in turn effects the credit deployment negatively. When loans become non-recoverable, it not only has negative impact on credit availability in the future, but also has bad effect on banks' financial soundness. NPAs negatively impact the performance of banks due to their undermining and negative influence on liquidity position, future funding, risk and productivity etc. Greater is the value of NIM, higher is the value of interest income on the earning assets of the bank, which in turn, depicts a better performance. A**ccepted for SIZE** Size has been found to have no significant impact on ROE of ICBs both before and after the crisis. **Not concluded** for bank age, bank size and market share as these variables were dropped from the sample due to endogeneity issues related with the data.

H6	There exists no relationship between bank's profitability and macroeconomic variables (LGDP, INF, LEXR and RIR) for commercial banks in India.	**Accepted for LEXR and RIR** LEXR and RIR were found to have non-significant relationship with ROE of ICBs both before and after the crisis. **Not concluded** as these variables were dropped from the sample due to to endogeneity issues related with the data.
H7	There is a strong impact of global financial crisis on the relationship ROE has with different research independent micro and macro variables.	**Accepted for CAPAD, LIQ and NPA** The relationship ROE has with CAPAD, LIQ and NPA was found to be different in the pre and post crisis periods. **Not Accepted for NIM** NIM was found to be related positively with ROE, both before and after the crisis. Greater is the value of interest margin earned by banks, higher is their profitability. After the crisis, when most of the firms around the world, specially the financial sector suffered in terms of low revenues, the significance of NIM heightened even more in its overall profit levels. Due to this, the relationship of NIM with ROE is positive both before and after the crisis.

Source: Author's own findings

9.5. Research contribution

This research work aims to add value to the existing research and literature on the topic of performance evaluation of banks, in the context of India, as an example of a developing economy. This research thesis has resulted in unique findings related to research on the evaluation of technical efficiency and profitability of banks.

The performance of any firm can be divided into financial and non-performance. According to Alharthi (2016), performance of a bank can be determined by analyzing its profitability, whereas efficiency measurements are one of the important tools for the determination of non-performance of institutions. Different research studies in the literature have used one or the other indicators of performance in their analysis. The research papers on performance evaluation of firms in India focus more on employing traditional performance evaluation methods such as profitability index (Tandon, Singh and Singh, 2016, Brindadevi, 2013, Thakarshibhai, 2014), Ratio analysis (Tarawneh, 2006, Cyree et al., 2000), Balanced Scorecard (Johnson et al., 2014, Denton and White, 2000). As discussed in the second chapter of the thesis, these traditional methods are accompanied with many limitations. To overcome these limitations, researchers are now focusing on better and more effective frontier methods to assess performance. The application of frontier methods, especially Data Envelopment Analysis (DEA) for performance evaluation is getting popular in many countries across various different industries, but the use of DEA for performance evaluation of firms is still limited in India (Gulati and Kumar, 2011).

The study contributes to the previous research in the context of commercial banks in India, in terms of employing a different dimension of research methodology. In the context of Indian banks, this research will prove to be a pioneering study as it has studied and evaluated both the profitability as well as technical efficiency of sample banks. The profitability of banks has been measured using ROE and the technical efficiency is determined using the non-parametric approach DEA. Another contribution of this research is that it has evaluated the efficiency and profitability of banks by studying a larger data sample (27 banks), over a longer sample time period (17 years).

The uniqueness of the proposed research thesis, at the international context, lies in the fact that both the micro and macro determinants of performance have been studied and the impact of internal (capital adequacy, bank age, bank size, market share, liquidity, non-performing assets and net interest margin) and external (GDP and inflation) variables on performance has been researched. Another contribution of the research thesis is that the impact of global financial crisis has been assessed on the technical efficiency, profitability and; the relationship of profitability with its different micro and macro determinants.

The robustness of the research lies in the fact that it has also tested and determined the relationship between technical efficiency and profitability of banks to establish whether higher efficiency leads to greater profitability and vice-versa. Most of the research papers in the literature have looked at profitability and efficiency as two different dimensions of performance and very limited studies have established the relationship between the two (Keramidou et al., 2013, Shieh, 2012, Košak & Zajc, 2006, Kosmidou et al., 2008, Afsharian et al., 2011, Sharma, 2018, Palečková, 2015, Pasiouras et al., 2006). The research thesis also evaluates whether the relationship between efficiency and profitability is same or different in the pre and post crisis periods.

The extensive research and results obtained from the research makes the research more reliable from the perspective of bank managers, regulators and policy makers.

9.6. Limitations of the research and recommendations for further future research on the topic

There are some limitations in this research work which can be considered and overcome in any future research in the same field. Firstly, the research data sample comprises of only 26 banks of India. Currently, there are 27 public sector banks, 18 private banks and 25 foreign banks in India. The use of 26 banks only for the research thesis was constrained by the lack of data availability. This limitation can be overcome by the use of all 70 banks as data sample in any future research in the field.

Secondly, the sample research time-period in this research is 16 years. Thus, the significance of the results can be further improved by using a longer time-period in the research.

Thirdly, the research looks at the technical efficiency and profitability of the banks only from the financial side. However, the performance of any firm can't be solemnly determined on the basis of financial figures. Thus, it is recommended to consider the non-financial side of the firm performance such as management skills, type of workforce, qualification of the workforce, skills, experience, expertise etc.

Fourth limitation is the employment of only secondary and quantitative research methods. Thus, the research results and their reliability can be improved by the use of a combination of both primary and secondary research methods.

Another limitation in this research work is related to the use of limited number of independent variables which effect the profitability of commercial banks in India. Though the initial plan was to assess the impact of micro (capital adequacy, bank age, bank size, market share, liquidity, net interest margin and non-performing assets) and external (inflation, GDP, exchange rate and real interest rate) variables on the performance of banks, the final analysis stage of regression analysis evaluated the impact of variables capital adequacy, liquidity, net interest margin and non-performing assets only on the profitability of banks due to endogeneity issues in data associated with the remaining five variables. Thus, the significance of the research thesis can be further improved by including these variables and other explanatory factors such as bank ownership, asset quality, operating efficiency, interest rate and exchange rate etc. which were not included in the set of independent variables.

Lastly, this research thesis is based on the technical efficiency and profitability of banks based in India only, as an example of a developing economy. Thus, the results obtained in this research and; the following implications and suggestions can be narrowly applied to the Indian context only and may not be applied to banks in other emerging markets. Any future research work in the field can make use of data sample for banks from a combination of different developing economies and conduct a comparison of the results to create a model based on the evaluation of efficiency and profitability of banks, which can then be applied on an international level.

10. References

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11.Appendices

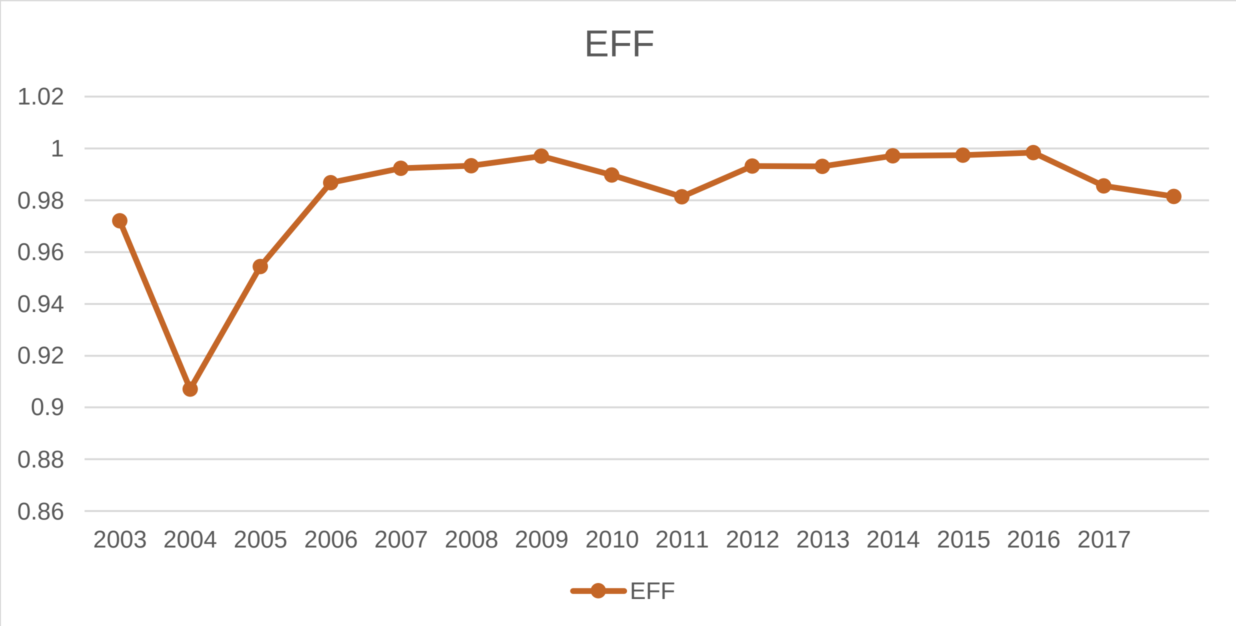
Appendix 1a. Visual representation of data for the justification of data into pre and post crisis periods

Table 4.1a. Mean values of research variables for the time-period 2002-2017

Year	EFF	ROE	CAPAD	TASS	MSHARE	LIQ	NIM	NPA
2002	0.97208	15.79478	11.3232	454525.28	3.057082724	6.028686	2.9264	0.059637
2003	0.90712	21.3548	12.278	508853.9091	3.131039428	5.572713	3.156136	0.118391
2004	0.954384615	24.71385	13.02615	563882.7442	2.919162199	6.033309	3.288481	0.030402
2005	0.986807692	16.75808	12.73385	670011.433	2.95149484	5.612911	3.191014	0.020071
2006	0.992269231	14.95885	12.23962	760628.3488	2.828858803	5.461659	3.048722	0.01249
2007	0.993269231	17.33346	12.24308	921843.1897	2.792896546	6.200687	2.83519	0.009325
2008	0.997038462	18.27185	12.06423	1142803.533	2.795360829	8.066129	2.304931	0.007713
2009	0.989730769	18.11824	13.18	1435646.608	2.919650373	6.302725	2.32634	0.007312
2010	0.981269231	18.46423	13.27308	1701132.89	1.848307931	6.363305	2.329799	0.009658
2011	0.993192308	17.59115	13.34115	2031059.34	1.86499504	6.405454	2.758719	0.010061
2012	0.993038462	14.8873	12.97885	2322930.712	1.864212003	4.967161	2.6456	0.014754
2013	0.997153846	12.57909	12.15	2677792.78	1.862477479	4.190955	2.494124	0.019901
2014	0.997346154	7.11164	11.12462	3064304.752	2.969827671	4.60825	2.368078	0.028014
2015	0.998384615	6.872369	11.29077	3337303.673	2.932749319	4.506046	2.268189	0.032078
2016	0.985461538	-3.64726	11.33154	3525414.109	2.85251343	4.445819	2.209011	0.059034
2017	0.981461538	-9.31947	11.66577	3743676.592	2.795623508	5.295983	2.049474	0.089332

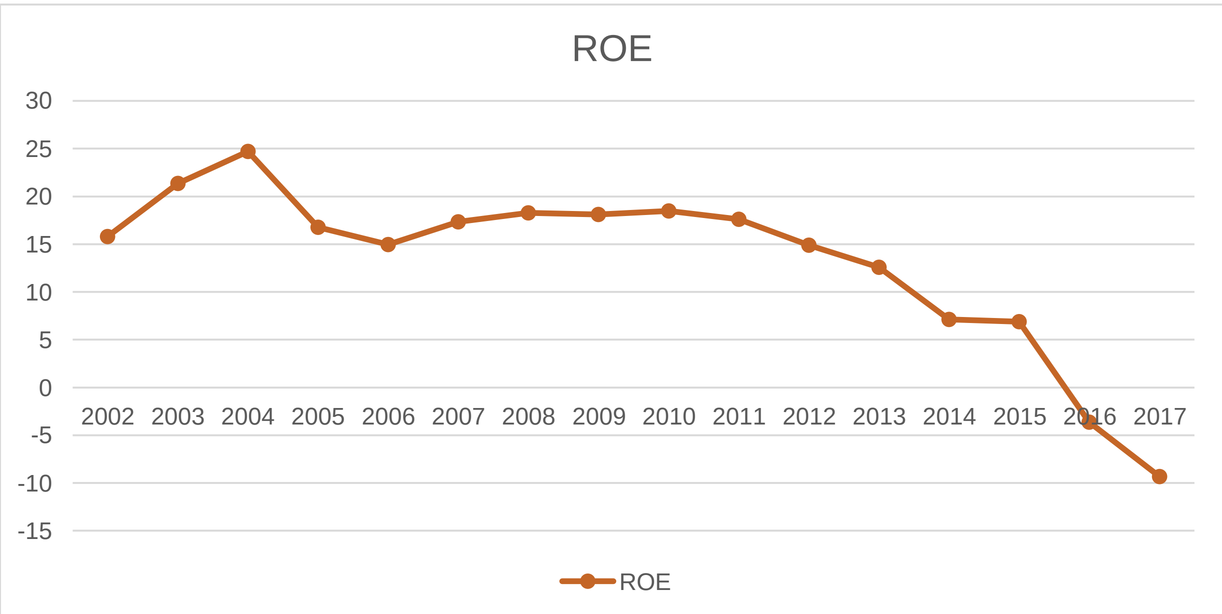
Source: Author’s work

Figure 4.1a. Visual presentation of mean EFF values for the time-period 2002-2017



Source: Generated by the author using Microsoft Excel

Fugure 4.1b. Visual presentation of mean ROE values for the time-period 2002-2017



Source: Generated by the author using Microsoft Excel

Figure 4.1c. Visual presentation of mean CAPAD values for the time-period 2002-2017

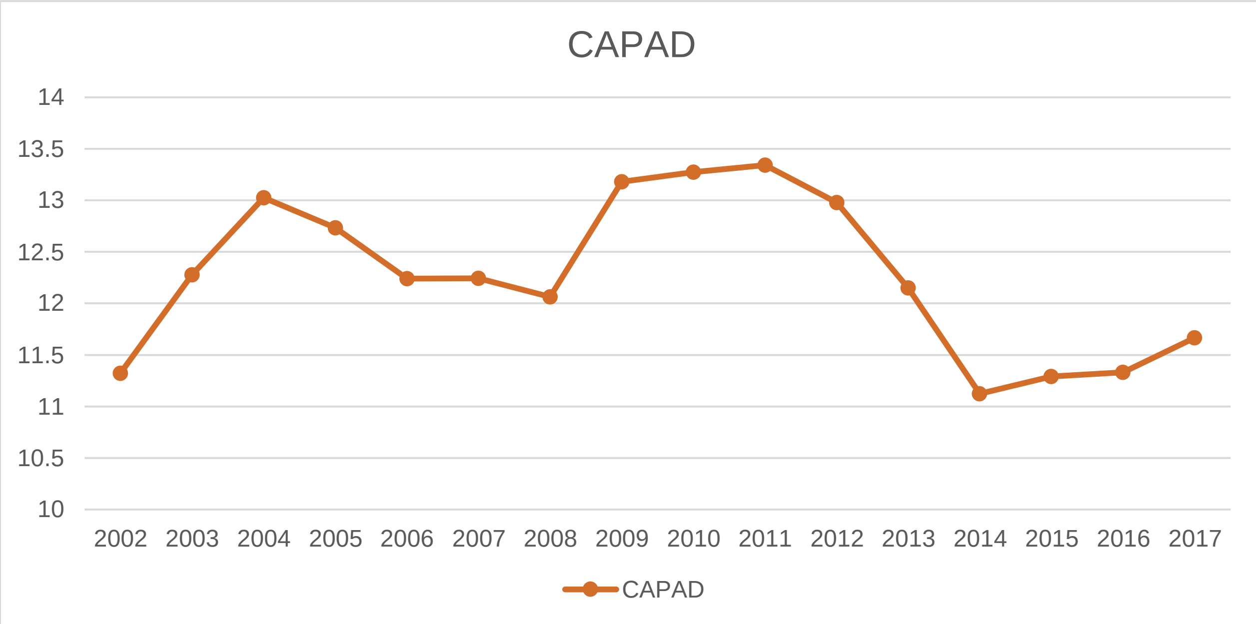


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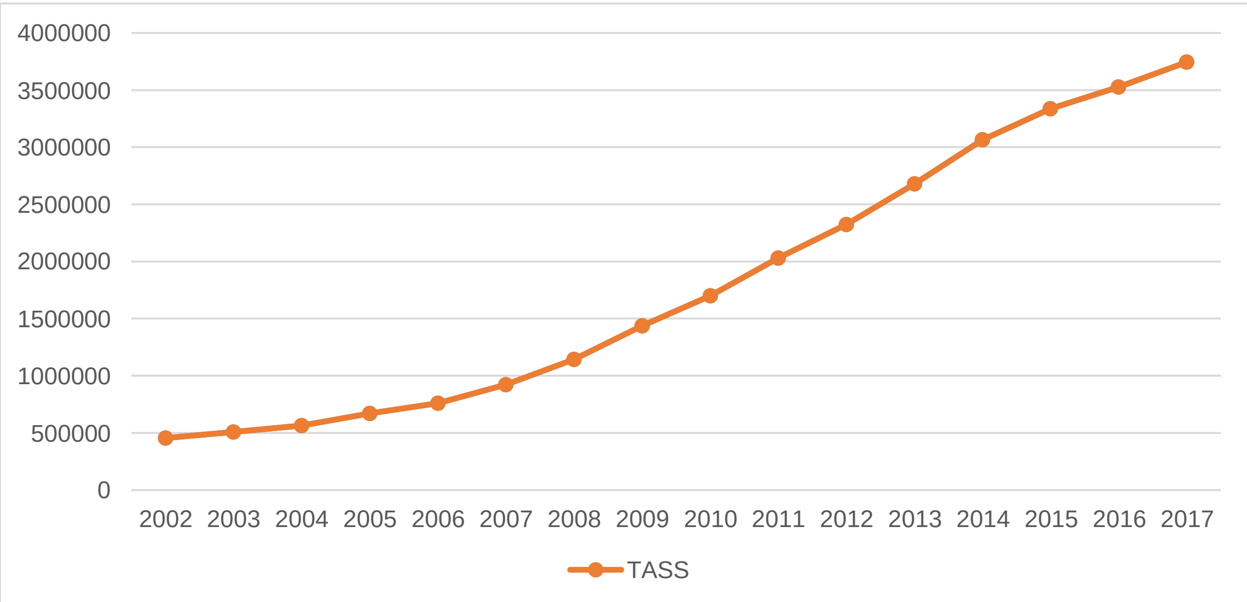
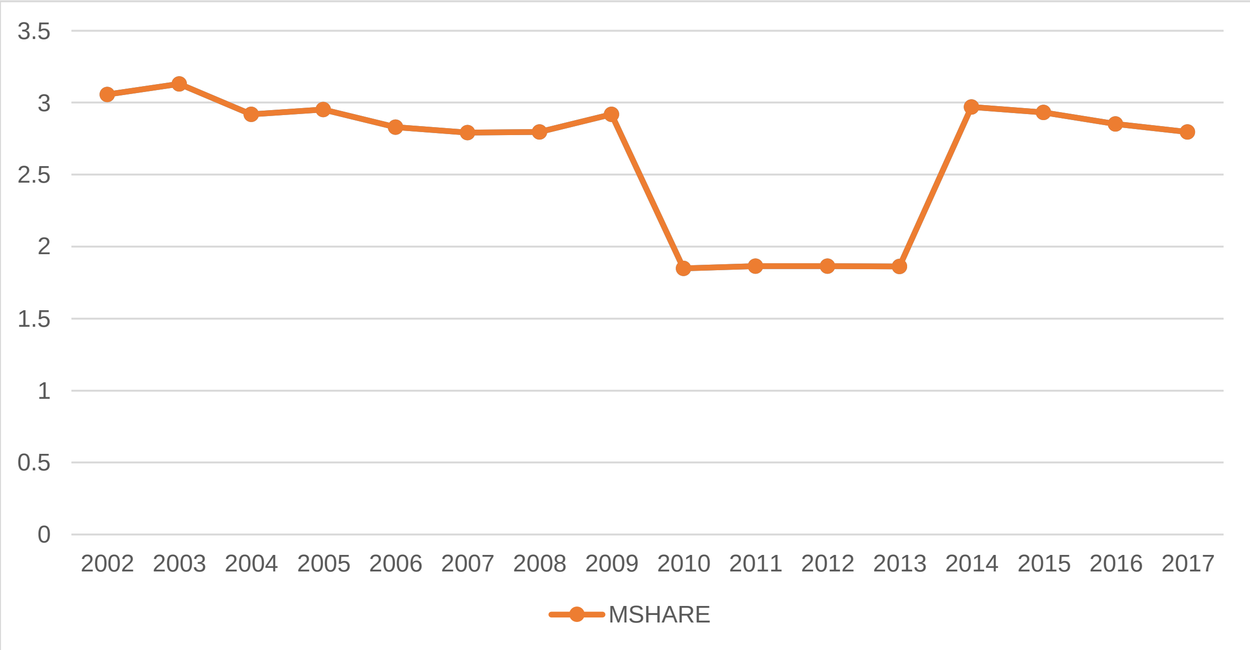
Figure. 4.1d. Visual presentation of mean TASS values for the time-period 2002-2017



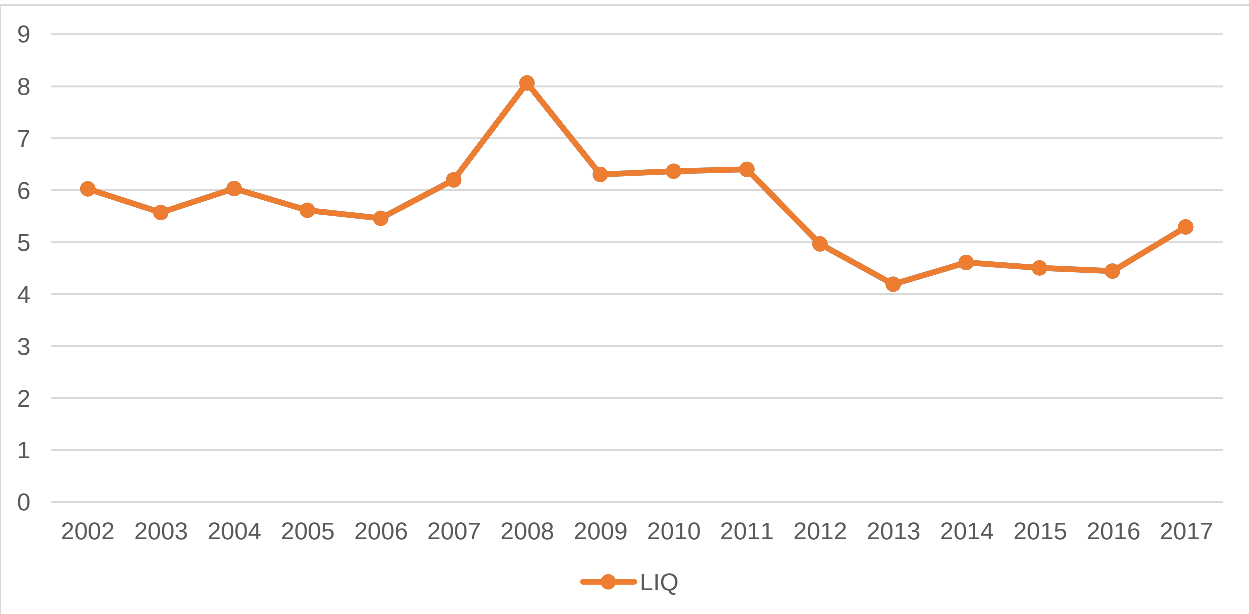
Source: Generated by the author using Microsoft Excel

Figure 4.1e. Visual presentation of mean MSHARE values for the time-period 2002-2017



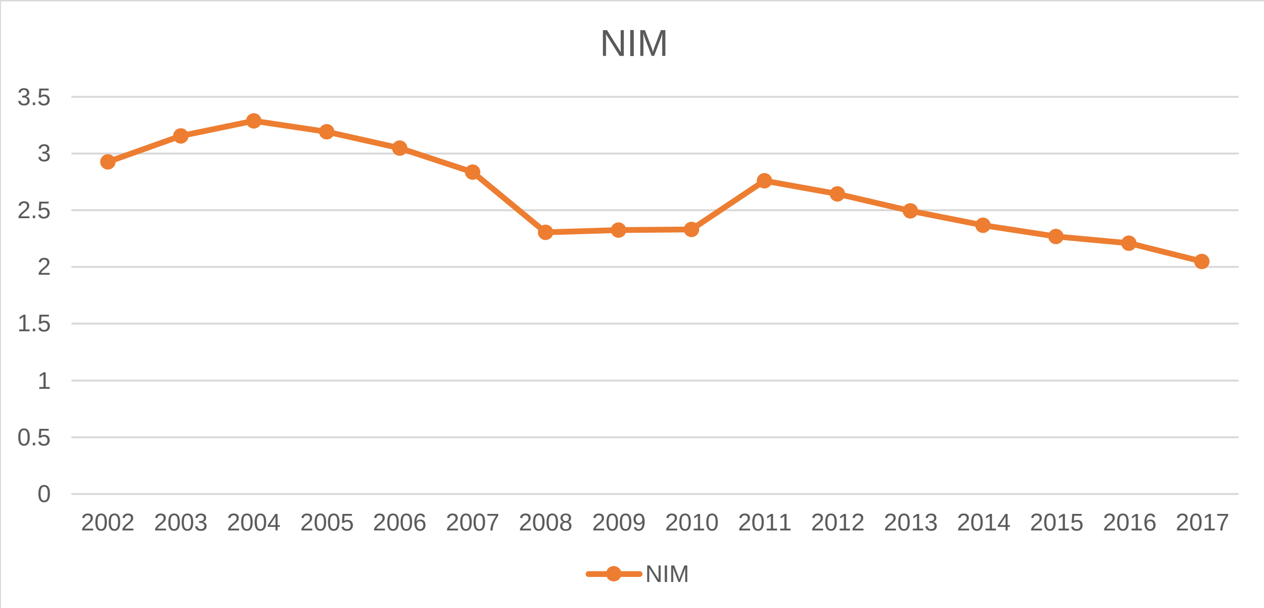
Source: Generated by the author using Microsoft Excel

Figure 4.1f. Visual presentation of mean LIQ values for the time-period 2002-2017



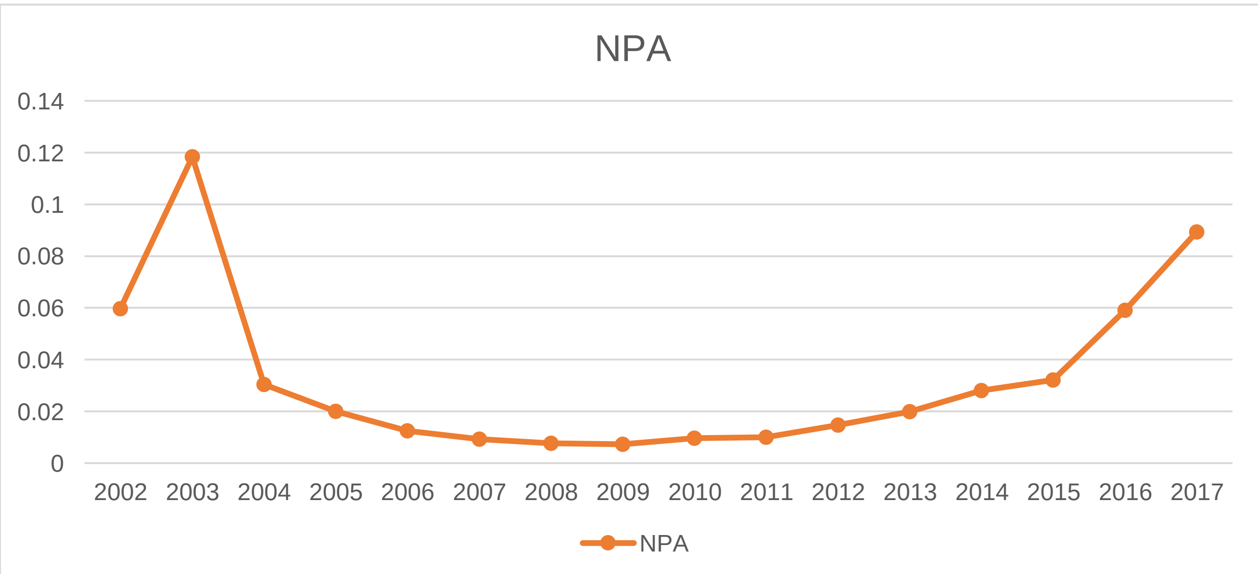
Source: Generated by the author using Microsoft Excel

Figure 4.1g. Visual presentation of mean NIM values for the time-period 2002-2017



Source: Generated by the author using Microsoft Excel

Figure 4.1h. Visual presentation of mean NPA values for the time-period 2002-2017



Source: Generated by the author using Microsoft Excel

Appendix 1: Data on input and output variables to be used in DEA calculations

Table 5.1. Data on inputs and output variables to be used in DEA calculations for the year 2001-2002

2002/2001 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	2506	7074	226659	606	103580	109925	7305	3849
ANDHRA BANK	1005	4540	184908	2190	18493	96777	5753	3040
BANK OF BARODA	4456	15633	618045	6926	238331	336630	18794	9932
BANK OF INDIA	6418	15309	597106	33477	220835	383108	18397	11033
BANK OF MAHARASHTRA	1380	4792	191306	4028	99092	82551	5868	3075
CANARA BANK	**	15926	640300	15936	232201	331267	18203	14285
CENTRAL BANK OF INDIA		14312	471374	2271	210998	212875	15350	6006
CORPORATION BANK	1287	3842	189243	14235	80565	109874	6252	3819
DENA BANK	3159	4604	153547	2662	76481	75230	4428	3530
IDBI BANK LIMITED	**	**	**	**	**	**	**	**
INDIAN BANK	2051	7258	240388	3720	124081	109084	5310	5019
INDIAN OVERSEAS BANK	2645	8845	318085	1509	150692	151623	29501	5308
ORIENTAL BANK OF								
COMMERCE	3170	5289	284884	6174	137243	141579	9721	4739
PUNJAB AND SIND BANK	1088	3813	124826	708	57449	55764	3168	2282
PUNJAB NATIONAL BANK	6713	17992	641235	4086	282072	343694	22953	9777
SYNDICATE BANK	743	10283	285483	366	119106	148847	11075	2760
UCO BANK	1829	8368	268488	3963	123018	128054	7297	5830
UNION BANK OF INDIA	3216	9665	397939	533	154097	213833	13366	4991
UNITED BANK OF INDIA	882	7584	196107	882	116564	68227	6017	3939
VIJAYA BANK	966	4216	146805	881	73607	61967	4853	1888
STATE BANK OF BIKANER & JAIPUR	635	4005	116610	228	63050	59313	4903	3008
STATE BANK OF HYDERABAD	1637	4149	174027	779	98279	84226	6497	3653
STATE BANK OF INDIA	21531	72109	2705601	93239	1451420	1208065	90812	41745
STATE BANK OF MYSORE	1149	3137	85248	795	41588	49145	3152	2333
STATE BANK OF PATIALA	1671	3568	139471	1592	57050	86788	6570	2645
STATE BANK OF TRAVANCORE	1459	3333	134597	640	63721	74355	4244	2302

Source: Compiled by the author using Reserve Bank of India database

Table 5.2. Data on inputs and output variables to be used in DEA calculations for the year 2002-2003

2003/2002 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	1731	9183	254634	437	123717	125436	9098	5244
ANDHRA BANK	1794	6018	210618	9906	1052	1151	7530	6036
BANK OF BARODA	3808	1648	663664	6253	301794	353481	21034	12617
BANK OF INDIA	5850	16486	644536	40269	244348	426332	20362	16424
BANK OF MAHARASHTRA	1620	5162	221758	3148	118015	95081	6763	3605
CANARA BANK	**	17477	720948	938	304582	404716	22330	15121
CENTRAL BANK OF INDIA	4138	15271	511651	1470	260454	231592	18974	5535
CORPORATION BANK	1742	4714	217246	8033	106699	120292	7921	5317
DENA BANK	2697	5113	164913	2282	85004	84356	5681	4370
IDBI BANK LIMITED	**	**	**	**	**	**	**	**
INDIAN BANK	1867	7551	270159	4492	148390	122750	8204	5250
INDIAN OVERSEAS BANK	2353	9472	366986	3560	186030	174470	12215	5199
ORIENTAL BANK OF COMMERCE	4185	5826	298091	7660	147805	156772	12048	5410
PUNJAB AND SIND BANK	2045	4126	132236	248	62375	58921	3863	3071
PUNJAB NATIONAL BANK	8347	20567	758135	6622	340300	402281	31237	12503
SYNDICATE BANK	984	10860	306605	789	138232	163053	12097	4951
UCO BANK	2247	8673	313434	4072	141375	159231	8820	6093
UNION BANK OF INDIA	4175	10183	447486	4421	193708	255148	14977	8245
UNITED BANK OF INDIA	952	5919	210313	577	126394	73517	7197	4282
VIJAYA BANK	1926	5570	170198	3208	88616	78913	6434	3460
STATE BANK OF BIKANER & JAIPUR	1040	4504	132336	3105	76820	67733	5514	3399
STATE BANK OF HYDERABAD	2401	4514	205989	4164	125187	96626	7477	4616
STATE BANK OF INDIA	25924	79424	296123	93036	1723479	1377585	99776	57403
STATE BANK OF MYSORE	1557	3277	90131	3354	47606	52607	3866	2939
STATE BANK OF PATIALA	1808	3950	178697	4340	81221	107464	7890	3455
STATE BANK OF TRAVANCORE	1600	3680	159263	484	80387	91707	5228	3002

Source: Compiled by the author using Reserve Bank of India database

Table 5.3. Data on inputs and output variables to be used in DEA calculations for the year 2003-2004

2004/2003 (in millions)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	advances	Net interest income	Total other income
ALLAHABAD BANK	4784	9593	31477	1690	155548	153415	10858	7498
ANDHRA BANK	2485	6585	229405	8430	103173	128855	9106	6780
BANK OF BARODA	0	18053	729673	8751	380188	356009	25716	17190
BANK OF INDIA	6337	17515	710031	45208	271629	458559	22014	17920
BANK OF MAHARASHTRA	2317	5605	264459	4699	139430	117315	7717	4652
CANARA BANK	0	18965	863446	7549	357930	476386	26824	20729
CENTRAL BANK OF INDIA	6430	15576	559086	1080	314051	228041	21222	9643
CORPORATION BANK	1064	5736	231909	9341	106850	138897	9639	5168
DENA BANK	3062	4991	183492	3084	97364	94118	5923	6174
IDBI BANK LIMITED	**	**	**	**	**	**	**	**
INDIAN BANK	3423	10619	304444	2989	166962	141261	11171	7473
INDIAN OVERSEAS BANK	5128	10149	414826	7295	201716	202949	15994	7407
ORIENTAL BANK OF COMMERCE	3347	6445	356735	7005	167941	196807	14558	7217
PUNJAB AND SIND BANK	864	5996	136420	101	67766	60300	4933	2559
PUNJAB NATIONAL BANK	11940	23707	879164	12890	421255	472247	36247	18669
SYNDICATE BANK	3047	11514	425848	2224	179166	206469	14292	7764
UCO BANK	3350	8715	392443	3864	176115	206264	11946	6253
UNION BANK OF INDIA	6436	10846	505589	9342	224420	294259	17362	8315
UNITED BANK OF INDIA	1691	6727	227582	295	139161	79633	7805	5054
VIJAYA BANK	2266	4978	210151	3366	108370	110453	8378	5257
STATE BANK OF BIKANER & JAIPUR	1080	5266	156423	6159	84300	85965	7164	4915
STATE BANK OF HYDERABAD	0	5346	242578	8254	150170	118137	8413	7074
STATE BANK OF INDIA	36935	92453	318619	134313	1856765	1579335	111863	76124
STATE BANK OF MYSORE	1662	3699	110837	2073	54867	63067	4544	3404
STATE BANK OF PATIALA	3093	4489	224733	4981	111102	130863	8222	6305
STATE BANK OF TRAVANCORE	2618	4524	197214	2706	107781	1113243	6833	4699

Source: Compiled by the author using Reserve Bank of India database

Table 5.4. Data on inputs and output variables to be used in DEA calculations for the year 2004-2005

2005/2004 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	400	10701	407621	1295	189883	211508	13640	6399
ANDHRA BANK	124	8295	275507	9832	106463	175168	10690	7533
BANK OF BARODA	4294	19822	813335	16408	370744	434004	29793	13048
BANK OF INDIA	3512	19323	788214	59620	286863	555289	22369	11558
BANK OF MAHARASHTRA	950	7204	288442	7211	144796	130616	8817	3852
CANARA BANK	-	21090	967959	1142	380539	604214	31505	15438
CENTRAL BANK OF INDIA	5987	16859	607517	1397	308348	272773	23749	9201
CORPORATION BANK	1160	6670	272332	12979	102611	185464	11294	5646
DENA BANK	2756	6156	208966	3350	96970	113086	6866	3112
IDBI BANK LIMITED	-379	4540	151026	500055	250547	454136	1879	6271
INDIAN BANK	1989	9144	348084	7246	179210	183801	13037	5688
INDIAN OVERSEAS BANK	2949	11585	442412	5907	190147	252052	18555	6398
ORIENTAL BANK OF COMMERCE	1520	7957	478503	7281	183422	252992	15237	5052
PUNJAB AND SIND BANK	871	5710	141707	33	70816	63222	5727	2561
PUNJAB NATIONAL BANK	1680	32780	1031669	27183	506728	604128	40067	16757
SYNDICATE BANK	1332	12642	462946	3220	203707	267292	16938	5645
UCO BANK	1835	10853	494702	2996	190644	276557	14082	5156
UNION BANK OF INDIA	2165	12575	618306	20210	227928	401051	20646	7661
UNITED BANK OF INDIA	725	7042	253484	270	144033	113897	9153	4785
VIJAYA BANK	1810	5384	256180	6408	120687	143358	9869	3537
STATE BANK OF BIKANER & JAIPUR	459	6224	190384	6158	83625	120362	8689	4831
STATE BANK OF HYDERABAD	-	6708	289295	8162	145594	155997	9624	4216
STATE BANK OF INDIA	12040	100742	3670475	191843	1970979	2023745	139446	71199
STATE BANK OF MYSORE	1278	4791	135852	3196	57962	87813	5508	3860
STATE BANK OF PATIALA	500	4790	264957	5597	123124	153593	9763	3557
STATE BANK OF TRAVANCORE	-600	5026	241330	1271	105921	148483	8962	4085

Source: Compiled by the author using Reserve Bank of India database

Table 5.5. Data on inputs and output variables to be used in DEA calculations for the year 2005-2006

2006/2005 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	768	10358	484997	468	179847	291478	15774	4824
ANDHRA BANK	400	8579	339224	7585	114442	221004	11690	3916
BANK OF BARODA	3400	23848	936620	48022	351142	599118	31749	11274
BANK OF INDIA	5356	21151	939320	58939	317818	651737	26320	11844
BANK OF MAHARASHTRA	830	6587	269062	4884	113543	164697	9716	522
CANARA BANK	6352	23471	1168032	258	369742	794257	35815	13156
CENTRAL BANK OF INDIA	660	17162	664826	3108	286391	374835	23801	5308
CORPORATION BANK	1870	7468	328765	16601	106520	239624	12268	4736
DENA BANK	2369	5613	236231	10	85707	142312	7227	4390
IDBI BANK LIMITED	1317	8595	260009	475302	253505	527391	3799	12804
INDIAN BANK	972	10798	408055	18873	190170	224846	15102	4632
INDIAN OVERSEAS BANK	1536	12616	505293	7366	189523	347562	20672	5411
ORIENTAL BANK OF COMMERCE	-550	9659	501975	8764	168176	335772	16051	5528
PUNJAB AND SIND BANK	946	4830	169246	2	69556	91075	6306	1200
PUNJAB NATIONAL BANK	616	30232	1196849	66649	410553	746274	46668	12735
SYNDICATE BANK	2901	14348	536244	3431	172691	364662	18809	5620
UCO BANK	1813	11774	545437	13528	196363	373776	15658	3740
UNION BANK OF INDIA	1557	14024	740943	39744	259176	533800	23743	4945
UNITED BANK OF INDIA	1342	8136	292498	2966	141295	155223	10205	4369
VIJAYA BANK	1268	6235	277093	5158	111797	166640	9728	2838
STATE BANK OF BIKANER & JAIPUR	425	7598	216936	12123	79325	158958	9929	2479
STATE BANK OF HYDERABAD	850	8161	340246	6362	142560	208630	10943	4590
STATE BANK OF INDIA	1478	117251	3800461	306412	1625342	2618009	155891	74352
STATE BANK OF MYSORE	1493	5095	163688	5822	56935	117542	6117	3357
STATE BANK OF PATIALA	-320	6115	337777	12506	126781	221800	9967	3470
STATE BANK OF TRAVANCORE	460	6324	259965	11664	106300	188664	9551	3511

Source: Compiled by the author using Reserve Bank of India database

Table 5.6. Data on inputs and output variables to be used in DEA calculations for the year 2006-2007

2007/2006 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	900	10272	595437	2571	187461	412900	17507	3764
ANDHRA BANK	926	9332	414540	7335	143007	278891	14175	4469
BANK OF BARODA	2272	25443	1249160	11426	349436	836209	35775	11732
BANK OF INDIA	5569	26084	1198817	66208	354928	851159	34405	15629
BANK OF MAHARASHTRA	1385	7461	339193	2009	112984	229194	10942	2650
CANARA BANK	4580	25653	1423815	15744	452255	985057	40268	14509
CENTRAL BANK OF INDIA	3266	16844	827763	7820	277419	517955	24744	4757
CORPORATION BANK	1863	8036	423569	30210	144175	299497	13081	5658
DENA BANK	2879	6115	276899	4509	92350	183034	8554	3915
IDBI BANK LIMITED	1392	7785	433540	424044	256753	624708	6579	10272
INDIAN BANK	943	12466	470909	19365	208777	290581	17822	7332
INDIAN OVERSEAS BANK	1353	13878	687404	28962	239745	470603	25608	3870
ORIENTAL BANK OF COMMERCE	-1991	9979	639960	6226	198084	441385	16913	6032
PUNJAB AND SIND BANK	997	5231	193188	2051	66931	117375	7670	2285
PUNJAB NATIONAL BANK	5998	33262	1398597	19489	451898	965965	52132	10423
SYNDICATE BANK	3037	13860	786336	13735	252340	516704	21501	6185
UCO BANK	2902	11926	648600	24659	195249	469889	15869	4427
UNION BANK OF INDIA	3300	14759	851802	42155	279818	623864	27902	6865
UNITED BANK OF INDIA	2315	7785	371667	3997	146018	221563	11499	3200
VIJAYA BANK	1207	6507	376045	1981	120184	242236	10720	2748
STATE BANK OF BIKANER & JAIPUR	757	7528	284805	11666	87354	205262	9388	3631
STATE BANK OF HYDERABAD	460	8085	415027	3934	139192	281093	12280	4575
STATE BANK OF INDIA	14283	118235	4355211	397033	1491489	3373365	150582	57692
STATE BANK OF MYSORE	404	5622	220223	9899	69897	164655	6836	3209
STATE BANK OF PATIALA	643	6586	391836	17415	123577	287698	10051	3372
STATE BANK OF TRAVANCORE	699	6452	309840	19031	97181	246299	9922	2219

Source: Compiled by the author using Reserve Bank of India database

Table 5.7. Data on inputs and output variables to be used in DEA calculations for the year 2007-2008

2008/2007 (in million Rs.)	Loan loss	Operating	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	2686	11576	716164	17920	234003	497205	16723	9648
ANDHRA BANK	987	9091	494365	5905	148982	342384	13396	6265
BANK OF BARODA	4360	30343	1520341	39270	438701	1067013	39118	20510
BANK OF INDIA	6973	26450	1500120	71724	418029	1134763	42293	21169
BANK OF MAHARASHTRA	863	8363	417583	1992	122830	292858	11287	3803
CANARA BANK	8750	27913	1540724	25172	498116	1072380	35378	22129
CENTRAL BANK OF INDIA	2891	17458	1103197	4491	314552	729974	21118	9023
CORPORATION BANK	1230	8920	554244	21376	173251	391856	14433	6998
DENA BANK	2640	6504	339432	3946	102830	230240	8588	4781
IDBI BANK LIMITED	1336	9588	729980	438230	328029	822127	6765	15818
INDIAN BANK	3496	14003	610459	12832	219151	398387	20539	10057
INDIAN OVERSEAS BANK	1254	14853	843256	63536	284747	604018	24500	10371
ORIENTAL BANK OF COMMERCE	-1895	10796	778567	18398	239507	545658	16710	6276
PUNJAB AND SIND BANK	655	5608	248314	29767	84736	183433	7858	3176
PUNJAB NATIONAL BANK	3771	35255	1664572	54466	539917	1195016	55342	19976
SYNDICATE BANK	3454	14945	951708	13062	280759	640510	20728	8900
UCO BANK	3701	13059	799089	17159	242496	550819	14877	7721
UNION BANK OF INDIA	5852	15930	1038586	47605	338226	742669	28537	13196
UNITED BANK OF INDIA	2450	9032	469707	11621	185146	278581	9046	4655
VIJAYA BANK	1006	7013	479520	19189	166173	316892	8301	5320
STATE BANK OF BIKANER &	759	7495	341084	10693	104984	250759	9390	4717
STATE BANK OF HYDERABAD	-305	7989	501083	9486	160271	358488	11129	6771
STATE BANK OF INDIA	20009	126086	5374039	517274	1895013	4167682	170212	86949
STATE BANK OF MYSORE	215	6169	274624	17315	84028	210271	7623	4221
STATE BANK OF PATIALA	768	7070	485705	28946	143748	364000	8906	5958
STATE BANK OF TRAVANCORE	978	6869	353539	28493	113530	281366	9573	4388

Source: Compiled by the author using Reserve Bank of India database

Table 5.8. Data on inputs and output variables to be used in DEA calculations for the year 2008-2009

2009/2008 (in million Rs.)	Loan loss	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest	Total other income
ALLAHABAD BANK	3132	13994	849718	38489	296510	588018	21587	11419
ANDHRA BANK	1701	11043	593900	33512	169111	441393	16269	7654
BANK OF BARODA	2686	35761	1923970	127679	524459	1432514	51234	27577
BANK OF INDIA	6227	30940	1897085	156732	526072	1429094	54989	30519
BANK OF MAHARASHTRA	1872	9630	522549	22575	183821	342908	12565	5000
CANARA BANK	9000	30652	1868925	140009	577769	1382194	47178	23112
CENTRAL BANK OF INDIA	3223	18617	1312718	8043	430607	854832	22285	10700
CORPORATION BANK	1700	10466	739839	48099	249378	485122	16910	11072
DENA BANK	1994	7682	430506	14431	124731	288780	10644	4301
IDBI BANK LIMITED	1191	13379	1124010	444170	500476	1034445	12394	13900
INDIAN BANK	137	15881	725818	8308	228006	513965	26085	10354
INDIAN OVERSEAS BANK	3655	19417	1001159	104946	312154	748853	28696	15958
ORIENTAL BANK OF COMMERCE	1706	13978	983688	29720	284890	685004	19965	10713
PUNJAB AND SIND BANK	628	6978	346757	36065	126274	246153	10119	4077
PUNJAB NATIONAL BANK	8211	42062	2097605	124597	633852	1547030	68319	29197
SYNDICATE BANK	3808	17910	1158851	54142	305372	815323	25478	8603
UCO BANK	2684	14630	1002216	51374	293848	688039	16447	10199
UNION BANK OF INDIA	5465	22141	1387028	87749	429970	965342	38136	14825
UNITED BANK OF INDIA	1988	9751	545359	4568	179242	353935	11615	4909
VIJAYA BANK	1342	9247	545354	22692	173877	354677	11248	6988
STATE BANK OF BIKANER & JAIPUR	734	7874	392244	24355	109988	298507	11032	5770
STATE BANK OF HYDERABAD	1348	9331	624489	45745	209817	436792	14668	7693
STATE BANK OF INDIA	24750	156487	7420731	840579	2759540	5425032	208731	126908
STATE BANK OF MYSORE	542	6651	329158	38271	113780	256161	8383	4804
STATE BANK OF PATIALA	735	7939	600062	31054	170292	435872	11277	6316
STATE BANK OF TRAVANCORE	588	7994	420411	25478	132317	326014	12826	5731

Source: Compiled by the author using Reserve Bank of India database

Table 5.9. Data on inputs and output variables to be used in DEA calculations for the year 2009-2010

2010/2009 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	8302	16178	1060558	54355	384286	716049	26505	15159
ANDHRA BANK	3052	13495	776882	58524	208810	561135	21947	9646
BANK OF BARODA	9007	38106	2412619	133501	611824	1750353	59395	28064
BANK OF INDIA	17543	36678	2297619	223999	670802	1684907	57559	26166
BANK OF MAHARASHTRA	2506	10729	633041	27970	213239	403147	12963	5912
CANARA BANK	14262	34776	2346514	84406	696770	1693346	56805	28579
CENTRAL BANK OF INDIA	2884	22220	1621075	73266	505629	1053835	25453	17352
CORPORATION BANK	3453	12600	927337	90775	345226	632026	19033	14933
DENA BANK	967	8481	513443	15619	156942	354624	11000	5886
IDBI BANK LIMITED	2363	18314	1676671	477095	733455	1382019	22561	23017
INDIAN BANK	3921	17302	882277	9574	282683	621461	31612	13164
INDIAN OVERSEAS BANK	9195	24665	1107947	89822	376506	789992	31679	11433
ORIENTAL BANK OF COMMERCE	5316	16860	1202576	48870	357853	834893	29074	12000
PUNJAB AND SIND BANK	919	7182	491551	37011	178868	326391	11839	4118
PUNJAB NATIONAL BANK	9943	47619	2493298	192624	777245	1866012	84781	36101
SYNDICATE BANK	5306	20336	1170258	121727	330109	904064	27398	11675
UCO BANK	3528	15844	1224156	62638	435214	825045	23241	9659
UNION BANK OF INDIA	6989	25078	1700397	92153	544035	1193153	41924	19747
UNITED BANK OF INDIA	2727	10741	681803	9153	260677	423300	13912	5587
VIJAYA BANK	4744	10716	619317	19386	211074	415067	14491	6795
STATE BANK OF BIKANER & JAIPUR	1419	8905	460588	29751	136005	351764	12115	5827
STATE BANK OF HYDERABAD	1375	9838	729707	48384	240085	528248	18632	8413
STATE BANK OF INDIA	46223	203187	8041162	1030116	2957852	6319142	236714	149682
STATE BANK OF MYSORE	863	7249	388800	22740	136005	295359	12366	4257
STATE BANK OF PATIALA	2194	9009	645519	34216	240085	463472	15342	6744
STATE BANK OF TRAVANCORE	805	9559	508834	32501	2957852	384613	14002	5280

Source: Compiled by the author using Reserve Bank of India database

Table 5.10. Data on inputs and output variables to be used in DEA calculations for the year 2010-2011

2011/2010 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	8000	23383	1318872	69182	432471	936249	40225	13704
ANDHRA BANK	4682	17049	921563	76397	242040	714354	32210	8970
BANK OF BARODA	10555	46298	3054395	223079	713966	2286764	88023	28092
BANK OF INDIA	10543	50682	2988858	220214	858724	2130962	78107	26418
BANK OF MAHARASHTRA	3420	16442	668447	30766	224911	468808	19684	5309
CANARA BANK	10012	44193	2934366	142616	836360	2112683	76993	27030
CENTRAL BANK OF INDIA	6320	39990	1793560	128880	545045	1297254	53253	12650
CORPORATION BANK	4793	16417	1167475	159654	434527	868504	29397	13244
DENA BANK	2813	10734	642096	16917	187689	448280	17634	5338
IDBI BANK LIMITED	3716	22547	1804858	515697	682692	1570981	42693	20836
INDIAN BANK	7137	19263	1058042	21004	347838	752499	40361	11819
INDIAN OVERSEAS BANK	10336	25725	1452288	193554	486105	1118330	42080	12251
ORIENTAL BANK OF	9344	18925	1390543	56392	495454	959082	41775	9601
PUNJAB AND SIND BANK	1600	9840	597232	28859	186437	426378	15604	4371
PUNJAB NATIONAL BANK	20037	63642	3128987	315897	951623	2421067	118073	36126
SYNDICATE BANK	9290	25481	1355961	95276	350676	1067819	43828	9151
UCO BANK	11799	20754	1452776	54748	429273	990708	38449	9254
UNION BANK OF INDIA	11877	39500	2024613	133160	583991	1509861	62162	20388
UNITED BANK OF INDIA	4192	12994	778448	44115	262589	535024	21693	6370
VIJAYA BANK	4135	14333	732483	20254	251386	487186	19468	5332
STATE BANK OF BIKANER	2984	12692	538523	30139	135207	412067	17697	6397
STATE BANK OF	4057	15128	886279	52897	284467	647203	28485	9837
STATE BANK OF INDIA	84154	230154	9339328	1195690	2956006	7567194	325264	158246
STATE BANK OF MYSORE	4558	9174	432255	33080	129271	340298	16360	4552
STATE BANK OF PATIALA	6752	13298	680661	50956	172746	514332	23335	7555
STATE BANK OF	2455	11013	581579	57265	179270	460442	16960	5812

Source: Compiled by the author using Reserve Bank of India database

Table 5.11. Data on inputs and output variables to be used in DEA calculations for the year 2011-2012

2012/2011 (in million Rs.)	Loan loss provisions	Operating expenses	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	11835	26914	1595931	90945	542832	1111451	51626	12987
ANDHRA BANK	4817	18042	1058512	82406	296289	832230	37593	8599
BANK OF BARODA	15689	51587	3848711	235731	832094	2873773	103170	34223
BANK OF INDIA	20252	49407	3182160	321142	867536	2488333	83134	33212
BANK OF MAHARASHTRA	6734	16425	765287	69448	260314	560598	25171	6407
CANARA BANK	12941	46737	3270537	155254	1020574	2324898	76893	29276
CENTRAL BANK OF INDIA	13750	37490	1961733	129196	592433	1475129	51686	13953
CORPORATION BANK	5572	17836	1361422	142481	474746	1004690	31469	14926
DENA BANK	2621	11547	771668	38809	230276	566925	21010	5822
IDBI BANK LIMITED	6455	26075	2104926	534776	831754	1805723	45448	21122
INDIAN BANK	7610	21870	1208038	48729	379760	903236	44180	12322
INDIAN OVERSEAS BANK	14702	31631	1784342	236138	555659	1407244	50162	16810
ORIENTAL BANK OF COMMERCE	10816	23155	1559649	52590	521013	1119777	42158	12402
PUNJAB AND SIND BANK	611	11585	631240	33823	200641	461514	15011	4175
PUNJAB NATIONAL BANK	24031	70028	3795885	372643	1227030	2937748	134144	42026
SYNDICATE BANK	13997	28141	1579411	105899	408151	1236202	50850	10759
UCO BANK	8000	20562	1540035	129014	457715	1155400	39021	9656
UNION BANK OF INDIA	15107	39875	2228689	179095	623636	1778821	67931	24482
UNITED BANK OF INDIA	6900	13833	891163	49202	290588	630433	24792	7329
VIJAYA BANK	4139	12014	830555	54184	286438	579037	19035	5279
STATE BANK OF BIKANER & JAIPUR	4796	13308	615721	29550	166695	492443	22214	5990
STATE BANK OF HYDERABAD	6166	17358	987319	59784	292418	770523	33645	10243
STATE BANK OF INDIA	114941	260690	10436474	1270056	3121976	8675789	432911	143514
STATE BANK OF MYSORE	5038	10411	501863	44256	147327	398353	15843	5164
STATE BANK OF PATIALA	3988	13234	794166	108099	220429	629345	23352	7510
STATE BANK OF TRAVANCORE	4209	12299	714698	76073	224376	553460	18978	5809

Source: Compiled by the author using Reserve Bank of India database

Table 5.12. Data on inputs and output variables to be used in DEA calculations for the year 2012-2013

2013/2012 (in million Rs.)	Loan Loss	Operating	Deposits	Borrowings	Investments	Advances	Net interest	Total other income
ALLAHABAD BANK	14812	29581	1787416	100976	583059	1294897	48664	14769
ANDHRA BANK	6151	20372	1237956	111193	376324	983733	37570	10474
BANK OF BARODA	30670	59467	4738833	265793	1213937	3281858	113153	36306
BANK OF INDIA	37266	53315	3818396	353676	946134	2893675	90240	37660
BANK OF MAHARASHTRA	5857	17966	943369	128775	314303	754708	30333	9120
CANARA BANK	18610	51420	3558560	202834	1211328	2421766	78790	31530
CENTRAL BANK OF INDIA	13580	42323	2260383	183055	726038	1719358	57376	16673
CORPORATION BANK	9281	19968	1660055	128988	581645	1187166	34258	16079
DENA BANK	3733	12997	972072	84137	343431	657812	23831	6555
IDBI BANK LIMITED	16129	31344	2271165	658089	988009	1963064	53731	32195
INDIAN BANK	9530	27509	1419802	28626	418050	1056425	45291	12832
INDIAN OVERSEAS BANK	21988	34078	2021353	233229	614173	1603641	52519	19729
ORIENTAL BANK OF	15824	26652	1758975	76793	585547	1289551	47012	16547
PUNJAB AND SIND BANK	2556	10964	706415	25401	225425	514308	16410	3942
PUNJAB NATIONAL BANK	33364	81651	3915601	396209	1298962	3087959	148490	42234
SYNDICATE BANK	11354	31788	1853559	128138	456477	1475690	54541	11744
UCO BANK	17890	21766	1734310	94924	522449	1282829	45815	9522
UNION BANK OF INDIA	15555	45122	2637616	237973	808304	2081022	75428	25520
UNITED BANK OF INDIA	10105	15039	1006515	49427	334634	689087	24873	10666
VIJAYA BANK	4284	13630	970172	63918	312850	697658	18780	6070
STATE BANK OF BIKANER	5617	15792	721162	58420	201459	575350	25658	7263
STATE BANK OF	10416	21051	1133243	54484	339680	898565	39179	9756
STATE BANK OF INDIA	106570	292844	12027396	1691827	3508775	10456166	443293	160368
STATE BANK OF MYSORE	4128	11048	569690	38542	167746	449326	18402	5956
STATE BANK OF PATIALA	2479	16679	886721	88406	239567	737998	24508	7588
STATE BANK OF TRAVANCORE	2881	14302	846237	87472	272255	674836	21282	6530

Source: Compiled by the author using Reserve Bank of India database

Table 5.13. Data on inputs and output variables to be used in DEA calculations for the year 2013-2014

2013/2014	Loan loss provisions	Operating expenses	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	28484	34566	1908428	121308	639605	1380066	53113	21658
ANDHRA BANK	23247	23099	1418451	131851	453566	1076442	37373	13328
BANK OF BARODA	47499	71371	5688944	368130	1161127	3970058	119653	44627
BANK OF INDIA	56936	66995	4769741	484275	1141524	3707335	108305	42918
BANK OF MAHARASHTRA	16204	23967	1168031	83265	372496	889204	35089	8942
CANARA BANK	43580	60810	4207228	272306	1268283	3010675	89444	39328
CENTRAL BANK OF INDIA	45009	51789	2400690	220798	861351	1773152	64944	19226
CORPORATION BANK	24777	23920	1933930	130214	661912	1370863	37837	16477
DENA BANK	12224	16478	1100277	51609	366121	775538	25051	9167
IDBI BANK LIMITED	45600	33188	2357736	601463	1037735	1976860	60215	29788
INDIAN BANK	17417	28315	1622748	49639	468099	1222090	43604	13717
INDIAN OVERSEAS BANK	33955	37489	2279761	245058	702368	1758816	55768	21693
ORIENTAL BANK OF	30161	29169	1934890	78636	614722	1390798	51271	19453
PUNJAB AND SIND BANK	4999	12473	847302	23050	282941	572391	16206	4273
PUNJAB NATIONAL BANK	80419	93382	4513967	480344	1437855	3492691	161460	45767
SYNDICATE BANK	18515	33018	2123433	192245	555394	1739124	55408	13239
UCO BANK	34299	24392	1995335	207182	674517	1495842	60591	13205
UNION BANK OF INDIA	35219	54828	2976756	293166	937232	2291044	78793	28215
UNITED BANK OF INDIA	32752	17079	1115097	44602	448763	657675	25628	12069
VIJAYA BANK	6878	16896	1242962	47448	425854	815040	20834	7099
STATE BANK OF BIKANER	9630	20055	738747	67064	177503	641721	28238	8763
STATE BANK OF	16715	22675	1195097	63364	342670	956538	39760	9825
STATE BANK OF INDIA	212181	357259	13944085	1831309	3987996	12098287	492822	185529
STATE BANK OF MYSORE	8902	13345	615603	54740	191902	494819	19264	5726
STATE BANK OF PATIALA	10007	20191	896732	123862	245989	759366	25961	8713
STATE BANK OF TRAVANCORE	10653	18654	893367	68184	279414	694046	23831	8519

Source: Compiled by the author using Reserve Bank of India database

Table 5.14. Data on inputs and output variables to be used in DEA calculations for the year 2014-2015

2014/2015	Loan loss	Operating	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	38388	37142	1934240	143159	549851	1498768	61779	38388
ANDHRA BANK	26600	27394	1550122	153072	458082	1259547	45380	26600
BANK OF BARODA	65167	76741	6175595	352643	1168122	4280651	131872	65167
BANK OF INDIA	57789	80886	5319066	400571	1197920	4020255	113785	57789
BANK OF MAHARASHTRA	19044	25259	1221189	111267	327650	985991	38750	19044
CANARA BANK	42477	72636	4738401	256716	1420614	3300355	96637	42477
CENTRAL BANK OF INDIA	29527	55822	2555724	259741	897400	1884775	72471	29527
CORPORATION BANK	24432	25254	1993458	104149	532980	1450660	40703	24432
DENA BANK	10648	18389	1159361	34360	327619	789343	24479	10648
IDBI BANK LIMITED	48547	40274	2598360	618325	977009	2083769	57479	48547
INDIAN BANK	20085	28109	1692253	26461	457283	1258635	44613	20085
INDIAN OVERSEAS BANK	37767	42002	2460487	182324	792981	1717560	53840	37767
ORIENTAL BANK OF COMMERCE	34496	32590	2040097	65450	620387	1452613	50842	34496
PUNJAB AND SIND BANK	6541	13325	867147	30482	240066	638702	16792	6541
PUNJAB NATIONAL BANK	88932	104915	5013786	456705	1498770	3805344	165556	88932
SYNDICATE BANK	24844	36226	2553881	265030	693397	2027198	55203	24844
UCO BANK	37724	26558	2143367	102525	642230	1473509	55625	37724
UNION BANK OF INDIA	40418	61434	3168699	353600	844617	2556546	84439	40418
UNITED BANK OF INDIA	21720	18096	1088176	40617	432455	667630	24907	21720
VIJAYA BANK	8196	19122	1263434	72782	407581	866959	22923	8196
STATE BANK OF BIKANER	13272	17637	842393	75734	221386	695484	29414	9264
STATE BANK OF	15965	28040	1301662	85025	364911	1050531	43926	13251
STATE BANK OF INDIA	264357	380539	15767932	2051503	4817587	13000264	550153	225759
STATE BANK OF MYSORE	9222	15235	660638	56883	180660	520259	20869	7676
STATE BANK OF PATIALA	12374	20042	914174	107970	244555	786421	25969	10067
STATE BANK OF TRAVANCORE	10366	19258	910769	37963	248195	687206	22831	10148

Source: Compiled by the author using Reserve Bank of India database

Table 5.15. Data on inputs and output variables to be used in DEA calculations for the year 2015-2016

2015/2016	Loan loss provisions	Operating expenses	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	48772	36747	2006444	187070	571549	1523721	58985	19101
ANDHRA BANK	34202	29254	1743024	97156	538642	1307879	53210	15645
BANK OF BARODA	142111	89231	5740379	334717	1204505	3837702	127399	49989
BANK OF INDIA	121248	93415	5130045	510831	1188489	3591890	117246	36525
BANK OF MAHARASHTRA	22445	25528	1389898	92281	362309	1075627	38787	10193
CANARA BANK	99595	74919	4797916	268733	1423093	3247148	97634	48752
CENTRAL BANK OF INDIA	37606	66620	2661842	92079	888675	1800096	70656	19388
CORPORATION BANK	36015	28796	2051708	131122	632806	1403222	42395	17352
DENA BANK	18606	22682	1174310	62713	352262	823283	24767	7168
IDBI BANK LIMITED	90349	41296	2657198	705916	929971	2158934	60890	34107
INDIAN BANK	23207	31955	1782858	35093	530893	1290491	44462	17814
INDIAN OVERSEAS BANK	57828	50255	2245142	271833	791896	1608607	53827	25283
ORIENTAL BANK OF	35260	34588	2089148	101239	662343	1488800	53746	17663
PUNJAB AND SIND BANK	9339	13844	912500	28390	276450	639161	21758	4785
PUNJAB NATIONAL BANK	153138	99725	5530511	597552	1578459	4123258	153118	60001
SYNDICATE BANK	48948	52421	2617353	255012	686219	2013685	59847	25087
UCO BANK	64026	28409	2071182	172404	839742	1259054	48480	15963
UNION BANK OF INDIA	42910	63022	3427200	309574	892083	2673540	83131	36317
UNITED BANK OF INDIA	10573	29728	1164013	29125	447234	680602	22806	14675
VIJAYA BANK	11671	20858	1254407	103006	418425	889870	27608	8739
STATE BANK OF BIKANER	14544	20564	940048	48884	247342	729275	33043	10570
STATE BANK OF	22277	27465	1371741	88745	380076	1110653	45936	14456
STATE BANK OF INDIA	333072	417824	17307224	3233446	5756518	14637004	571948	278454
STATE BANK OF MYSORE	8937	16758	705683	42947	201240	539542	21153	8120
STATE BANK OF PATIALA	28000	19193	1069537	77573	314170	821857	26255	11214
STATE BANK OF TRAVANCORE	14606	19038	1011188	29494	360618	654663	25539	11482

Source: Compiled by the author using Reserve Bank of India database

Table 5.16. Data on inputs and output variables to be used in DEA calculations for the year 2016-2017

2016/2017 (in million INR)	Loan loss provisions	Operating expenses	Deposits	Borrowings	Investments	Advances	Net interest income	Total other income
ALLAHABAD BANK	41803	40646	2018702	146703	551361	1507527	52870	26443
ANDHRA BANK	42136	34520	1954412	88552	596975	1368463	55316	23083
BANK OF BARODA	95919	92964	6016752	306114	1296305	3832592	135134	67581
BANK OF INDIA	112910	88658	5400320	394057	1278269	3664817	118261	67723
BANK OF	31996	28557	1390528	81367	385902	955152	31747	15081
CANARA BANK	77920	85123	4952752	395036	1502659	3420088	98718	75544
CENTRAL BANK OF	55277	63610	2966712	92824	920949	1393988	65740	28756
CORPORATION BANK	38783	31018	2205596	64682	640730	1403568	44510	30903
DENA BANK	22538	22695	1139428	50609	397372	725746	24084	12514
IDBI BANK LIMITED	97366	51408	2685381	563640	929344	1908259	57517	39676
INDIAN BANK	25950	33567	1825093	126369	675518	1276993	51461	22114
INDIAN OVERSEAS BANK	70669	49120	2113426	160977	715492	1404586	51896	33726
ORIENTAL BANK OF	52642	35049	2193394	145922	592293	1577060	49095	27655
PUNJAB AND SIND BANK	10408	14956	855402	29584	279485	583345	21593	5781
PUNJAB NATIONAL	132404	93794	6217040	407633	1867254	4194931	149932	89514
SYNDICATE BANK	38743	55001	2605609	174755	654654	1996694	62760	34574
UCO BANK	47767	30052	2012845	95350	740191	1197245	38168	21145
UNION BANK OF INDIA	68749	64378	3783916	412259	1121490	2864666	89033	49646
UNITED BANK OF INDIA	13334	25615	1269393	25518	530355	661393	19277	21866
VIJAYA BANK	16707	27365	1330120	110618	444246	945489	35064	16513
STATE BANK OF	33105	23521	1040087	15538	349224	648300	28786	14156
STATE BANK OF	56701	27998	1418989	56191	436288	793756	37987	19109
STATE BANK OF INDIA	403638	464728	20447514	3176937	7659896	15710784	618597	354609
STATE BANK OF MYSORE	29198	19569	784742	26485	238616	344746	18731	9974
STATE BANK OF PATIALA	50343	22879	1007946	40716	327061	700190	22622	14805
STATE BANK OF TRAVANCORE	36558	24158	1146889	30350	407771	486176	24375	14816

Source: Compiled by the author using Reserve Bank of India database

Appendix 2. Data on dependent and independent variables

Table 5.17. Data on dependent and independent variables before for the time-period 2001-2017

Name of Bank	Year	EFF	MSHARE	CAPAD	GDP	TASS	AGE	INF	NPA	ROE	NIM	LIQ	EXR	RIR
Allahabad Bank	2002	0.922	1.817286021	10.62	26802.8	247645	137	4.31	0.105541051	8.45	3.12	6.727455	48.61	7.9
Allahabad Bank	2003	1	1.878356856	11.15	27850.13	280509	138	3.81	0.070711757	15.44	3.45	5.510346	46.58	7.3
Allahabad Bank	2004	1	0.199787119	12.52	30062.54	347043	139	3.77	0.023325919	34.04	3.46	6.21295	45.32	4.9
Allahabad Bank	2005	0.979	2.218275368	12.53	32422.09	451449.299	140	4.25	0.012798556	27.93	3.42	5.376373782	44.10	4.9
Allahabad Bank	2006	1	2.240712639	13.37	35432.44	552919.9	141	5.79	0.00844284	23.67	3.14	4.814545693	45.31	2.6
Allahabad Bank	2007	1	2.207792577	12.52	38714.89	676637.413	142	6.39	0.010660926	18.49	2.85	6.011993819	41.35	5.7
Allahabad Bank	2008	1	2.15707969	11.99	42509.47	829393	143	8.32	0.008041156	20.10	2.22	7.58247707	43.51	3.8
Allahabad Bank	2009	1	2.091250863	13.11	44163.51	976480.078	144	10.83	0.007178526	13.88	2.39	5.238590238	48.41	4.8
Allahabad Bank	2010	1	1.392916279	13.62	47908.46	1216992.13	145	12.11	0.006565894	19.14	2.42	5.902896648	45.73	-2
Allahabad Bank	2011	0.976	1.463765993	12.96	52823.841	1512863.609	146	8.87	0.00786511	18.65	2.95	5.222498886	46.67	1.3
Allahabad Bank	2012	1	1.546457015	12.83	87363.28711	1829345.678	147	9.3	0.009822295	19.64	3.09	4.762601699	53.44	2.5
Allahabad Bank	2013	0.977	1.506424221	11.03	92130.16662	2043731.889	148	10.92	0.03186942	10.84	2.51	3.820570351	58.60	3.9
Allahabad Bank	2014	1	2.236481189	9.96	98013.69876	2204342.831	149	6.37	0.041460417	10.12	2.50	4.007745766	61.03	6.7
Allahabad Bank	2015	1	2.050321904	10.45	105276.7363	2270965	150	5.88	0.03989202	5.08	2.76	4.253797102	64.15	7.6
Allahabad Bank	2016	0.959	1.988024671	11.02	113861.4489	2398253.646	151	4.97	0.067548543	-5.57	2.53	3.94918132	67.20	6.2
Allahabad Bank	2017	1	1.816370183	11.45	121960.0563	2370378.832	152	2.49	0.089109582	-2.21	2.22	3.622120601	65.12	5.3
ANDHRA BANK	2002	0.973	1.482538631	12.59	26802.8	209372	79	4.31	0.024513056	24.66	2.78	6.085248	48.61	7.9
ANDHRA BANK	2003	0.926	1.553664335	13.62	27850.13	24678	80	3.81	1.792093831	40.31	3.3	5.24049	46.58	7.3
ANDHRA BANK	2004	0.871	1.456052483	13.71	30062.54	270090	81	3.77	0.011637735	36.1	3.52	7.568154	45.32	4.9

ANDHRA BANK	2005	1	1.499311858	12.11	32422.09	327286.84	82	4.25	0.002795595	31.62	3.58	6.33672869	44.10	4.9
ANDHRA BANK	2006	0.968	1.567234453	14	35432.44	406693.389	83	5.79	0.00237371	20.52	3.19	9.49293428	45.31	2.6
ANDHRA BANK	2007	1	1.53705504	11.33	38714.89	475409.977	84	6.39	0.001694212	17.78	3.21	6.203185014	41.35	5.7
ANDHRA BANK	2008	1	1.489024831	11.61	42509.47	565924	85	8.32	0.001568415	17.97	2.57	8.661355027	43.51	3.8
ANDHRA BANK	2009	0.97	1.461654881	13.22	44163.51	684692.076	86	10.83	0.001794774	18.94	3.21	7.08835242	48.41	4.8
ANDHRA BANK	2010	0.963	1.020342272	13.93	47908.46	903424.023	87	12.11	0.001705828	25.96	2.76	7.414788837	45.73	-2
ANDHRA BANK	2011	1	1.022807912	14.38	52823.841	1089007.195	88	8.87	0.003831156	23.24	3.23	6.597206315	46.67	1.3
ANDHRA BANK	2012	1	1.025698347	13.18	87363.28711	1245453.869	89	9.3	0.009082227	19.25	3.22	4.467357109	53.44	2.5
ANDHRA BANK	2013	1	1.043342227	11.76	92130.16662	1462989.442	90	10.92	0.024490182	16.19	2.77	4.116322485	58.60	3.9
ANDHRA BANK	2014	0.974	1.662278783	10.78	98013.69876	1673409.251	91	6.37	0.031051092	5.07	2.38	4.728107381	61.03	6.7
ANDHRA BANK	2015	1	1.643151436	10.63	105276.7363	1851703	92	5.88	0.029285364	6.79	2.57	4.059723447	64.15	7.6
ANDHRA BANK	2016	1	1.72702293	11.58	113861.4489	1999617.586	93	4.97	0.046148385	5.13	2.76	4.396347362	67.20	6.2
ANDHRA BANK	2017	1	1.758524153	12.38	121960.0563	2221261.31	94	2.49	0.075667427	1.56	2.62	4.178671881	65.12	5.3
BANK OF BARODA	2002	0.972	4.955305278	11.32	26802.8	709101	94	4.31	0.005685471	15.2	2.8	3.643288	48.61	7.9
BANK OF BARODA	2003	1	4.895645612	12.65	27850.13	764178	95	3.81	0.048101029	18.81	2.86	4.53357	46.58	7.3
BANK OF BARODA	2004	1	4.631294799	13.91	30062.54	851087	96	3.77	0.046319716	20.32	3.18	3.592087	45.32	4.9
BANK OF BARODA	2005	0.943	4.426173681	12.61	32422.09	946642.37	97	4.25	0.014277293	12.58	3.31	2.865202601	44.10	4.9
BANK OF BARODA	2006	0.903	4.32723632	13.65	35432.44	1133925.273	98	5.79	0.008646714	12.28	3.05	2.939729075	45.31	2.6
BANK OF BARODA	2007	0.976	4.631703544	11.80	38714.89	1431461.746	99	6.39	0.00599934	12.45	2.79	4.480399101	41.35	5.7
BANK OF BARODA	2008	0.974	4.579255665	12.94	42509.47	1795995	100	8.32	0.004625528	14.58	2.42	5.217009288	43.51	3.8
BANK OF BARODA	2009	1	4.735104408	14.05	44163.51	2266722.377	101	10.83	0.003134629	18.65	2.52	4.674742278	48.41	4.8
BANK OF BARODA	2010	0.985	3.168688641	14.36	47908.46	2783167.028	102	12.11	0.003441135	21.86	2.35	4.864950244	45.73	-2

BANK OF BARODA	2011	1	3.389957942	14.52	52823.841	3583971.754	103	8.87	0.003458512	23.50	2.76	5.543620269	46.67	1.3
BANK OF BARODA	2012	1	3.729401175	14.67	87363.28711	4473214.67	104	9.3	0.005371475	20.64	2.56	4.840245902	53.44	2.5
BANK OF BARODA	2013	1	3.993862244	13.30	92130.16662	5471354.403	105	10.92	0.012773345	15.07	2.28	2.458637837	58.60	3.9
BANK OF BARODA	2014	1	6.666856404	12.28	98013.69876	6595045.334	106	6.37	0.015200684	13.36	1.98	2.824710722	61.03	6.7
BANK OF BARODA	2015	1	6.546217172	12.61	105276.7363	7149885	107	5.88	0.01885108	8.96	1.92	3.145308679	64.15	7.6
BANK OF BARODA	2016	0.947	5.68768161	13.18	113861.4489	6713764.769	108	4.97	0.050567921	-13.48	1.84	3.228057006	67.20	6.2
BANK OF BARODA	2017	0.979	5.413700284	12.24	121960.0563	6948754.235	109	2.49	0.047174807	3.44	1.98	3.27831616	65.12	5.3
BANK OF INDIA	2002	1	4.787422459	10.68	26802.8	698058	67	4.31	0.0601397	18.4	2.84	5.200832	48.61	7.9
BANK OF INDIA	2003	0.837	4.754544227	12.02	27850.13	766268	68	3.81	0.053623467	26.65	2.78	4.37372	46.58	7.3
BANK OF INDIA	2004	1	4.506625402	13.01	30062.54	848600	69	3.77	0.075896535	26.71	2.73	4.986732	45.32	4.9
BANK OF INDIA	2005	1	4.289469002	11.52	32422.09	949781.835	70	4.25	0.027990476	8.03	2.49	4.111179276	44.10	4.9
BANK OF INDIA	2006	0.944	4.339712323	10.75	35432.44	1122742.744	71	5.79	0.014875622	14.85	2.54	4.977467735	45.31	2.6
BANK OF INDIA	2007	0.971	4.445041103	11.75	38714.89	1418169.913	72	6.39	0.009540286	20.65	2.71	5.074772047	41.35	5.7
BANK OF INDIA	2008	1	4.51834879	12.04	42509.47	1788300	73	8.32	0.005216771	24.38	2.64	6.565929515	43.51	3.8
BANK OF INDIA	2009	1	4.668938102	13.01	44163.51	2255017.671	74	10.83	0.004395863	24.97	2.72	3.953531609	48.41	4.8
BANK OF INDIA	2010	0.963	3.017650055	12.94	47908.46	2749664.585	75	12.11	0.013101316	12.56	2.30	5.674373418	45.73	-2
BANK OF INDIA	2011	0.954	3.317221161	12.17	52823.841	3511725.491	76	8.87	0.009127287	15.79	2.49	6.20277207	46.67	1.3
BANK OF INDIA	2012	0.997	3.083513493	11.95	87363.28711	3845354.714	77	9.3	0.015441902	14.00	2.26	3.897354039	53.44	2.5
BANK OF INDIA	2013	1	3.218122658	11.02	92130.16662	4526027.183	78	10.92	0.020847677	12.25	2.16	4.853491992	58.60	3.9
BANK OF INDIA	2014	1	5.589644714	9.97	98013.69876	5731901.989	79	6.37	0.020744279	10.14	2.11	3.327594135	61.03	6.7
BANK OF INDIA	2015	1	5.638284593	10.73	105276.7363	6186978	80	5.88	0.033623659	5.57	1.91	4.391486762	64.15	7.6
BANK OF INDIA	2016	0.884	5.082951014	12.01	113861.4489	6099139.267	81	4.97	0.077943376	-19.50	1.91	5.568263539	67.20	6.2

BANK OF INDIA	2017	0.947	4.859052801	12.14	121960.0563	6263092.666	82	2.49	0.069048556	-5.04	1.91	4.36647892	65.12	5.3
BANK OF MAHARASHTRA	2002	0.972	1.533835937	11.16	26802.8	214704	66	4.31	0.058110744	22.8	2.9	7.62696	48.61	7.9
BANK OF MAHARASHTRA	2003	0.786	1.635840696	12.05	27850.13	249232	67	3.81	0.048289353	26.46	2.92	7.723464	46.58	7.3
BANK OF MAHARASHTRA	2004	0.999	1.678543116	11.88	30062.54	322130	68	3.77	0.020672739	25.21	2.70	14.08836	45.32	4.9
BANK OF MAHARASHTRA	2005	0.923	1.569702284	12.68	32422.09	328848.389	69	4.25	0.021493468	11.9	2.71	6.475077369	44.10	4.9
BANK OF MAHARASHTRA	2006	1	1.243080889	11.27	35432.44	312145.137	70	5.79	0.020340958	3.26	3.03	6.00146627	45.31	2.6
BANK OF MAHARASHTRA	2007	1	1.257679932	12.06	38714.89	390094.727	71	6.39	0.012102419	16.41	3.12	5.819621558	41.35	5.7
BANK OF MAHARASHTRA	2008	1	1.257757605	10.85	42509.47	481509	72	8.32	0.008674507	18.64	2.59	8.08683198	43.51	3.8
BANK OF MAHARASHTRA	2009	1	1.286052081	12.05	44163.51	590303.536	73	10.83	0.007929247	17.46	2.34	6.575293757	48.41	4.8
BANK OF MAHARASHTRA	2010	0.866	0.831423713	12.78	47908.46	710557.893	74	12.11	0.016431477	16.35	1.99	7.480591451	45.73	-2
BANK OF MAHARASHTRA	2011	0.997	0.741884577	13.35	52823.841	764422.177	75	8.87	0.013202643	9.68	2.67	5.031255677	46.67	1.3
BANK OF MAHARASHTRA	2012	1	0.741562658	12.43	87363.28711	911373.861	76	9.3	0.008376239	9.91	3.00	4.976527833	53.44	2.5
BANK OF MAHARASHTRA	2013	1	0.795066381	12.59	92130.16662	1169528.056	78	10.92	0.005206386	13.66	2.92	4.502064184	58.60	3.9
BANK OF MAHARASHTRA	2014	1	1.368811924	10.79	98013.69876	1363200.52	79	6.37	0.020325145	5.61	2.77	4.395089008	61.03	6.7
BANK OF MAHARASHTRA	2015	1	1.294477841	11.94	105276.7363	1460188	80	5.88	0.041852005	5.84	2.74	4.556091165	64.15	7.6
BANK OF MAHARASHTRA	2016	0.993	1.377138807	11.2	113861.4489	1609573.244	81	4.97	0.063516738	1.19	2.53	5.207769594	67.20	6.2

BANK OF MAHARASHTRA	2017	0.94	1.251157472	11.18	121960.0563	1593239.812	82	2.49	0.080094086	-16.98	1.98	9.587206604	65.12	5.3
CANARA BANK	2002	1	5.133739404	11.88	26802.8	722114	96	4.31	0.038892796	23.59	2.63	10.888676	48.61	7.9
CANARA BANK	2003	1	5.318212096	12.5	27850.13		97	3.81	0.035923462	26.74	2.89	6.835508	46.58	7.3
CANARA BANK	2004	1	5.480363079	12.66	30062.54	995394	98	3.77	0.038507809	28.47	2.95	6.921852	45.32	4.9
CANARA BANK	2005	1	5.267641689	12.78	32422.09	1103051.733	99	4.25	0.018623864	19.53	3.01	4.518720895	44.10	4.9
CANARA BANK	2006	1	5.396374545	11.22	35432.44	1328218.587	100	5.79	0.011069213	20.29	2.95	5.958353569	45.31	2.6
CANARA BANK	2007	1	5.279297966	13.50	38714.89	1659610.427	101	6.39	0.00941032	16.25	2.70	5.480317398	41.35	5.7
CANARA BANK	2008	1	4.640648946	13.25	42509.47	1805287	102	8.32	0.008383499	15.01	2.04	7.403137484	43.51	3.8
CANARA BANK	2009	0.984	4.599633868	14.10	44163.51	2196458.034	103	10.83	0.010904764	18.25	2.36	4.569535495	48.41	4.8
CANARA BANK	2010	1	3.081867817	13.43	47908.46	2647410.828	104	12.11	0.010628068	22.48	2.35	5.937674739	45.73	-2
CANARA BANK	2011	1	3.256742931	15.38	52823.841	3359448.567	105	8.87	0.011028205	23.20	2.56	6.553097369	46.67	1.3
CANARA BANK	2012	1	3.169150751	13.76	87363.28711	3741601.927	106	9.3	0.014565412	15.36	2.17	4.756020968	53.44	2.5
CANARA BANK	2013	1	2.999134377	12.40	92130.16662	4123426.086	107	10.92	0.0217943	12.08	2.00	3.736196751	58.60	3.9
CANARA BANK	2014	1	4.930438182	10.63	98013.69876	4919218.543	108	6.37	0.019814362	8.95	1.98	4.503516644	61.03	6.7
CANARA BANK	2015	1	5.022771251	10.56	105276.7363	5480006	109	5.88	0.026482271	8.79	1.86	4.009476909	64.15	7.6
CANARA BANK	2016	1	4.753870392	11.08	113861.4489	5529607.783	110	4.97	0.064157558	-8.86	1.77	3.73698313	67.20	6.2
CANARA BANK	2017	1	4.456344287	12.86	121960.0563	5835194.435	111	2.49	0.06329949	3.44	1.74	3.414195966	65.12	5.3
CENTRAL BANK OF INDIA	2002	1	3.779339806	9.58	26802.8	526137	91	4.31	0.079812096	7.2	3.07	5.805432	48.61	7.9
CENTRAL BANK OF INDIA	2003	1	3.774292372	10.51	27850.13	571052	92	3.81	0.067446198	13.82	3.46	6.46016	46.58	7.3
CENTRAL BANK OF INDIA	2004	1	3.54856502	12.43	30062.54	633453	93	3.77	0.040471134	22.9	3.52	5.410338	45.32	4.9
CENTRAL BANK OF INDIA	2005	1	3.306110967	12.15	32422.09	685958.944	94	4.25	0.029841642	11.46	3.60	8.122650982	44.10	4.9
CENTRAL BANK OF INDIA	2006	1	3.071535476	11.03	35432.44	746810.417	95	5.79	0.025931423	7.68	3.32	4.529745572	45.31	2.6

CENTRAL BANK OF INDIA	2007	0.954	3.069224428	10.40	38714.89	930080.841	96	6.39	0.016951291	13.77	2.95	5.885153184	41.35	5.7
CENTRAL BANK OF INDIA	2008	1	3.322819453	9.39	42509.47	1239558	97	8.32	0.014521059	11.31	1.95	9.30750105	43.51	3.8
CENTRAL BANK OF INDIA	2009	1	3.230747184	13.12	44163.51	1476552.237	98	10.83	0.012435193	9.25	1.64	7.474781385	48.41	4.8
CENTRAL BANK OF INDIA	2010	1	2.129088934	12.23	47908.46	1826716.238	99	12.11	0.006898614	15.01	1.54	9.312847047	45.73	-2
CENTRAL BANK OF INDIA	2011	1	1.990604963	11.64	52823.841	2097573.269	100	8.87	0.006529176	13.49	2.71	6.713468562	46.67	1.3
CENTRAL BANK OF INDIA	2012	0.971	1.900919618	12.40	87363.28711	2297997.392	101	9.3	0.031183724	4.57	2.35	5.70678503	53.44	2.5
CENTRAL BANK OF INDIA	2013	0.98	1.905038265	11.49	92130.16662	2681295.49	102	10.92	0.029010821	7.31	2.30	5.057319273	58.60	3.9
CENTRAL BANK OF INDIA	2014	1	2.813361332	9.87	98013.69876	2894962.244	103	6.37	0.037503841	-8.12	2.33	4.11978766	61.03	6.7
CENTRAL BANK OF INDIA	2015	1	2.709103069	10.9	105276.7363	3119405	104	5.88	0.036115711	3.65	2.41	4.52485311	64.15	7.6
CENTRAL BANK OF INDIA	2016	0.995	2.637405963	10.4	113861.4489	3054660.996	105	4.97	0.073562748	-8.07	2.29	4.605914541	67.20	6.2
CENTRAL BANK OF INDIA	2017	0.887	2.669362135	10.94	121960.0563	3334019.442	106	2.49	0.101995161	-13.96	2.06	22.52139089	65.12	5.3
CORPORATION BANK	2002	1	1.517295402	17.9	26802.8	236042	96	4.31	0.023065511	18.16	2.89	5.660002	48.61	7.9
CORPORATION BANK	2003	0.873	1.602557057	18.5	27850.13	262720	97	3.81	0.016492369	18.84	3.18	4.886979	46.58	7.3
CORPORATION BANK	2004	1	1.471945578	20.12	30062.54	291537	98	3.77	0.023386991	19.62	3.48	5.815105	45.32	4.9
CORPORATION BANK	2005	1	1.482030653	16.23	32422.09	339238.477	99	4.25	0.011154199	13.81	3.58	5.662354838	44.10	4.9
CORPORATION BANK	2006	1	1.518913977	13.92	35432.44	405066.311	100	5.79	0.006417964	13.82	3.30	4.048209133	45.31	2.6
CORPORATION BANK	2007	1	1.570532255	12.76	38714.89	527206.436	101	6.39	0.004738954	15.02	2.81	5.659387182	41.35	5.7
CORPORATION BANK	2008	1	1.669379132	12.09	42509.47	665977	102	8.32	0.003239202	18.39	2.42	10.6663353	43.51	3.8
CORPORATION BANK	2009	1	1.820826889	13.61	44163.51	869058.102	103	10.83	0.002850832	19.57	2.20	6.43294689	48.41	4.8
CORPORATION BANK	2010	1	1.217946477	15.37	47908.46	1116672.986	104	12.11	0.003120918	21.93	1.92	7.911925901	45.73	-2

CORPORATION BANK	2011	1	1.295736571	14.11	52823.841	1435085.931	105	8.87	0.004579599	21.89	2.30	5.673748113	46.67	1.3
CORPORATION BANK	2012	1	1.31921798	13.00	87363.28711	1635604.209	106	9.3	0.008653215	19.54	2.05	5.678779046	53.44	2.5
CORPORATION BANK	2013	1	1.399084681	12.33	92130.16662	1934423.335	107	10.92	0.011884433	16.08	1.92	4.573892868	58.60	3.9
CORPORATION BANK	2014	1	2.266366891	11.65	98013.69876	2220484.706	108	6.37	0.023201152	5.72	1.82	6.187931659	61.03	6.7
CORPORATION BANK	2015	1	2.113093514	11.09	105276.7363	2259930	109	5.88	0.030778948	5.68	1.81	4.490817013	64.15	7.6
CORPORATION BANK	2016	1	2.032873597	10.56	113861.4489	2348636.156	110	4.97	0.065279317	-4.64	1.84	4.294924088	67.20	6.2
CORPORATION BANK	2017	1	1.984532065	11.32	121960.0563	2478910.547	111	2.49	0.083303271	4.66	1.84	7.058195352	65.12	5.3
DENA BANK	2002	0.956	1.231095243	7.64	26802.8	188421	64	4.31	0.163133059	1.29	2.41	5.435383	48.61	7.9
DENA BANK	2003	0.963	1.21651258	6.02	27850.13		65	3.81	0.11822277	11.56	2.91	5.529004	46.58	7.3
DENA BANK	2004	1	1.16463888	9.48	30062.54	221602	66	3.77	0.090829259	19.89	2.80	5.56416	45.32	4.9
DENA BANK	2005	0.948	1.137192087	11.91	32422.09	240285.872	67	4.25	0.052261171	5.65	2.97	6.20113012	44.10	4.9
DENA BANK	2006	1	1.091398514	10.62	35432.44	265453.333	68	5.79	0.030415487	5.98	2.86	6.353092981	45.31	2.6
DENA BANK	2007	1	1.026701614	11.52	38714.89	314506.475	69	6.39	0.019930734	14.22	2.95	6.223495743	41.35	5.7
DENA BANK	2008	1	1.022365874	11.09	42509.47	386417	70	8.32	0.009356765	21.82	2.45	9.142997263	43.51	3.8
DENA BANK	2009	0.929	1.059523817	12.07	44163.51	484605.066	71	10.83	0.010851876	21.29	2.44	10.28138124	48.41	4.8
DENA BANK	2010	1	0.67434604	12.77	47908.46	575865.764	72	12.11	0.012055853	21.43	2.07	7.562581501	45.73	-2
DENA BANK	2011	1	0.712638414	13.41	52823.841	708384.195	73	8.87	0.012245682	19.55	2.75	6.665043682	46.67	1.3
DENA BANK	2012	1	0.747746295	11.51	87363.28711	873879.166	74	9.3	0.010084749	19.75	2.66	5.944707425	53.44	2.5
DENA BANK	2013	1	0.819256426	11.03	92130.16662	1134404.24	75	10.92	0.013942886	15.83	2.37	7.620293165	58.60	3.9
DENA BANK	2014	1	1.289411198	11.14	98013.69876	1248634.886	76	6.37	0.023453662	8.55	2.10	5.000621362	61.03	6.7
DENA BANK	2015	1	1.228938626	10.93	105276.7363	1299205	77	5.88	0.038187448	3.64	1.92	6.992775709	64.15	7.6
DENA BANK	2016	0.951	1.163529352	11	113861.4489	1334416.391	78	4.97	0.063531833	-12.83	1.88	4.008296613	67.20	6.2

DENA BANK	2017	0.969	1.025224274	11.39	121960.0563	1296235.388	79	2.49	0.106581618	-11.65	1.83	4.640498973	65.12	5.3
IDBI BANK LIMITED	2002	**	#VALUE!	**	**	**	0	4.31	**		**	#VALUE!	48.61	7.9
IDBI BANK LIMITED	2003	**	#VALUE!	**	**	**	0	3.81	**		**	#VALUE!	46.58	7.3
IDBI BANK LIMITED	2004	**	#VALUE!	**	**	**	0	3.77	**		**	#VALUE!	45.32	4.9
IDBI BANK LIMITED	2005	1	0.821886799	15.51	32422.09	813602.493	1	4.25	0.018661603	5.18	0.23	2.920216547	44.10	4.9
IDBI BANK LIMITED	2006	1	1.201256858	14.80	35432.44	885647.81	2	5.79	0.010677474	9.12	0.45	3.026140741	45.31	2.6
IDBI BANK LIMITED	2007	1	1.607505047	13.73	38714.89	1038393.238	3	6.39	0.011556275	8.59	0.68	5.206573691	41.35	5.7
IDBI BANK LIMITED	2008	1	2.198693416	11.95	42509.47	1306944	4	8.32	0.013172054	8.52	0.58	5.12251125	43.51	3.8
IDBI BANK LIMITED	2009	1	2.766314778	11.57	44163.51	1724023.21	5	10.83	0.009173617	9.41	0.82	4.983401939	48.41	4.8
IDBI BANK LIMITED	2010	1	2.202107788	11.31	47908.46	2335727.502	6	12.11	0.01017584	10.53	1.11	5.952522513	45.73	-2
IDBI BANK LIMITED	2011	1	2.003143891	13.64	52823.841	2533767.928	7	8.87	0.010680653	13.35	1.75	7.719351908	46.67	1.3
IDBI BANK LIMITED	2012	1	2.039672999	14.58	87363.28711	2903163.344	8	9.3	0.016120579	11.95	1.67	5.197851405	53.44	2.5
IDBI BANK LIMITED	2013	1	1.914124935	13.13	92130.16662	3227685.106	9	10.92	0.01579347	9.26	1.75	3.266722177	58.60	3.9
IDBI BANK LIMITED	2014	1	2.763024181	11.68	98013.69876	3289883.556	10	6.37	0.024798417	5.00	1.85	3.863696939	61.03	6.7
IDBI BANK LIMITED	2015	1	2.754297602	11.76	105276.7363	3561440	11	5.88	0.028758087	3.64	1.68	3.693120437	64.15	7.6
IDBI BANK LIMITED	2016	1	2.632805031	11.67	113861.4489	3753898.307	12	4.97	0.067826931	-14.08	1.66	3.682280677	67.20	6.2
IDBI BANK LIMITED	2017	0.987	2.416228609	10.7	121960.0563	3617679.015	13	2.49	0.132087921	-20.52	1.56	3.688272616	65.12	5.3
INDIAN BANK	2002	0.926	1.927361155	1.7	26802.8	302629	95	4.31	0.082833413	0.94	1.87	4.241562	48.61	7.9
INDIAN BANK	2003	0.777	1.992880016	10.85	27850.13	353752	96	3.81	0.061503055	4.05	2.5	5.384085	46.58	7.3
INDIAN BANK	2004	0.802	1.932331214	12.82	30062.54	391541	97	3.77	0.022951929	7.61	3	7.262784	45.32	4.9
INDIAN BANK	2005	0.993	1.894277854	14.14	32422.09	438607.044	98	4.25	0.013461296	7.12	3.14	4.473351757	44.10	4.9

INDIAN BANK	2006	1	1.885238035	13.19	35432.44	476352.707	99	5.79	0.007856919	11.97	3.30	4.834623257	45.31	2.6
INDIAN BANK	2007	1	1.746062584	14.14	38714.89	561486.464	100	6.39	0.003514681	24	3.43	6.64210223	41.35	5.7
INDIAN BANK	2008	1	1.838699015	12.74	42509.47	705077	101	8.32	0.002449627	22.41	3.24	9.123749034	43.51	3.8
INDIAN BANK	2009	1	1.786320131	13.98	44163.51	840538.313	102	10.83	0.00182522	20.26	3.38	7.38999609	48.41	4.8
INDIAN BANK	2010	1	1.158765428	12.71	47908.46	1013893.147	103	12.11	0.002332084	20.18	3.41	6.963965191	45.73	-2
INDIAN BANK	2011	1	1.174280834	13.56	52823.841	1217183.058	104	8.87	0.005276286	19.27	3.62	5.65070175	46.67	1.3
INDIAN BANK	2012	1	1.170588867	13.47	87363.28711	1414191.998	105	9.3	0.013250468	17.19	3.36	4.468185538	53.44	2.5
INDIAN BANK	2013	1	1.196600799	13.08	92130.16662	1628226.048	106	10.92	0.022569505	13.89	2.98	4.338613754	58.60	3.9
INDIAN BANK	2014	1	1.901693777	12.64	98013.69876	1872262.208	107	6.37	0.022614131	8.97	2.49	4.143479908	61.03	6.7
INDIAN BANK	2015	1	1.793811508	12.86	105276.7363	1928360	108	5.88	0.025002871	6.94	2.35	4.304730971	64.15	7.6
INDIAN BANK	2016	1	1.766491651	13.2	113861.4489	2037103.82	109	4.97	0.041994876	4.54	2.24	4.503673897	67.20	6.2
INDIAN BANK	2017	1	1.642166071	13.64	121960.0563	2182331.47	110	2.49	0.043904476	8.41	2.44	2.560885171	65.12	5.3
INDIAN OVERSEAS BANK	2002	1	2.550313132	10.82	26802.8	354411	65	4.31	0.063150709	22.29	2.95	6.2466	48.61	7.9
INDIAN OVERSEAS BANK	2003	0.851	2.707143073	11.3	27850.13	411547	66	3.81	0.052284633	32.1	3.19	6.527244	46.58	7.3
INDIAN OVERSEAS BANK	2004	0.86	2.632934885	12.49	30062.54	473220	67	3.77	0.028630352	28.96	3.62	9.151704	45.32	4.9
INDIAN OVERSEAS BANK	2005	1	2.407611769	14.20	32422.09	508150.422	68	4.25	0.012664059	27.98	3.78	8.216929747	44.10	4.9
INDIAN OVERSEAS BANK	2006	1	2.334482572	13.04	35432.44	593578.117	69	5.79	0.006454388	27.23	3.75	5.185430965	45.31	2.6
INDIAN OVERSEAS BANK	2007	1	2.548794999	13.27	38714.89	822568.284	70	6.39	0.005478717	28.14	3.62	5.696922364	41.35	5.7
INDIAN OVERSEAS BANK	2008	1	2.539879764	11.93	42509.47	1018377	71	8.32	0.006013064	27.15	2.66	8.959581354	43.51	3.8

INDIAN OVERSEAS BANK	2009	0.996	2.463964143	13.20	44163.51	1210733.987	72	10.83	0.013342276	22.07	2.57	4.906481916	48.41	4.8
INDIAN OVERSEAS BANK	2010	0.928	1.455156847	14.78	47908.46	1310916.294	73	12.11	0.025253054	9.63	2.51	5.848158817	45.73	-2
INDIAN OVERSEAS BANK	2011	0.978	1.611839292	14.55	52823.841	1787842.785	74	8.87	0.011878607	12.73	2.72	5.599426194	46.67	1.3
INDIAN OVERSEAS BANK	2012	0.961	1.729027243	13.32	87363.28711	2196371.26	75	9.3	0.013554433	9.88	2.52	4.6435283	53.44	2.5
INDIAN OVERSEAS BANK	2013	0.98	1.703585399	11.85	92130.16662	2446560.347	76	10.92	0.025112912	4.47	2.26	4.021083874	58.60	3.9
INDIAN OVERSEAS BANK	2014	0.973	2.671644972	10.78	98013.69876	2748986.666	77	6.37	0.032170052	4.06	2.15	4.268880809	61.03	6.7
INDIAN OVERSEAS BANK	2015	1	2.608150802	10.11	105276.7363	2856370	78	5.88	0.05713529	-2.86	1.92	4.424418594	64.15	7.6
INDIAN OVERSEAS BANK	2016	0.98	2.224531819	9.67	113861.4489	2744367.636	79	4.97	0.119436157	-18.51	1.92	5.113561396	67.20	6.2
INDIAN OVERSEAS BANK	2017	0.99	1.901600215	10.49	121960.0563	2471674.874	80	2.49	0.140605968	-23.23	1.99	4.652701462	65.12	5.3
ORIENTAL BANK OF COMMERCE	2002	1	2.284117158	10.99	26802.8	322629	59	4.31	0.032052776	20.23	3.28	7.28475	48.61	7.9
ORIENTAL BANK OF COMMERCE	2003	0.822	2.198925806	14.04	27850.13	339876	60	3.81	0.014369913	24.51	3.64	5.578356	46.58	7.3
ORIENTAL BANK OF COMMERCE	2004	1	2.26422651	14.47	30062.54	410065	61	3.77	0	28.67	3.88	6.419862	45.32	4.9
ORIENTAL BANK OF COMMERCE	2005	1	2.604018602	9.21	32422.09	540694.525	62	4.25	0.012930846	25.34	3.21	11.93111779	44.10	4.9
ORIENTAL BANK OF COMMERCE	2006	1	2.319150704	11.04	35432.44	589373.726	63	5.79	0.004853883	13.11	2.84	7.23347759	45.31	2.6
ORIENTAL BANK OF COMMERCE	2007	1	2.372877726	12.51	38714.89	739362.743	64	6.39	0.004885988	10.78	2.55	7.21714398	41.35	5.7

ORIENTAL BANK OF COMMERCE	2008	1	2.345037397	12.12	42509.47	907053	65	8.32	0.00986698	6.21	2.03	8.072573587	43.51	3.8
ORIENTAL BANK OF COMMERCE	2009	1	2.4209675	12.98	44163.51	1125825.934	66	10.83	0.006458798	13.74	1.96	6.11097457	48.41	4.8
ORIENTAL BANK OF COMMERCE	2010	1	1.579440483	12.54	47908.46	1374309.933	67	12.11	0.008669614	14.51	2.33	5.884254945	45.73	-2
ORIENTAL BANK OF COMMERCE	2011	1	1.543310904	14.23	52823.841	1613433.732	68	8.87	0.009781748	15.55	2.80	5.897443206	46.67	1.3
ORIENTAL BANK OF COMMERCE	2012	1	1.511300164	12.69	87363.28711	1775345.827	69	9.3	0.021959999	9.91	2.49	4.766227555	53.44	2.5
ORIENTAL BANK OF COMMERCE	2013	1	1.48245449	12.04	92130.16662	2006972.027	70	10.92	0.022509081	10.74	2.49	4.071773326	58.60	3.9
ORIENTAL BANK OF COMMERCE	2014	1	2.267491368	11.01	98013.69876	2203025.038	71	6.37	0.028073227	8.70	2.44	4.530658054	61.03	6.7
ORIENTAL BANK OF COMMERCE	2015	1	2.162531259	11.41	105276.7363	2305136	72	5.88	0.033155699	3.65	2.26	4.419862397	64.15	7.6
ORIENTAL BANK OF COMMERCE	2016	0.995	2.069969629	11.76	113861.4489	2397680.025	73	4.97	0.066712458	1.09	2.29	3.934170574	67.20	6.2
ORIENTAL BANK OF COMMERCE	2017	1	1.973552763	11.64	121960.0563	2530647.25	74	2.49	0.089519928	-7.53	1.99	4.272856559	65.12	5.3
PUNJAB AND SIND BANK	2002	0.863	1.000818608	10.7	26802.8	137536	94	4.31	0.116779643	5.27	2.33	6.26244	48.61	7.9
PUNJAB AND SIND BANK	2003	1	0.975464381	10.43	27850.13	144909	95	3.81	0.108530066	0.98	2.74	6.2415	46.58	7.3
PUNJAB AND SIND BANK	2004	1	0.865869008	11.06	30062.54	150114	96	3.77	0.085191689	1.92	3.34	7.106816	45.32	4.9
PUNJAB AND SIND BANK	2005	1	0.771168345	9.46	32422.09	157175.159	97	4.25	0.080637841	-15.67	3.73	6.026540508	44.10	4.9
PUNJAB AND SIND BANK	2006	1	0.781925076	12.83	35432.44	190430.379	98	5.79	0.02420211	13.03	3.63	4.37782919	45.31	2.6
PUNJAB AND SIND BANK	2007	1	0.716311485	12.88	38714.89	219630.333	99	6.39	0.006563572	16.63	3.74	4.891853773	41.35	5.7
PUNJAB AND SIND BANK	2008	1	0.747920021	11.57	42509.47	309492	100	8.32	0.003650924	21.86	2.97	6.317096204	43.51	3.8

PUNJAB AND SIND BANK	2009	1	0.853406688	14.35	44163.51	413637.869	101	10.83	0.003169973	20.65	2.80	4.731352479	48.41	4.8
PUNJAB AND SIND BANK	2010	0.916	0.645593627	13.10	47908.46	566648.788	102	12.11	0.003573321	21.40	2.42	6.68538009	45.73	-2
PUNJAB AND SIND BANK	2011	1	0.662845268	12.94	52823.841	685501.412	103	8.87	0.005580488	16.39	2.49	6.680949415	46.67	1.3
PUNJAB AND SIND BANK	2012	1	0.611671379	13.26	87363.28711	729052.651	104	9.3	0.011864427	11.21	2.12	4.992990257	53.44	2.5
PUNJAB AND SIND BANK	2013	1	0.595362629	12.91	92130.16662	804779.033	105	10.92	0.021589793	7.66	2.14	4.03703358	58.60	3.9
PUNJAB AND SIND BANK	2014	1	0.992950279	11.04	98013.69876	945091.547	106	6.37	0.033519065	6.25	1.85	5.115367448	61.03	6.7
PUNJAB AND SIND BANK	2015	1	0.919188097	11.24	105276.7363	977534	107	5.88	0.035478217	2.29	1.75	3.842430795	64.15	7.6
PUNJAB AND SIND BANK	2016	1	0.904122823	10.91	113861.4489	1025814.186	108	4.97	0.046145982	5.81	2.17	3.726365898	67.20	6.2
PUNJAB AND SIND BANK	2017	1	0.769665787	11.05	121960.0563	966434.371	109	2.49	0.074999828	3.32	2.17	4.516268596	65.12	5.3
PUNJAB NATIONAL BANK	2002	0.946	5.141235962	10.7	26802.8	729147	108	4.31	0.052663416	18.59	3.37	7.000024	48.61	7.9
PUNJAB NATIONAL BANK	2003	1	5.59252918	12.02	27850.13	862218	109	3.81	0.037956304	23.14	3.93	7.614738	46.58	7.3
PUNJAB NATIONAL BANK	2004	0.9	5.580126523	13.1	30062.54	1023317	110	3.77	0.010657678	24.52	3.84	6.589297	45.32	4.9
PUNJAB NATIONAL BANK	2005	1	5.614350298	14.78	32422.09	1262412.809	111	4.25	0.001977066	21.41	3.51	7.493743039	44.10	4.9
PUNJAB NATIONAL BANK	2006	1	5.529509997	11.95	35432.44	1452673.864	112	5.79	0.002816259	16.41	3.44	16.10447814	45.31	2.6
PUNJAB NATIONAL BANK	2007	1	5.185793987	12.29	38714.89	1624224.965	113	6.39	0.007511865	15.55	3.39	7.617189823	41.35	5.7
PUNJAB NATIONAL BANK	2008	1	5.013678239	13.46	42509.47	1990204	114	8.32	0.0063077	18.01	3.06	7.666628578	43.51	3.8
PUNJAB NATIONAL BANK	2009	0.993	5.162440692	14.03	44163.51	2469186.173	115	10.83	0.001705526	22.92	3.06	6.90845204	48.41	4.8

PUNJAB NATIONAL BANK	2010	1	3.274650627	14.16	47908.46	2966327.772	116	12.11	0.005260898	24.12	3.12	6.178540299	45.73	-2
PUNJAB NATIONAL BANK	2011	1	3.472745293	12.42	52823.841	3783252.402	117	8.87	0.008420379	22.60	3.50	6.284776457	46.67	1.3
PUNJAB NATIONAL BANK	2012	1	3.678212521	12.63	87363.28711	4581923.472	118	9.3	0.015162058	19.80	3.21	4.036055578	53.44	2.5
PUNJAB NATIONAL BANK	2013	1	3.300046297	12.72	92130.16662	4789477.339	119	10.92	0.023434572	15.70	3.17	3.734488581	58.60	3.9
PUNJAB NATIONAL BANK	2014	1	5.289905036	11.52	98013.69876	5504199.153	120	6.37	0.028393549	9.75	3.14	4.041565429	61.03	6.7
PUNJAB NATIONAL BANK	2015	1	5.314683576	12.21	105276.7363	6033336	121	5.88	0.040460205	8.17	2.87	4.015181896	64.15	7.6
PUNJAB NATIONAL BANK	2016	0.973	5.479740768	11.28	113861.4489	6673904.554	122	4.97	0.085909152	-10.27	2.41	3.967552665	67.20	6.2
PUNJAB NATIONAL BANK	2017	1	5.593914061	11.66	121960.0563	7203305.484	123	2.49	0.077956219	3.30	2.16	3.499781559	65.12	5.3
SYNDICATE BANK	2002	1	2.288919766	12.12	26802.8	317562	77	4.31	#VALUE!	19.06	3.69	6.21209	48.61	7.9
SYNDICATE BANK	2003	1	2.261730971	11.03	27850.13	344354	78	3.81	0.043514072	23.02	3.66	4.790352	46.58	7.3
SYNDICATE BANK	2004	0.975	2.702892429	11.49	30062.54	472232	79	3.77	0.056212674	24.92	3.5	9.541044	45.32	4.9
SYNDICATE BANK	2005	0.969	2.519353821	10.70	32422.09	521094.246	80	4.25	0.015933509	19.64	3.41	5.162220552	44.10	4.9
SYNDICATE BANK	2006	0.998	2.477476983	11.73	35432.44	610767.552	81	5.79	0.008570394	21.32	3.32	5.1494797	45.31	2.6
SYNDICATE BANK	2007	0.964	2.915618769	11.74	38714.89	892773.604	82	6.39	0.007567383	22.18	2.86	7.363828594	41.35	5.7
SYNDICATE BANK	2008	0.99	2.866536971	11.82	42509.47	1071323	83	8.32	0.009722407	21.42	2.11	9.684205463	43.51	3.8
SYNDICATE BANK	2009	0.962	2.852063069	12.68	44163.51	1302556.653	84	10.83	0.007748711	19.63	2.15	9.629702231	48.41	4.8
SYNDICATE BANK	2010	0.999	1.536994725	12.70	47908.46	1390509.487	85	12.11	0.010654118	15.29	2.03	5.170136545	45.73	-2
SYNDICATE BANK	2011	1	1.504929908	13.04	52823.841	1565387.876	86	8.87	0.009653694	16.53	2.97	6.671264541	46.67	1.3

SYNDICATE BANK	2012	0.994	1.530448906	12.24	87363.28711	1824680.675	87	9.3	0.009589292	16.32	3.00	4.827489615	53.44	2.5
SYNDICATE BANK	2013	1	1.562169039	12.59	92130.16662	2151223.251	88	10.92	0.007621993	20.47	2.74	3.76312156	58.60	3.9
SYNDICATE BANK	2014	1	2.488444864	11.41	98013.69876	2518614.738	89	6.37	0.015643507	15.29	2.37	5.047215536	61.03	6.7
SYNDICATE BANK	2015	1	2.707149487	10.54	105276.7363	3031353	90	5.88	0.018960406	12.23	1.99	3.950229285	64.15	7.6
SYNDICATE BANK	2016	0.945	2.593325937	11.16	113861.4489	3079674.448	91	4.97	0.044768027	-12.94	1.96	4.331158252	67.20	6.2
SYNDICATE BANK	2017	1	2.344451764	12.03	121960.0563	2990733.357	92	2.49	0.052141102	2.71	2.07	4.383188448	65.12	5.3
UCO BANK	2002	0.897	2.152658793	9.64	26802.8	313814	59	4.31	0.058581536	6.11	2.49	4.252332	48.61	7.9
UCO BANK	2003	0.745	2.312106407	10.04	27850.13	349141	60	3.81	0.043781676	10.5	2.66	6.113337	46.58	7.3
UCO BANK	2004	0.978	2.490868135	11.88	30062.54	437978	61	3.77	0.042752179	29.14	3.04	5.34912	45.32	4.9
UCO BANK	2005	0.902	2.692174278	11.26	32422.09	545894.564	62	4.25	0.029315472	18.04	2.86	5.455060936	44.10	4.9
UCO BANK	2006	0.986	2.519950778	11.12	35432.44	618393.977	63	5.79	0.021000288	8.68	2.69	3.286167353	45.31	2.6
UCO BANK	2007	0.97	2.40491504	11.56	38714.89	748638.955	64	6.39	0.021410582	12.34	2.32	5.068226839	41.35	5.7
UCO BANK	2008	0.959	2.406850914	11.02	42509.47	897949	65	8.32	0.019830473	14.75	1.81	6.350822228	43.51	3.8
UCO BANK	2009	0.953	2.466564969	11.93	44163.51	1116641.678	66	10.83	0.0118114	16.20	1.63	5.900598685	48.41	4.8
UCO BANK	2010	1	1.607782762	13.21	47908.46	1373194.902	67	12.11	0.011711841	22.08	1.87	5.274363839	45.73	-2
UCO BANK	2011	0.984	1.612381467	13.71	52823.841	1633984.532	68	8.87	0.018416625	14.36	2.56	6.367273515	46.67	1.3
UCO BANK	2012	1	1.492293879	12.35	87363.28711	1804983.991	69	9.3	0.019594424	13.83	2.27	4.327755736	53.44	2.5
UCO BANK	2013	1	1.461667145	14.15	92130.16662	1986513.993	70	10.92	0.031721384	6.76	2.42	2.872046761	58.60	3.9
UCO BANK	2014	1	2.33832771	12.68	98013.69876	2391247.535	71	6.37	0.02377537	14.45	2.77	3.366114593	61.03	6.7
UCO BANK	2015	1	2.27199903	12.17	105276.7363	2459169	72	5.88	0.042962625	9.57	2.29	3.361916819	64.15	7.6
UCO BANK	2016	1	2.052168803	9.63	113861.4489	2448825.314	73	4.97	0.090890406	-22.33	1.98	3.246436508	67.20	6.2
UCO BANK	2017	1	1.811100182	10.93	121960.0563	2313397.065	74	2.49	0.089400199	-14.64	1.60	3.799715117	65.12	5.3

UNION BANK OF INDIA	2002	1	3.190559307	11.07	26802.8	443750	83	4.31	0.06258903	15.88	3.21	5.389768	48.61	7.9
UNION BANK OF INDIA	2003	0.896	3.300966863	12.41	27850.13	510605	84	3.81	0.049125606	23.65	3.14	4.399528	46.58	7.3
UNION BANK OF INDIA	2004	0.979	3.209015142	12.32	30062.54	583166	85	3.77	0.0376593	25.19	3.17	4.11825	45.32	4.9
UNION BANK OF INDIA	2005	1	3.364825684	12.09	32422.09	724132.483	86	4.25	0.026440042	21.46	3.16	5.036616376	44.10	4.9
UNION BANK OF INDIA	2006	1	3.423197933	11.41	35432.44	891260.392	87	5.79	0.015622906	16.52	2.94	4.922549124	45.31	2.6
UNION BANK OF INDIA	2007	1	3.158359122	12.80	38714.89	1026778.758	88	6.39	0.009637032	17.34	2.91	5.763240435	41.35	5.7
UNION BANK OF INDIA	2008	1	3.128214021	12.51	42509.47	1239919	89	8.32	0.001717723	22.13	2.52	7.625290709	43.51	3.8
UNION BANK OF INDIA	2009	1	3.413632013	13.27	44163.51	1609755.115	90	10.83	0.003376419	21.46	2.68	5.585972449	48.41	4.8
UNION BANK OF INDIA	2010	0.965	2.233269907	12.51	47908.46	1951618.43	91	12.11	0.00809058	21.65	2.35	6.38866892	45.73	-2
UNION BANK OF INDIA	2011	0.976	2.247041665	12.95	52823.841	2359844.47	92	8.87	0.011944412	17.96	2.88	7.462548175	46.67	1.3
UNION BANK OF INDIA	2012	1	2.159600176	11.85	87363.28711	2622114.375	93	9.3	0.017005816	13.05	2.73	4.436709812	53.44	2.5
UNION BANK OF INDIA	2013	0.999	2.222967774	11.45	92130.16662	3121337.676	94	10.92	0.016114055	13.52	2.63	3.448174704	58.60	3.9
UNION BANK OF INDIA	2014	0.985	3.48845196	10.80	98013.69876	3537809.023	95	6.37	0.02330924	9.48	2.37	5.206521098	61.03	6.7
UNION BANK OF INDIA	2015	1	3.358865364	10.22	105276.7363	3816159	96	5.88	0.027063745	9.32	2.30	3.947182441	64.15	7.6
UNION BANK OF INDIA	2016	1	3.395738135	10.56	113861.4489	4046959.024	97	4.97	0.052462054	6.34	2.11	3.85591275	67.20	6.2
UNION BANK OF INDIA	2017	1	3.404658646	11.79	121960.0563	4527044.402	98	2.49	0.065739257	2.37	2.08	3.649278852	65.12	5.3
UNITED BANK OF INDIA	2002	1	1.57232896	12.02	26802.8	227764	84	4.31	0.079439225	6.06	2.72	6.66414	48.61	7.9
UNITED BANK OF INDIA	2003	1	1.551414444	15.17	27850.13	242707	85	3.81	0.055233483	15.6	3.06	7.01403	46.58	7.3
UNITED BANK OF INDIA	2004	1	1.444481751	17.04	30062.54	258426	86	3.77	0.021453568	16.07	3.12	4.112402	45.32	4.9
UNITED BANK OF INDIA	2005	1	1.379461323	18.16	32422.09	290978.618	87	4.25	0.024328163	15.33	3.33	5.459098983	44.10	4.9

UNITED BANK OF INDIA	2006	1	1.351355718	13.12	35432.44	332477.226	88	5.79	0.01952609	10.81	3.27	4.313756856	45.31	2.6
UNITED BANK OF INDIA	2007	1	1.378086027	12.02	38714.89	423097.448	89	6.39	0.015029572	12.6	3.04	6.349378103	41.35	5.7
UNITED BANK OF INDIA	2008	1	1.414754282	11.24	42509.47	543109	90	8.32	0.010984235	12.57	1.87	9.665493822	43.51	3.8
UNITED BANK OF INDIA	2009	1	1.34218958	13.28	44163.51	620407.138	91	10.83	0.014833213	6.44	2.00	7.305315403	48.41	4.8
UNITED BANK OF INDIA	2010	1	0.895467494	12.80	47908.46	770049.896	92	12.11	0.018392376	9.24	2.00	6.112614361	45.73	-2
UNITED BANK OF INDIA	2011	0.974	0.863970164	13.05	52823.841	900405.256	93	8.87	0.014156551	11.74	2.60	6.600530497	46.67	1.3
UNITED BANK OF INDIA	2012	0.968	0.86353662	12.69	87363.28711	1020103.927	94	9.3	0.017060498	11.93	2.58	4.991441979	53.44	2.5
UNITED BANK OF INDIA	2013	1	0.848285574	11.66	92130.16662	1146151.131	95	10.92	0.028588278	6.84	2.30	3.356113361	58.60	3.9
UNITED BANK OF INDIA	2014	1	1.306778956	9.81	98013.69876	1251049.502	96	6.37	0.070918146	-21.73	2.14	5.011614027	61.03	6.7
UNITED BANK OF INDIA	2015	1	1.153481742	10.57	105276.7363	1230276	97	5.88	0.061132331	4.61	2.01	4.72707094	64.15	7.6
UNITED BANK OF INDIA	2016	1	1.153327039	10.08	113861.4489	1294317.504	98	4.97	0.089783897	-4.83	1.81	4.690075334	67.20	6.2
UNITED BANK OF INDIA	2017	1	1.142162898	11.14	121960.0563	1410531.124	99	2.49	0.099666167	3.33	1.43	4.703518403	65.12	5.3
VIJAYA BANK	2002	0.916	1.177039846	12.25	26802.8	161445	71	4.31	0.060232059	20.74	3.19	6.356007	48.61	7.9
VIJAYA BANK	2003	0.776	1.255498403	12.66	27850.13		72	3.81	0.02608062	26.67	3.65	5.691598	46.58	7.3
VIJAYA BANK	2004	0.988	1.333845754	14.11	30062.54	240710	73	3.77	0.009224878	38.32	3.88	3.64041	45.32	4.9
VIJAYA BANK	2005	1	1.394132753	12.92	32422.09	293354.959	74	4.25	0.005902014	26.02	3.70	4.370497396	44.10	4.9
VIJAYA BANK	2006	1	1.280184627	11.94	35432.44	315340.952	75	5.79	0.008540561	7.79	3.20	7.130819057	45.31	2.6
VIJAYA BANK	2007	1	1.394320356	11.21	38714.89	423574.925	76	6.39	0.005942976	18.58	2.90	8.026238477	41.35	5.7
VIJAYA BANK	2008	1	1.444310778	11.22	42509.47	561843	77	8.32	0.005730972	16.59	1.68	10.0767446	43.51	3.8
VIJAYA BANK	2009	0.946	1.342177865	13.15	44163.51	623821.599	78	10.83	0.008241027	9.36	1.90	9.185968815	48.41	4.8
VIJAYA BANK	2010	0.927	0.81339987	12.50	47908.46	702070.409	79	12.11	0.014017745	15.32	2.19	5.839267386	45.73	-2

VIJAYA BANK	2011	1	0.812955546	13.88	52823.841	820133.707	80	8.87	0.015213073	12.63	2.56	5.952491075	46.67	1.3
VIJAYA BANK	2012	1	0.804807929	13.06	87363.28711	957640.12	81	9.3	0.017235673	11.54	2.14	4.743466931	53.44	2.5
VIJAYA BANK	2013	0.99	0.817655842	11.32	92130.16662	1109817.502	82	10.92	0.013039204	10.83	1.82	3.530037759	58.60	3.9
VIJAYA BANK	2014	1	1.456622991	10.56	98013.69876	1373586.128	83	6.37	0.015488436	7.27	1.68	4.03338956	61.03	6.7
VIJAYA BANK	2015	1	1.339257157	11.43	105276.7363	1425922	84	5.88	0.019144051	7.29	1.64	4.582505056	64.15	7.6
VIJAYA BANK	2016	1	1.242891676	12.58	113861.4489	1454087.409	85	4.97	0.048061198	5.54	1.92	4.31084807	67.20	6.2
VIJAYA BANK	2017	1	1.196803317	12.73	121960.0563	1548815.759	86	2.49	0.04355588	9.51	2.34	3.72569892	65.12	5.3
STATE BANK OF BIKANER AND JAIPUR	2002	1	0.934945107	13.42	26802.8	155522	39	4.31	0.057678755	24.17	3.33	5.840942	48.61	7.9
STATE BANK OF BIKANER AND JAIPUR	2003	0.82	0.976202051	13.08	27850.13	180381	40	3.81	0.041603059	24.56	3.28	4.871104	46.58	7.3
STATE BANK OF BIKANER AND JAIPUR	2004	0.922	0.992829701	12.93	30062.54	202564	41	3.77	0.01271293	29.39	3.74	6.223932	45.32	4.9
STATE BANK OF BIKANER AND JAIPUR	2005	1	1.03607142	12.60	32422.09	234304.348	42	4.25	0.016113906	16.81	3.98	3.951297211	44.10	4.9
STATE BANK OF BIKANER AND JAIPUR	2006	1	1.002257013	12.08	35432.44	275140.226	43	5.79	0.01177418	10.73	3.90	5.931581003	45.31	2.6
STATE BANK OF BIKANER AND JAIPUR	2007	0.99	1.056015476	12.89	38714.89	345074.797	44	6.39	0.01085441	19.99	3.03	10.58727089	41.35	5.7
STATE BANK OF BIKANER AND JAIPUR	2008	1	1.027343294	12.51	42509.47	411540	45	8.32	0.008338271	18.71	2.48	9.496767389	43.51	3.8
STATE BANK OF BIKANER AND JAIPUR	2009	1	0.965356933	14.52	44163.51	463702.005	46	10.83	0.008473501	21.46	2.52	7.759652438	48.41	4.8
STATE BANK OF BIKANER AND JAIPUR	2010	1	0.604928169	13.30	47908.46	541435.16	47	12.11	0.00768072	20.39	2.41	6.828043002	45.73	-2

STATE BANK OF BIKANER AND JAIPUR	2011	1	0.597686704	11.68	52823.841	629544.917	48	8.87	0.008283372	20.91	3.02	8.540838097	46.67	1.3
STATE BANK OF BIKANER AND JAIPUR	2012	1	0.596633593	13.76	87363.28711	725281.333	49	9.3	0.019198354	18.59	3.28	5.979907584	53.44	2.5
STATE BANK OF BIKANER AND JAIPUR	2013	1	0.60779148	12.16	92130.16662	860168.252	50	10.92	0.022665521	16.36	3.24	7.156576783	58.60	3.9
STATE BANK OF BIKANER AND JAIPUR	2014	1	0.865735731	11.55	98013.69876	908769.736	51	6.37	0.027595329	14.46	3.19	7.423662311	61.03	6.7
STATE BANK OF BIKANER AND JAIPUR	2015	1	0.892948063	11.57	105276.7363	1023015	52	5.88	0.02543796	13.67	3.05	7.612005432	64.15	7.6
STATE BANK OF BIKANER AND JAIPUR	2016	1	0.931418748	10.44	113861.4489	1102880.804	53	4.97	0.027495677	13.34	3.11	8.808918303	67.20	6.2
STATE BANK OF BIKANER AND JAIPUR	2017	1	0.935840616	9.00	121960.0563	1162933.423	54	2.49	0.10534781	-20.90	2.54	7.392222401	65.12	5.3
STATE BANK OF HYDERABAD	2002	1	1.395297934	14.03	26802.8	221208	61	4.31	0.049565455	25.74	3.21	5.931718	48.61	7.9
STATE BANK OF HYDERABAD	2003	0.834	1.519517623	14.91	27850.13	261316	62	3.81	0.032640283	26.8	3.1	6.992221	46.58	7.3
STATE BANK OF HYDERABAD	2004	1	1.539662602	14.29	30062.54	306461	63	3.77	0.005142172	26.99	2.96	5.93625	45.32	4.9
STATE BANK OF HYDERABAD	2005	1	1.574346543	11.74	32422.09	349222.903	64	4.25	0.006110359	15.03	2.94	3.982315679	44.10	4.9
STATE BANK OF HYDERABAD	2006	1	1.571955328	12.08	35432.44	406304.027	65	5.79	0.003613571	22.01	2.90	5.605883039	45.31	2.6
STATE BANK OF HYDERABAD	2007	1	1.538859074	12.34	38714.89	490523.272	66	6.39	0.002180777	21.72	2.74	5.855318134	41.35	5.7
STATE BANK OF HYDERABAD	2008	1	1.509257914	11.97	42509.47	616197	67	8.32	0.001589177	21.28	2.01	9.001696675	43.51	3.8

STATE BANK OF HYDERABAD	2009	1	1.536937569	11.53	44163.51	767218.928	68	10.83	0.00379563	20.87	2.12	7.075316905	48.41	4.8
STATE BANK OF HYDERABAD	2010	1	0.95838372	14.90	47908.46	883860.163	69	12.11	0.005469586	22.02	2.26	5.777036109	45.73	-2
STATE BANK OF HYDERABAD	2011	1	0.983647349	14.25	52823.841	1066980.408	70	8.87	0.008694643	24.35	2.92	7.531789126	46.67	1.3
STATE BANK OF HYDERABAD	2012	1	0.956712264	13.56	87363.28711	1183154.466	71	9.3	0.013003504	21.98	2.99	4.849191843	53.44	2.5
STATE BANK OF HYDERABAD	2013	1	0.955090503	12.36	92130.16662	1360780.614	72	10.92	0.016121814	17.70	3.08	4.685522664	58.60	3.9
STATE BANK OF HYDERABAD	2014	1	1.400530672	12.00	98013.69876	1414890.538	73	6.37	0.031205137	12.74	2.86	4.691242105	61.03	6.7
STATE BANK OF HYDERABAD	2015	1	1.379779759	11.26	105276.7363	1545028	74	5.88	0.02235545	14.66	2.97	3.748593943	64.15	7.6
STATE BANK OF HYDERABAD	2016	1	1.35914797	11.62	113861.4489	1645967.81	75	4.97	0.033702321	10.65	2.88	3.959588128	67.20	6.2
STATE BANK OF HYDERABAD	2017	0.991	1.276765833	11.72	121960.0563	1631898.8	76	2.49	0.128425288	-28.62	2.32	4.490874557	65.12	5.3
STATE BANK OF INDIA	2002	0.959	21.69272289	13.35	26802.8	3482282	196	4.31	0.056373457	16.95	2.74	6.27816	48.61	7.9
STATE BANK OF INDIA	2003	1	21.84408474	13.5	27850.13	3758765	197	3.81	0.044882893	19.15	2.76	3.38754	46.58	7.3
STATE BANK OF INDIA	2004	0.814	20.22301109	13.53	30062.54	4078153	198	3.77	0.029307586	19.67	2.85	4.672174	45.32	4.9
STATE BANK OF INDIA	2005	1	19.97475597	12.45	32422.09	4598828.667	199	4.25	0.026430658	19.43	3.21	3.655350119	44.10	4.9
STATE BANK OF INDIA	2006	1	17.55834	11.88	35432.44	4940289.545	200	5.79	0.018760093	17.04	3.27	4.3828812	45.31	2.6
STATE BANK OF INDIA	2007	1	16.14849105	11.77	38714.89	5665652.388	201	6.39	0.01558598	15.41	2.84	5.132052324	41.35	5.7
STATE BANK OF INDIA	2008	1	16.18656341	13.54	42509.47	7215263	202	8.32	0.017814051	16.75	2.64	7.142444158	43.51	3.8
STATE BANK OF INDIA	2009	1	18.26325058	14.25	44163.51	9644320.807	203	10.83	0.017838457	17.05	2.48	5.759469347	48.41	4.8
STATE BANK OF INDIA	2010	1	10.56111093	13.39	47908.46	10534137.31	204	12.11	0.017201973	14.80	2.35	5.818308891	45.73	-2

STATE BANK OF INDIA	2011	1	10.36536906	11.98	52823.841	12237362.01	205	8.87	0.016316351	12.62	2.86	7.713713432	46.67	1.3
STATE BANK OF INDIA	2012	1	10.11294337	13.86	87363.28711	13355192.31	206	9.3	0.018233327	15.72	3.38	4.049057472	53.44	2.5
STATE BANK OF INDIA	2013	1	10.13662181	12.92	92130.16662	15662112.74	207	10.92	0.020998596	15.43	3.06	4.203162893	58.60	3.9
STATE BANK OF INDIA	2014	1	16.34103176	12.44	98013.69876	17927482.91	208	6.37	0.02570287	10.03	2.93	4.73885061	61.03	6.7
STATE BANK OF INDIA	2015	1	16.71422855	12.00	105276.7363	20480798	209	5.88	0.021223092	10.62	2.86	5.658170627	64.15	7.6
STATE BANK OF INDIA	2016	1	17.14834273	13.12	113861.4489	23576175.39	210	4.97	0.038127351	7.30	2.6	5.498318669	67.20	6.2
STATE BANK OF INDIA	2017	1	18.39808539	13.11	121960.0563	27059663.04	211	2.49	0.037093872	6.31	2.44	4.730199985	65.12	5.3
STATE BANK OF MYSORE	2002	1	0.683493701	11.81	26802.8	103537	89	4.31	0.073559874	20.49	3.19	5.541482	48.61	7.9
STATE BANK OF MYSORE	2003	0.874	0.664868721	11.62	27850.13	113357	90	3.81	0.051875226	29.63	3.56	4.102716	46.58	7.3
STATE BANK OF MYSORE	2004	0.853	0.703491594	11.53	30062.54	137581	91	3.77	0.033969417	34.83	3.62	5.163896	45.32	4.9
STATE BANK OF MYSORE	2005	1	0.739306068	12.08	32422.09	165526.231	92	4.25	0.009223053	30.82	3.63	5.688109813	44.10	4.9
STATE BANK OF MYSORE	2006	1	0.756245525	11.37	35432.44	193374.508	93	5.79	0.007355696	25.62	3.41	3.85629163	45.31	2.6
STATE BANK OF MYSORE	2007	1	0.816556652	11.47	38714.89	268426.504	94	6.39	0.004547681	24	2.96	7.80710551	41.35	5.7
STATE BANK OF MYSORE	2008	1	0.827165188	11.73	42509.47	330697	95	8.32	0.004251171	25.31	2.54	8.048296525	43.51	3.8
STATE BANK OF MYSORE	2009	1	0.810093953	12.99	44163.51	404857.9	96	10.83	0.005038637	18.47	2.28	4.285573198	48.41	4.8
STATE BANK OF MYSORE	2010	1	0.510642632	12.42	47908.46	454089.364	97	12.11	0.010150035	18.06	2.88	6.090475538	45.73	-2
STATE BANK OF MYSORE	2011	1	0.479743203	13.76	52823.841	520324.601	98	8.87	0.013749121	15.77	3.36	5.199992182	46.67	1.3
STATE BANK OF MYSORE	2012	0.984	0.48630527	12.55	87363.28711	604035.677	99	9.3	0.019289923	9.62	2.82	5.009381169	53.44	2.5
STATE BANK OF MYSORE	2013	1	0.480131905	11.79	92130.16662	672327.57	100	10.92	0.026901419	10.00	2.88	3.57662963	58.60	3.9
STATE BANK OF MYSORE	2014	0.999	0.721423608	11.08	98013.69876	739763.459	101	6.37	0.032946762	6.18	2.73	3.864535785	61.03	6.7

STATE BANK OF MYSORE	2015	0.965	0.700285131	11.42	105276.7363	794689	102	5.88	0.021558124	8.62	2.72	4.89741374	64.15	7.6
STATE BANK OF MYSORE	2016	1	0.699204675	12.43	113861.4489	829750.038	103	4.97	0.041835129	7.03	2.6	4.417696815	67.20	6.2
STATE BANK OF MYSORE	2017	0.883	0.706088483	12.41	121960.0563	889957.545	104	2.49	0.168945694	-44.37	2.18	5.247368176	65.12	5.3
STATE BANK OF PATIALA	2002	1	1.118237964	12.55	26802.8	173369	85	4.31	0.029356593	22.48	3.41	4.11904	48.61	7.9
STATE BANK OF PATIALA	2003	0.898	1.318192917	13.57	27850.13	212889	86	3.81	0.014949192	25.22	3.34	5.523252	46.58	7.3
STATE BANK OF PATIALA	2004	1	1.426398913	13.56	30062.54	268967	87	3.77	0	27.39	2.74	4.04382	45.32	4.9
STATE BANK OF PATIALA	2005	1	1.441896611	14.21	32422.09	315027.968	88	4.25	0.012337172	15.21	3.34	5.29777243	44.10	4.9
STATE BANK OF PATIALA	2006	1	1.560549098	13.67	35432.44	412333.032	89	5.79	0.009935069	14.17	2.74	3.660680526	45.31	2.6
STATE BANK OF PATIALA	2007	1	1.452872012	12.38	38714.89	474606.978	90	6.39	0.008286825	15.52	2.27	4.670764587	41.35	5.7
STATE BANK OF PATIALA	2008	1	1.462940638	13.56	42509.47	590600	91	8.32	0.005961257	15.92	1.67	7.27112252	43.51	3.8
STATE BANK OF PATIALA	2009	1	1.476819234	12.60	44163.51	696185.25	92	10.83	0.006048334	18.20	1.75	5.344770968	48.41	4.8
STATE BANK OF PATIALA	2010	1	0.847812992	13.26	47908.46	760769.671	93	12.11	0.010415294	16.01	2.11	5.237358148	45.73	-2
STATE BANK OF PATIALA	2011	0.984	0.755439504	13.41	52823.841	812862.46	94	8.87	0.012069442	16.65	2.97	4.933099869	46.67	1.3
STATE BANK OF PATIALA	2012	0.973	0.769546898	12.30	87363.28711	985270.726	95	9.3	0.013481002	17.95	2.60	7.241468867	53.44	2.5
STATE BANK OF PATIALA	2013	1	0.747323359	11.12	92130.16662	1085506.268	96	10.92	0.016181753	13.17	2.37	3.691592356	58.60	3.9
STATE BANK OF PATIALA	2014	1	1.050877049	10.38	98013.69876	1141207.339	97	6.37	0.031664853	7.80	2.33	7.137853218	61.03	6.7
STATE BANK OF PATIALA	2015	1	0.969037536	12.06	105276.7363	1167091	98	5.88	0.03877349	5.41	2.25	4.491054853	64.15	7.6
STATE BANK OF PATIALA	2016	1	1.059718184	10.88	113861.4489	1316622.936	99	4.97	0.039765552	-12.85	2.11	3.899668432	67.20	6.2
STATE BANK OF PATIALA	2017	1	0.906921126	11.18	121960.0563	1228291.649	100	2.49	0.154819878	-43.75	1.78	4.268496822	65.12	5.3
STATE BANK OF TRAVANCORE	2002	1	1.079159648	12.54	26802.8	164933	57	4.31	0.057164952	21.5	2.74	6.022818	48.61	7.9

STATE BANK OF TRAVANCORE	2003	1	1.174834264	11.3	27850.13	190332	58	3.81	0.03053202	25.66	2.94	3.992976	46.58	7.3
STATE BANK OF TRAVANCORE	2004	1	1.251733547	11.36	30062.54	240033	59	3.77	0.014314211	29.68	3.18	4.35136	45.32	4.9
STATE BANK OF TRAVANCORE	2005	1	1.31332012	11.05	32422.09	288746.061	60	4.25	0.018136716	24.05	3.15	7.146041352	44.10	4.9
STATE BANK OF TRAVANCORE	2006	1	1.201053507	11.15	35432.44	318623.937	61	5.79	0.014653564	21.02	2.84	3.885529388	45.31	2.6
STATE BANK OF TRAVANCORE	2007	1	1.148842326	11.68	38714.89	379931.32	62	6.39	0.01086566	22.26	2.34	6.484327198	41.35	5.7
STATE BANK OF TRAVANCORE	2008	1	1.064856313	13.53	42509.47	438944	63	8.32	0.009514646	23.28	2.75	7.460746191	43.51	3.8
STATE BANK OF TRAVANCORE	2009	1	1.034677907	14.03	44163.51	493510.075	64	10.83	0.005752509	30.64	2.57	4.718698605	48.41	4.8
STATE BANK OF TRAVANCORE	2010	1	0.668292803	13.74	47908.46	594547.045	65	12.11	0.009110466	26.88	2.60	5.833081967	45.73	-2
STATE BANK OF TRAVANCORE	2011	1	0.64547289	12.54	52823.841	709767.534	66	8.87	0.009794713	23.09	2.42	6.635372564	46.67	1.3
STATE BANK OF TRAVANCORE	2012	0.971	0.692542664	13.55	87363.28711	859866.883	67	9.3	0.015422447	13.93	2.27	5.555100167	53.44	2.5
STATE BANK OF TRAVANCORE	2013	1	0.713203985	11.70	92130.16662	1015793.258	68	10.92	0.014649185	14.94	2.3	4.473355546	58.60	3.9
STATE BANK OF TRAVANCORE	2014	1	1.046933915	10.79	98013.69876	1052854.179	69	6.37	0.027786337	6.81	2.32	4.234744702	61.03	6.7
STATE BANK OF TRAVANCORE	2015	0.993	0.965428227	10.89	105276.7363	1055954	70	5.88	0.020352846	6.83	2.17	5.056967867	64.15	7.6
STATE BANK OF TRAVANCORE	2016	1	1.001905216	11.60	113861.4489	1145067.799	71	4.97	0.027703884	5.99	2.32	4.649325398	67.20	6.2
STATE BANK OF TRAVANCORE	2017	0.945	1.031937792	12.19	121960.0563	1259166.088	72	2.49	0.102157299	-41.25	2.03	5.44716298	65.12	5.3

Source: Compiled by the author using Reserve Bank of India database

Table 5.18. Data on dependent and independent variables before financial crisis (i.e. 2001-2007)

Bank	EFF	MSHARE	CAPAD	GDP	RIR	XER	TASS	AGE	INF	NPA	ROE	NIM	LIQ	Year
Allahabad Bank	0.922	1.81728602	10.62	26802.8	7.9	48.61	247645	137	4.31	0.10554105	8.45	3.12	6.727455	2002
Allahabad Bank	1	1.87835686	11.15	27850.13	7.3	46.58	280509	138	3.81	0.07071176	15.44	3.45	5.510346	2003
Allahabad Bank	1	0.19978712	12.52	30062.54	4.9	45.32	347043	139	3.77	0.02332592	34.04	3.46	6.21295	2004
Allahabad Bank	0.979	2.21827537	12.53	32422.09	4.9	44.1	451449.299	140	4.25	0.01279856	27.93	3.42	5.3763738	2005
Allahabad Bank	1	2.24071264	13.37	35432.44	2.6	45.31	552919.9	141	5.79	0.00844284	23.67	3.14	4.8145457	2006
Allahabad Bank	1	2.20779258	12.52	38714.89	5.7	41.35	676637.413	142	6.39	0.01066093	18.49	2.85	6.0119938	2007
ANDHRA BANK	0.973	1.48253863	12.59	26802.8	7.9	48.61	209372	79	4.31	0.02451306	24.66	2.78	6.085248	2002
ANDHRA BANK	0.926	1.55366434	13.62	27850.13	7.3	46.58	24678	80	3.81	1.79209383	40.31	3.3	5.24049	2003
ANDHRA BANK	0.871	1.45605248	13.71	30062.54	4.9	45.32	270090	81	3.77	0.01163773	36.1	3.52	7.568154	2004
ANDHRA BANK	1	1.49931186	12.11	32422.09	4.9	44.1	327286.84	82	4.25	0.0027956	31.62	3.58	6.3367287	2005
ANDHRA BANK	0.968	1.56723445	14	35432.44	2.6	45.31	406693.389	83	5.79	0.00237371	20.52	3.19	9.4929343	2006
ANDHRA BANK	1	1.53705504	11.33	38714.89	5.7	41.35	475409.977	84	6.39	0.00169421	17.78	3.21	6.203185	2007
BANK OF BARODA	0.972	4.95530528	11.32	26802.8	7.9	48.61	709101	94	4.31	0.00568547	15.2	2.8	3.643288	2002
BANK OF BARODA	1	4.89564561	12.65	27850.13	7.3	46.58	764178	95	3.81	0.04810103	18.81	2.86	4.53357	2003
BANK OF BARODA	1	4.6312948	13.91	30062.54	4.9	45.32	851087	96	3.77	0.04631972	20.32	3.18	3.592087	2004
BANK OF BARODA	0.943	4.42617368	12.61	32422.09	4.9	44.1	946642.37	97	4.25	0.01427729	12.58	3.31	2.8652026	2005
BANK OF BARODA	0.903	4.32723632	13.65	35432.44	2.6	45.31	1133925.273	98	5.79	0.00864671	12.28	3.05	2.9397291	2006
BANK OF BARODA	0.976	4.63170354	11.80	38714.89	5.7	41.35	1431461.746	99	6.39	0.00599934	12.45	2.79	4.4803991	2007
BANK OF INDIA	1	4.78742246	10.68	26802.8	7.9	48.61	698058	67	4.31	0.0601397	18.4	2.84	5.200832	2002
BANK OF INDIA	0.837	4.75454423	12.02	27850.13	7.3	46.58	766268	68	3.81	0.05362347	26.65	2.78	4.37372	2003

BANK OF INDIA	1	4.5066254	13.01	30062.54	4.9	45.32	848600	69	3.77	0.07589654	26.71	2.73	4.986732	2004
BANK OF INDIA	1	4.289469	11.52	32422.09	4.9	44.1	949781.835	70	4.25	0.02799048	8.03	2.49	4.1111793	2005
BANK OF INDIA	0.944	4.33971232	10.75	35432.44	2.6	45.31	1122742.744	71	5.79	0.01487562	14.85	2.54	4.9774677	2006
BANK OF INDIA	0.971	4.4450411	11.75	38714.89	5.7	41.35	1418169.913	72	6.39	0.00954029	20.65	2.71	5.074772	2007
BANK OF MAHARASHTRA	0.972	1.53383594	11.16	26802.8	7.9	48.61	214704	66	4.31	0.05811074	22.8	2.9	7.62696	2002
BANK OF MAHARASHTRA	0.786	1.6358407	12.05	27850.13	7.3	46.58	249232	67	3.81	0.04828935	26.46	2.92	7.723464	2003
BANK OF MAHARASHTRA	0.999	1.67854312	11.88	30062.54	4.9	45.32	322130	68	3.77	0.02067274	25.21	2.70	14.08836	2004
BANK OF MAHARASHTRA	0.923	1.56970228	12.68	32422.09	4.9	44.1	328848.389	69	4.25	0.02149347	11.9	2.71	6.4750774	2005
BANK OF MAHARASHTRA	1	1.24308089	11.27	35432.44	2.6	45.31	312145.137	70	5.79	0.02034096	3.26	3.03	6.0014663	2006
BANK OF MAHARASHTRA	1	1.25767993	12.06	38714.89	5.7	41.35	390094.727	71	6.39	0.01210242	16.41	3.12	5.8196216	2007
CANARA BANK	1	5.1337394	11.88	26802.8	7.9	48.61	722114	96	4.31	0.0388928	23.59	2.63	10.888676	2002
CANARA BANK	1	5.3182121	12.5	27850.13	7.3	46.58		97	3.81	0.03592346	26.74	2.89	6.835508	2003
CANARA BANK	1	5.48036308	12.66	30062.54	4.9	45.32	995394	98	3.77	0.03850781	28.47	2.95	6.921852	2004
CANARA BANK	1	5.26764169	12.78	32422.09	4.9	44.1	1103051.733	99	4.25	0.01862386	19.53	3.01	4.5187209	2005
CANARA BANK	1	5.39637455	11.22	35432.44	2.6	45.31	1328218.587	100	5.79	0.01106921	20.29	2.95	5.9583536	2006
CANARA BANK	1	5.27929797	13.50	38714.89	5.7	41.35	1659610.427	101	6.39	0.00941032	16.25	2.70	5.4803174	2007
CENTRAL BANK OF INDIA	1	3.77933981	9.58	26802.8	7.9	48.61	526137	91	4.31	0.0798121	7.2	3.07	5.805432	2002
CENTRAL BANK OF INDIA	1	3.77429237	10.51	27850.13	7.3	46.58	571052	92	3.81	0.0674462	13.82	3.46	6.46016	2003
CENTRAL BANK OF INDIA	1	3.54856502	12.43	30062.54	4.9	45.32	633453	93	3.77	0.04047113	22.9	3.52	5.410338	2004
CENTRAL BANK OF INDIA	1	3.30611097	12.15	32422.09	4.9	44.1	685958.944	94	4.25	0.02984164	11.46	3.60	8.122651	2005
CENTRAL BANK OF INDIA	1	3.07153548	11.03	35432.44	2.6	45.31	746810.417	95	5.79	0.02593142	7.68	3.32	4.5297456	2006
CENTRAL BANK OF INDIA	0.954	3.06922443	10.40	38714.89	5.7	41.35	930080.841	96	6.39	0.01695129	13.77	2.95	5.8851532	2007

CORPORATION BANK	1	1.5172954	17.9	26802.8	7.9	48.61	236042	96	4.31	0.02306551	18.16	2.89	5.660002	2002
CORPORATION BANK	0.873	1.60255706	18.5	27850.13	7.3	46.58	262720	97	3.81	0.01649237	18.84	3.18	4.886979	2003
CORPORATION BANK	1	1.47194558	20.12	30062.54	4.9	45.32	291537	98	3.77	0.02338699	19.62	3.48	5.815105	2004
CORPORATION BANK	1	1.48203065	16.23	32422.09	4.9	44.1	339238.477	99	4.25	0.0111542	13.81	3.58	5.6623548	2005
CORPORATION BANK	1	1.51891398	13.92	35432.44	2.6	45.31	405066.311	100	5.79	0.00641796	13.82	3.30	4.0482091	2006
CORPORATION BANK	1	1.57053226	12.76	38714.89	5.7	41.35	527206.436	101	6.39	0.00473895	15.02	2.81	5.6593872	2007
DENA BANK	0.956	1.23109524	7.64	26802.8	7.9	48.61	188421	64	4.31	0.16313306	1.29	2.41	5.435383	2002
DENA BANK	0.963	1.21651258	6.02	27850.13	7.3	46.58		65	3.81	0.11822277	11.56	2.91	5.529004	2003
DENA BANK	1	1.16463888	9.48	30062.54	4.9	45.32	221602	66	3.77	0.09082926	19.89	2.80	5.56416	2004
DENA BANK	0.948	1.13719209	11.91	32422.09	4.9	44.1	240285.872	67	4.25	0.05226117	5.65	2.97	6.2011301	2005
DENA BANK	1	1.09139851	10.62	35432.44	2.6	45.31	265453.333	68	5.79	0.03041549	5.98	2.86	6.353093	2006
DENA BANK	1	1.02670161	11.52	38714.89	5.7	41.35	314506.475	69	6.39	0.01993073	14.22	2.95	6.2234957	2007
IDBI BANK LIMITED	**	#VALUE!	**	**	**	**	**	0	4.31	#VALUE!		**	#VALUE!	2002
IDBI BANK LIMITED	**	#VALUE!	**	**	**	**	**	0	3.81	**		**	#VALUE!	2003
IDBI BANK LIMITED	**	#VALUE!	**	**	**	**	**	0	3.77	#VALUE!		**	#VALUE!	2004
IDBI BANK LIMITED	1	0.8218868	15.51	32422.09	4.9	44.1	813602.493	1	4.25	0.0186616	5.18	0.23	2.9202165	2005
IDBI BANK LIMITED	1	1.20125686	14.80	35432.44	2.6	45.31	885647.81	2	5.79	0.01067747	9.12	0.45	3.0261407	2006
IDBI BANK LIMITED	1	1.60750505	13.73	38714.89	5.7	41.35	1038393.238	3	6.39	0.01155627	8.59	0.68	5.2065737	2007
INDIAN BANK	0.926	1.92736116	1.7	26802.8	7.9	48.61	302629	95	4.31	0.08283341	0.94	1.87	4.241562	2002
INDIAN BANK	0.777	1.99288002	10.85	27850.13	7.3	46.58	353752	96	3.81	0.06150305	4.05	2.5	5.384085	2003
INDIAN BANK	0.802	1.93233121	12.82	30062.54	4.9	45.32	391541	97	3.77	0.02295193	7.61	3	7.262784	2004
INDIAN BANK	0.993	1.89427785	14.14	32422.09	4.9	44.1	438607.044	98	4.25	0.0134613	7.12	3.14	4.4733518	2005

INDIAN BANK	1	1.88523803	13.19	35432.44	2.6	45.31	476352.707	99	5.79	0.00785692	11.97	3.30	4.8346233	2006
INDIAN BANK	1	1.74606258	14.14	38714.89	5.7	41.35	561486.464	100	6.39	0.00351468	24	3.43	6.6421022	2007
INDIAN OVERSEAS BANK	1	2.55031313	10.82	26802.8	7.9	48.61	354411	65	4.31	0.06315071	22.29	2.95	6.2466	2002
INDIAN OVERSEAS BANK	0.851	2.70714307	11.3	27850.13	7.3	46.58	411547	66	3.81	0.05228463	32.1	3.19	6.527244	2003
INDIAN OVERSEAS BANK	0.86	2.63293488	12.49	30062.54	4.9	45.32	473220	67	3.77	0.02863035	28.96	3.62	9.151704	2004
INDIAN OVERSEAS BANK	1	2.40761177	14.20	32422.09	4.9	44.1	508150.422	68	4.25	0.01266406	27.98	3.78	8.2169297	2005
INDIAN OVERSEAS BANK	1	2.33448257	13.04	35432.44	2.6	45.31	593578.117	69	5.79	0.00645439	27.23	3.75	5.185431	2006
INDIAN OVERSEAS BANK	1	2.548795	13.27	38714.89	5.7	41.35	822568.284	70	6.39	0.00547872	28.14	3.62	5.6969224	2007
ORIENTAL BANK OF COMMERCE	1	2.28411716	10.99	26802.8	7.9	48.61	322629	59	4.31	0.03205278	20.23	3.28	7.28475	2002
ORIENTAL BANK OF COMMERCE	0.822	2.19892581	14.04	27850.13	7.3	46.58	339876	60	3.81	0.01436991	24.51	3.64	5.578356	2003
ORIENTAL BANK OF COMMERCE	1	2.26422651	14.47	30062.54	4.9	45.32	410065	61	3.77	0	28.67	3.88	6.419862	2004
ORIENTAL BANK OF COMMERCE	1	2.6040186	9.21	32422.09	4.9	44.1	540694.525	62	4.25	0.01293085	25.34	3.21	11.931118	2005
ORIENTAL BANK OF COMMERCE	1	2.3191507	11.04	35432.44	2.6	45.31	589373.726	63	5.79	0.00485388	13.11	2.84	7.2334776	2006
ORIENTAL BANK OF COMMERCE	1	2.37287773	12.51	38714.89	5.7	41.35	739362.743	64	6.39	0.00488599	10.78	2.55	7.217144	2007
PUNJAB AND SIND BANK	0.863	1.00081861	10.7	26802.8	7.9	48.61	137536	94	4.31	0.11677964	5.27	2.33	6.26244	2002
PUNJAB AND SIND BANK	1	0.97546438	10.43	27850.13	7.3	46.58	144909	95	3.81	0.10853007	0.98	2.74	6.2415	2003
PUNJAB AND SIND BANK	1	0.86586901	11.06	30062.54	4.9	45.32	150114	96	3.77	0.08519169	1.92	3.34	7.106816	2004
PUNJAB AND SIND BANK	1	0.77116834	9.46	32422.09	4.9	44.1	157175.159	97	4.25	0.08063784	-15.67	3.73	6.0265405	2005
PUNJAB AND SIND BANK	1	0.78192508	12.83	35432.44	2.6	45.31	190430.379	98	5.79	0.02420211	13.03	3.63	4.3778292	2006
PUNJAB AND SIND BANK	1	0.71631149	12.88	38714.89	5.7	41.35	219630.333	99	6.39	0.00656357	16.63	3.74	4.8918538	2007
PUNJAB NATIONAL BANK	0.946	5.14123596	10.7	26802.8	7.9	48.61	729147	108	4.31	0.05266342	18.59	3.37	7.000024	2002
PUNJAB NATIONAL BANK	1	5.59252918	12.02	27850.13	7.3	46.58	862218	109	3.81	0.0379563	23.14	3.93	7.614738	2003

PUNJAB NATIONAL BANK	0.9	5.58012652	13.1	30062.54	4.9	45.32	1023317	110	3.77	0.01065768	24.52	3.84	6.589297	2004
PUNJAB NATIONAL BANK	1	5.6143503	14.78	32422.09	4.9	44.1	1262412.809	111	4.25	0.00197707	21.41	3.51	7.493743	2005
PUNJAB NATIONAL BANK	1	5.52951	11.95	35432.44	2.6	45.31	1452673.864	112	5.79	0.00281626	16.41	3.44	16.104478	2006
PUNJAB NATIONAL BANK	1	5.18579399	12.29	38714.89	5.7	41.35	1624224.965	113	6.39	0.00751186	15.55	3.39	7.6171898	2007
SYNDICATE BANK	1	2.28891977	12.12	26802.8	7.9	48.61	317562	77	4.31	#VALUE!	19.06	3.69	6.21209	2002
SYNDICATE BANK	1	2.26173097	11.03	27850.13	7.3	46.58	344354	78	3.81	0.04351407	23.02	3.66	4.790352	2003
SYNDICATE BANK	0.975	2.70289243	11.49	30062.54	4.9	45.32	472232	79	3.77	0.05621267	24.92	3.5	9.541044	2004
SYNDICATE BANK	0.969	2.51935382	10.70	32422.09	4.9	44.1	521094.246	80	4.25	0.01593351	19.64	3.41	5.1622206	2005
SYNDICATE BANK	0.998	2.47747698	11.73	35432.44	2.6	45.31	610767.552	81	5.79	0.00857039	21.32	3.32	5.1494797	2006
SYNDICATE BANK	0.964	2.91561877	11.74	38714.89	5.7	41.35	892773.604	82	6.39	0.00756738	22.18	2.86	7.3638286	2007
UCO BANK	0.897	2.15265879	9.64	26802.8	7.9	48.61	313814	59	4.31	0.05858154	6.11	2.49	4.252332	2002
UCO BANK	0.745	2.31210641	10.04	27850.13	7.3	46.58	349141	60	3.81	0.04378168	10.5	2.66	6.113337	2003
UCO BANK	0.978	2.49086813	11.88	30062.54	4.9	45.32	437978	61	3.77	0.04275218	29.14	3.04	5.34912	2004
UCO BANK	0.902	2.69217428	11.26	32422.09	4.9	44.1	545894.564	62	4.25	0.02931547	18.04	2.86	5.4550609	2005
UCO BANK	0.986	2.51995078	11.12	35432.44	2.6	45.31	618393.977	63	5.79	0.02100029	8.68	2.69	3.2861674	2006
UCO BANK	0.97	2.40491504	11.56	38714.89	5.7	41.35	748638.955	64	6.39	0.02141058	12.34	2.32	5.0682268	2007
UNION BANK OF INDIA	1	3.19055931	11.07	26802.8	7.9	48.61	443750	83	4.31	0.06258903	15.88	3.21	5.389768	2002
UNION BANK OF INDIA	0.896	3.30096686	12.41	27850.13	7.3	46.58	510605	84	3.81	0.04912561	23.65	3.14	4.399528	2003
UNION BANK OF INDIA	0.979	3.20901514	12.32	30062.54	4.9	45.32	583166	85	3.77	0.0376593	25.19	3.17	4.11825	2004
UNION BANK OF INDIA	1	3.36482568	12.09	32422.09	4.9	44.1	724132.483	86	4.25	0.02644004	21.46	3.16	5.0366164	2005
UNION BANK OF INDIA	1	3.42319793	11.41	35432.44	2.6	45.31	891260.392	87	5.79	0.01562291	16.52	2.94	4.9225491	2006
UNION BANK OF INDIA	1	3.15835912	12.80	38714.89	5.7	41.35	1026778.758	88	6.39	0.00963703	17.34	2.91	5.7632404	2007

UNITED BANK OF INDIA	1	1.57232896	12.02	26802.8	7.9	48.61	227764	84	4.31	0.07943922	6.06	2.72	6.66414	2002
UNITED BANK OF INDIA	1	1.55141444	15.17	27850.13	7.3	46.58	242707	85	3.81	0.05523348	15.6	3.06	7.01403	2003
UNITED BANK OF INDIA	1	1.44448175	17.04	30062.54	4.9	45.32	258426	86	3.77	0.02145357	16.07	3.12	4.112402	2004
UNITED BANK OF INDIA	1	1.37946132	18.16	32422.09	4.9	44.1	290978.618	87	4.25	0.02432816	15.33	3.33	5.459099	2005
UNITED BANK OF INDIA	1	1.35135572	13.12	35432.44	2.6	45.31	332477.226	88	5.79	0.01952609	10.81	3.27	4.3137569	2006
UNITED BANK OF INDIA	1	1.37808603	12.02	38714.89	5.7	41.35	423097.448	89	6.39	0.01502957	12.6	3.04	6.3493781	2007
VIJAYA BANK	0.916	1.17703985	12.25	26802.8	7.9	48.61	161445	71	4.31	0.06023206	20.74	3.19	6.356007	2002
VIJAYA BANK	0.776	1.2554984	12.66	27850.13	7.3	46.58		72	3.81	0.02608062	26.67	3.65	5.691598	2003
VIJAYA BANK	0.988	1.33384575	14.11	30062.54	4.9	45.32	240710	73	3.77	0.00922488	38.32	3.88	3.64041	2004
VIJAYA BANK	1	1.39413275	12.92	32422.09	4.9	44.1	293354.959	74	4.25	0.00590201	26.02	3.70	4.3704974	2005
VIJAYA BANK	1	1.28018463	11.94	35432.44	2.6	45.31	315340.952	75	5.79	0.00854056	7.79	3.20	7.1308191	2006
VIJAYA BANK	1	1.39432036	11.21	38714.89	5.7	41.35	423574.925	76	6.39	0.00594298	18.58	2.90	8.0262385	2007
STATE BANK OF BIKANER AND JAIPUR	1	0.93494511	13.42	26802.8	7.9	48.61	155522	39	4.31	0.05767876	24.17	3.33	5.840942	2002
STATE BANK OF BIKANER AND JAIPUR	0.82	0.97620205	13.08	27850.13	7.3	46.58	180381	40	3.81	0.04160306	24.56	3.28	4.871104	2003
STATE BANK OF BIKANER AND JAIPUR	0.922	0.9928297	12.93	30062.54	4.9	45.32	202564	41	3.77	0.01271293	29.39	3.74	6.223932	2004
STATE BANK OF BIKANER AND JAIPUR	1	1.03607142	12.60	32422.09	4.9	44.1	234304.348	42	4.25	0.01611391	16.81	3.98	3.9512972	2005
STATE BANK OF BIKANER AND JAIPUR	1	1.00225701	12.08	35432.44	2.6	45.31	275140.226	43	5.79	0.01177418	10.73	3.90	5.931581	2006
STATE BANK OF BIKANER AND JAIPUR	0.99	1.05601548	12.89	38714.89	5.7	41.35	345074.797	44	6.39	0.01085441	19.99	3.03	10.587271	2007
STATE BANK OF HYDERABAD	1	1.39529793	14.03	26802.8	7.9	48.61	221208	61	4.31	0.04956545	25.74	3.21	5.931718	2002
STATE BANK OF HYDERABAD	0.834	1.51951762	14.91	27850.13	7.3	46.58	261316	62	3.81	0.03264028	26.8	3.1	6.992221	2003
STATE BANK OF HYDERABAD	1	1.5396626	14.29	30062.54	4.9	45.32	306461	63	3.77	0.00514217	26.99	2.96	5.93625	2004
STATE BANK OF HYDERABAD	1	1.57434654	11.74	32422.09	4.9	44.1	349222.903	64	4.25	0.00611036	15.03	2.94	3.9823157	2005

STATE BANK OF HYDERABAD	1	1.57195533	12.08	35432.44	2.6	45.31	406304.027	65	5.79	0.00361357	22.01	2.90	5.605883	2006
STATE BANK OF HYDERABAD	1	1.53885907	12.34	38714.89	5.7	41.35	490523.272	66	6.39	0.00218078	21.72	2.74	5.8553181	2007
STATE BANK OF INDIA	0.959	21.6927229	13.35	26802.8	7.9	48.61	3482282	196	4.31	0.05637346	16.95	2.74	6.27816	2002
STATE BANK OF INDIA	1	21.8440847	13.5	27850.13	7.3	46.58	3758765	197	3.81	0.04488289	19.15	2.76	3.38754	2003
STATE BANK OF INDIA	0.814	20.2230111	13.53	30062.54	4.9	45.32	4078153	198	3.77	0.02930759	19.67	2.85	4.672174	2004
STATE BANK OF INDIA	1	19.974756	12.45	32422.09	4.9	44.1	4598828.667	199	4.25	0.02643066	19.43	3.21	3.6553501	2005
STATE BANK OF INDIA	1	17.55834	11.88	35432.44	2.6	45.31	4940289.545	200	5.79	0.01876009	17.04	3.27	4.3828812	2006
STATE BANK OF INDIA	1	16.148491	11.77	38714.89	5.7	41.35	5665652.388	201	6.39	0.01558598	15.41	2.84	5.1320523	2007
STATE BANK OF MYSORE	1	0.6834937	11.81	26802.8	7.9	48.61	103537	89	4.31	0.07355987	20.49	3.19	5.541482	2002
STATE BANK OF MYSORE	0.874	0.66486872	11.62	27850.13	7.3	46.58	113357	90	3.81	0.05187523	29.63	3.56	4.102716	2003
STATE BANK OF MYSORE	0.853	0.70349159	11.53	30062.54	4.9	45.32	137581	91	3.77	0.03396942	34.83	3.62	5.163896	2004
STATE BANK OF MYSORE	1	0.73930607	12.08	32422.09	4.9	44.1	165526.231	92	4.25	0.00922305	30.82	3.63	5.6881098	2005
STATE BANK OF MYSORE	1	0.75624553	11.37	35432.44	2.6	45.31	193374.508	93	5.79	0.0073557	25.62	3.41	3.8562916	2006
STATE BANK OF MYSORE	1	0.81655665	11.47	38714.89	5.7	41.35	268426.504	94	6.39	0.00454768	24	2.96	7.8071055	2007
STATE BANK OF PATIALA	1	1.11823796	12.55	26802.8	7.9	48.61	173369	85	4.31	0.02935659	22.48	3.41	4.11904	2002
STATE BANK OF PATIALA	0.898	1.31819292	13.57	27850.13	7.3	46.58	212889	86	3.81	0.01494919	25.22	3.34	5.523252	2003
STATE BANK OF PATIALA	1	1.42639891	13.56	30062.54	4.9	45.32	268967	87	3.77	0	27.39	2.74	4.04382	2004
STATE BANK OF PATIALA	1	1.44189661	14.21	32422.09	4.9	44.1	315027.968	88	4.25	0.01233717	15.21	3.34	5.2977724	2005
STATE BANK OF PATIALA	1	1.5605491	13.67	35432.44	2.6	45.31	412333.032	89	5.79	0.00993507	14.17	2.74	3.6606805	2006
STATE BANK OF PATIALA	1	1.45287201	12.38	38714.89	5.7	41.35	474606.978	90	6.39	0.00828683	15.52	2.27	4.6707646	2007
STATE BANK OF TRAVANCORE	1	1.07915965	12.54	26802.8	7.9	48.61	164933	57	4.31	0.05716495	21.5	2.74	6.022818	2002
STATE BANK OF TRAVANCORE	1	1.17483426	11.3	27850.13	7.3	46.58	190332	58	3.81	0.03053202	25.66	2.94	3.992976	2003

STATE BANK OF TRAVANCORE	1	1.25173355	11.36	30062.54	4.9	45.32	240033	59	3.77	0.01431421	29.68	3.18	4.35136	2004
STATE BANK OF TRAVANCORE	1	1.31332012	11.05	32422.09	4.9	44.1	288746.061	60	4.25	0.01813672	24.05	3.15	7.1460414	2005
STATE BANK OF TRAVANCORE	1	1.20105351	11.15	35432.44	2.6	45.31	318623.937	61	5.79	0.01465356	21.02	2.84	3.8855294	2006
STATE BANK OF TRAVANCORE	1	1.14884233	11.68	38714.89	5.7	41.35	379931.32	62	6.39	0.01086566	22.26	2.34	6.4843272	2007

Source: Complied by the author using Reserve Bank of India database

Table 5.19. Data on dependent and independent variables after financial crisis (i.e. 2010-2017)

Bank	EFF	MSHARE	CAPAD	GDP	TASS	AGE	INF	NPA	ROE	NIM	LIQ	Year	EXR	RIR
Allahabad Bank	1	1.392916279	13.62	47908.46	1216992.13	145	12.11	0.006565894	19.14	2.42	5.902896648	2010	45.73	-2
Allahabad Bank	0.976	1.463765993	12.96	52823.841	1512863.609	146	8.87	0.00786511	18.65	2.95	5.222498886	2011	46.67	1.3
Allahabad Bank	1	1.546457015	12.83	87363.28711	1829345.678	147	9.3	0.009822295	19.64	3.09	4.762601699	2012	53.44	2.5
Allahabad Bank	0.977	1.506424221	11.03	92130.16662	2043731.889	148	10.92	0.03186942	10.84	2.51	3.820570351	2013	58.60	3.9
Allahabad Bank	1	2.236481189	9.96	98013.69876	2204342.831	149	6.37	0.041460417	10.12	2.50	4.007745766	2014	61.03	6.7
Allahabad Bank	1	2.050321904	10.45	105276.7363	2270965	150	5.88	0.03989202	5.08	2.76	4.253797102	2015	64.15	7.6
Allahabad Bank	0.959	1.988024671	11.02	113861.4489	2398253.646	151	4.97	0.067548543	-5.57	2.53	3.94918132	2016	67.20	6.2
Allahabad Bank	1	1.816370183	11.45	121960.0563	2370378.832	152	2.49	0.089109582	-2.21	2.22	3.622120601	2017	65.12	5.3
ANDHRA BANK	0.963	1.020342272	13.93	47908.46	903424.023	87	12.11	0.001705828	25.96	2.76	7.414788837	2010	45.73	-2
ANDHRA BANK	1	1.022807912	14.38	52823.841	1089007.195	88	8.87	0.003831156	23.24	3.23	6.597206315	2011	46.67	1.3
ANDHRA BANK	1	1.025698347	13.18	87363.28711	1245453.869	89	9.3	0.009082227	19.25	3.22	4.467357109	2012	53.44	2.5
ANDHRA BANK	1	1.043342227	11.76	92130.16662	1462989.442	90	10.92	0.024490182	16.19	2.77	4.116322485	2013	58.60	3.9
ANDHRA BANK	0.974	1.662278783	10.78	98013.69876	1673409.251	91	6.37	0.031051092	5.07	2.38	4.728107381	2014	61.03	6.7
ANDHRA BANK	1	1.643151436	10.63	105276.7363	1851703	92	5.88	0.029285364	6.79	2.57	4.059723447	2015	64.15	7.6
ANDHRA BANK	1	1.72702293	11.58	113861.4489	1999617.586	93	4.97	0.046148385	5.13	2.76	4.396347362	2016	67.20	6.2
ANDHRA BANK	1	1.758524153	12.38	121960.0563	2221261.31	94	2.49	0.075667427	1.56	2.62	4.178671881	2017	65.12	5.3
BANK OF BARODA	0.985	3.168688641	14.36	47908.46	2783167.028	102	12.11	0.003441135	21.86	2.35	4.864950244	2010	45.73	-2
BANK OF BARODA	1	3.389957942	14.52	52823.841	3583971.754	103	8.87	0.003458512	23.50	2.76	5.543620269	2011	46.67	1.3
BANK OF BARODA	1	3.729401175	14.67	87363.28711	4473214.67	104	9.3	0.005371475	20.64	2.56	4.840245902	2012	53.44	2.5
BANK OF BARODA	1	3.993862244	13.30	92130.16662	5471354.403	105	10.92	0.012773345	15.07	2.28	2.458637837	2013	58.60	3.9
BANK OF BARODA	1	6.666856404	12.28	98013.69876	6595045.334	106	6.37	0.015200684	13.36	1.98	2.824710722	2014	61.03	6.7

BANK OF BARODA	1	6.546217172	12.61	105276.7363	7149885	107	5.88	0.01885108	8.96	1.92	3.145308679	2015	64.15	7.6
BANK OF BARODA	0.947	5.68768161	13.18	113861.4489	6713764.769	108	4.97	0.050567921	-13.48	1.84	3.228057006	2016	67.20	6.2
BANK OF BARODA	0.979	5.413700284	12.24	121960.0563	6948754.235	109	2.49	0.047174807	3.44	1.98	3.27831616	2017	65.12	5.3
BANK OF INDIA	0.963	3.017650055	12.94	47908.46	2749664.585	75	12.11	0.013101316	12.56	2.30	5.674373418	2010	45.73	-2
BANK OF INDIA	0.954	3.317221161	12.17	52823.841	3511725.491	76	8.87	0.009127287	15.79	2.49	6.20277207	2011	46.67	1.3
BANK OF INDIA	0.997	3.083513493	11.95	87363.28711	3845354.714	77	9.3	0.015441902	14.00	2.26	3.897354039	2012	53.44	2.5
BANK OF INDIA	1	3.218122658	11.02	92130.16662	4526027.183	78	10.92	0.020847677	12.25	2.16	4.853491992	2013	58.60	3.9
BANK OF INDIA	1	5.589644714	9.97	98013.69876	5731901.989	79	6.37	0.020744279	10.14	2.11	3.327594135	2014	61.03	6.7
BANK OF INDIA	1	5.638284593	10.73	105276.7363	6186978	80	5.88	0.033623659	5.57	1.91	4.391486762	2015	64.15	7.6
BANK OF INDIA	0.884	5.082951014	12.01	113861.4489	6099139.267	81	4.97	0.077943376	-19.50	1.91	5.568263539	2016	67.20	6.2
BANK OF INDIA	0.947	4.859052801	12.14	121960.0563	6263092.666	82	2.49	0.069048556	-5.04	1.91	4.36647892	2017	65.12	5.3
BANK OF MAHARASHTRA	0.866	0.831423713	12.78	47908.46	710557.893	74	12.11	0.016431477	16.35	1.99	7.480591451	2010	45.73	-2
BANK OF MAHARASHTRA	0.997	0.741884577	13.35	52823.841	764422.177	75	8.87	0.013202643	9.68	2.67	5.031255677	2011	46.67	1.3
BANK OF MAHARASHTRA	1	0.741562658	12.43	87363.28711	911373.861	76	9.3	0.008376239	9.91	3.00	4.976527833	2012	53.44	2.5
BANK OF MAHARASHTRA	1	0.795066381	12.59	92130.16662	1169528.056	78	10.92	0.005206386	13.66	2.92	4.502064184	2013	58.60	3.9
BANK OF MAHARASHTRA	1	1.368811924	10.79	98013.69876	1363200.52	79	6.37	0.020325145	5.61	2.77	4.395089008	2014	61.03	6.7
BANK OF MAHARASHTRA	1	1.294477841	11.94	105276.7363	1460188	80	5.88	0.041852005	5.84	2.74	4.556091165	2015	64.15	7.6
BANK OF MAHARASHTRA	0.993	1.377138807	11.2	113861.4489	1609573.244	81	4.97	0.063516738	1.19	2.53	5.207769594	2016	67.20	6.2
BANK OF MAHARASHTRA	0.94	1.251157472	11.18	121960.0563	1593239.812	82	2.49	0.080094086	-16.98	1.98	9.587206604	2017	65.12	5.3
CANARA BANK	1	3.081867817	13.43	47908.46	2647410.828	104	12.11	0.010628068	22.48	2.35	5.937674739	2010	45.73	-2
CANARA BANK	1	3.256742931	15.38	52823.841	3359448.567	105	8.87	0.011028205	23.20	2.56	6.553097369	2011	46.67	1.3
CANARA BANK	1	3.169150751	13.76	87363.28711	3741601.927	106	9.3	0.014565412	15.36	2.17	4.756020968	2012	53.44	2.5

CANARA BANK	1	2.999134377	12.40	92130.16662	4123426.086	107	10.92	0.0217943	12.08	2.00	3.736196751	2013	58.60	3.9
CANARA BANK	1	4.930438182	10.63	98013.69876	4919218.543	108	6.37	0.019814362	8.95	1.98	4.503516644	2014	61.03	6.7
CANARA BANK	1	5.022771251	10.56	105276.7363	5480006	109	5.88	0.026482271	8.79	1.86	4.009476909	2015	64.15	7.6
CANARA BANK	1	4.753870392	11.08	113861.4489	5529607.783	110	4.97	0.064157558	-8.86	1.77	3.73698313	2016	67.20	6.2
CANARA BANK	1	4.456344287	12.86	121960.0563	5835194.435	111	2.49	0.06329949	3.44	1.74	3.414195966	2017	65.12	5.3
CENTRAL BANK OF INDIA	1	2.129088934	12.23	47908.46	1826716.238	99	12.11	0.006898614	15.01	1.54	9.312847047	2010	45.73	-2
CENTRAL BANK OF INDIA	1	1.990604963	11.64	52823.841	2097573.269	100	8.87	0.006529176	13.49	2.71	6.713468562	2011	46.67	1.3
CENTRAL BANK OF INDIA	0.971	1.900919618	12.40	87363.28711	2297997.392	101	9.3	0.031183724	4.57	2.35	5.70678503	2012	53.44	2.5
CENTRAL BANK OF INDIA	0.98	1.905038265	11.49	92130.16662	2681295.49	102	10.92	0.029010821	7.31	2.30	5.057319273	2013	58.60	3.9
CENTRAL BANK OF INDIA	1	2.813361332	9.87	98013.69876	2894962.244	103	6.37	0.037503841	-8.12	2.33	4.11978766	2014	61.03	6.7
CENTRAL BANK OF INDIA	1	2.709103069	10.9	105276.7363	3119405	104	5.88	0.036115711	3.65	2.41	4.52485311	2015	64.15	7.6
CENTRAL BANK OF INDIA	0.995	2.637405963	10.4	113861.4489	3054660.996	105	4.97	0.073562748	-8.07	2.29	4.605914541	2016	67.20	6.2
CENTRAL BANK OF INDIA	0.887	2.669362135	10.94	121960.0563	3334019.442	106	2.49	0.101995161	-13.96	2.06	22.52139089	2017	65.12	5.3
CORPORATION BANK	1	1.217946477	15.37	47908.46	1116672.986	104	12.11	0.003120918	21.93	1.92	7.911925901	2010	45.73	-2
CORPORATION BANK	1	1.295736571	14.11	52823.841	1435085.931	105	8.87	0.004579599	21.89	2.30	5.673748113	2011	46.67	1.3
CORPORATION BANK	1	1.31921798	13.00	87363.28711	1635604.209	106	9.3	0.008653215	19.54	2.05	5.678779046	2012	53.44	2.5
CORPORATION BANK	1	1.399084681	12.33	92130.16662	1934423.335	107	10.92	0.011884433	16.08	1.92	4.573892868	2013	58.60	3.9
CORPORATION BANK	1	2.266366891	11.65	98013.69876	2220484.706	108	6.37	0.023201152	5.72	1.82	6.187931659	2014	61.03	6.7
CORPORATION BANK	1	2.113093514	11.09	105276.7363	2259930	109	5.88	0.030778948	5.68	1.81	4.490817013	2015	64.15	7.6
CORPORATION BANK	1	2.032873597	10.56	113861.4489	2348636.156	110	4.97	0.065279317	-4.64	1.84	4.294924088	2016	67.20	6.2
CORPORATION BANK	1	1.984532065	11.32	121960.0563	2478910.547	111	2.49	0.083303271	4.66	1.84	7.058195352	2017	65.12	5.3

DENA BANK	1	0.67434604	12.77	47908.46	575865.764	72	12.11	0.012055853	21.43	2.07	7.562581501	2010	45.73	-2
DENA BANK	1	0.712638414	13.41	52823.841	708384.195	73	8.87	0.012245682	19.55	2.75	6.665043682	2011	46.67	1.3
DENA BANK	1	0.747746295	11.51	87363.28711	873879.166	74	9.3	0.010084749	19.75	2.66	5.944707425	2012	53.44	2.5
DENA BANK	1	0.819256426	11.03	92130.16662	1134404.24	75	10.92	0.013942886	15.83	2.37	7.620293165	2013	58.60	3.9
DENA BANK	1	1.289411198	11.14	98013.69876	1248634.886	76	6.37	0.023453662	8.55	2.10	5.000621362	2014	61.03	6.7
DENA BANK	1	1.228938626	10.93	105276.7363	1299205	77	5.88	0.038187448	3.64	1.92	6.992775709	2015	64.15	7.6
DENA BANK	0.951	1.163529352	11	113861.4489	1334416.391	78	4.97	0.063531833	-12.83	1.88	4.008296613	2016	67.20	6.2
DENA BANK	0.969	1.025224274	11.39	121960.0563	1296235.388	79	2.49	0.106581618	-11.65	1.83	4.640498973	2017	65.12	5.3
IDBI BANK LIMITED	1	2.202107788	11.31	47908.46	2335727.502	6	12.11	0.01017584	10.53	1.11	5.952522513	2010	45.73	-2
IDBI BANK LIMITED	1	2.003143891	13.64	52823.841	2533767.928	7	8.87	0.010680653	13.35	1.75	7.719351908	2011	46.67	1.3
IDBI BANK LIMITED	1	2.039672999	14.58	87363.28711	2903163.344	8	9.3	0.016120579	11.95	1.67	5.197851405	2012	53.44	2.5
IDBI BANK LIMITED	1	1.914124935	13.13	92130.16662	3227685.106	9	10.92	0.01579347	9.26	1.75	3.266722177	2013	58.60	3.9
IDBI BANK LIMITED	1	2.763024181	11.68	98013.69876	3289883.556	10	6.37	0.024798417	5.00	1.85	3.863696939	2014	61.03	6.7
IDBI BANK LIMITED	1	2.754297602	11.76	105276.7363	3561440	11	5.88	0.028758087	3.64	1.68	3.693120437	2015	64.15	7.6
IDBI BANK LIMITED	1	2.632805031	11.67	113861.4489	3753898.307	12	4.97	0.067826931	-14.08	1.66	3.682280677	2016	67.20	6.2
IDBI BANK LIMITED	0.987	2.416228609	10.7	121960.0563	3617679.015	13	2.49	0.132087921	-20.52	1.56	3.688272616	2017	65.12	5.3
INDIAN BANK	1	1.158765428	12.71	47908.46	1013893.147	103	12.11	0.002332084	20.18	3.41	6.963965191	2010	45.73	-2
INDIAN BANK	1	1.174280834	13.56	52823.841	1217183.058	104	8.87	0.005276286	19.27	3.62	5.65070175	2011	46.67	1.3
INDIAN BANK	1	1.170588867	13.47	87363.28711	1414191.998	105	9.3	0.013250468	17.19	3.36	4.468185538	2012	53.44	2.5
INDIAN BANK	1	1.196600799	13.08	92130.16662	1628226.048	106	10.92	0.022569505	13.89	2.98	4.338613754	2013	58.60	3.9
INDIAN BANK	1	1.901693777	12.64	98013.69876	1872262.208	107	6.37	0.022614131	8.97	2.49	4.143479908	2014	61.03	6.7
INDIAN BANK	1	1.793811508	12.86	105276.7363	1928360	108	5.88	0.025002871	6.94	2.35	4.304730971	2015	64.15	7.6
INDIAN BANK	1	1.766491651	13.2	113861.4489	2037103.82	109	4.97	0.041994876	4.54	2.24	4.503673897	2016	67.20	6.2

INDIAN BANK	1	1.642166071	13.64	121960.0563	2182331.47	110	2.49	0.043904476	8.41	2.44	2.560885171	2017	65.12	5.3
INDIAN OVERSEAS BANK	0.928	1.455156847	14.78	47908.46	1310916.294	73	12.11	0.025253054	9.63	2.51	5.848158817	2010	45.73	-2
INDIAN OVERSEAS BANK	0.978	1.611839292	14.55	52823.841	1787842.785	74	8.87	0.011878607	12.73	2.72	5.599426194	2011	46.67	1.3
INDIAN OVERSEAS BANK	0.961	1.729027243	13.32	87363.28711	2196371.26	75	9.3	0.013554433	9.88	2.52	4.6435283	2012	53.44	2.5
INDIAN OVERSEAS BANK	0.98	1.703585399	11.85	92130.16662	2446560.347	76	10.92	0.025112912	4.47	2.26	4.021083874	2013	58.60	3.9
INDIAN OVERSEAS BANK	0.973	2.671644972	10.78	98013.69876	2748986.666	77	6.37	0.032170052	4.06	2.15	4.268880809	2014	61.03	6.7
INDIAN OVERSEAS BANK	1	2.608150802	10.11	105276.7363	2856370	78	5.88	0.05713529	-2.86	1.92	4.424418594	2015	64.15	7.6
INDIAN OVERSEAS BANK	0.98	2.224531819	9.67	113861.4489	2744367.636	79	4.97	0.119436157	-18.51	1.92	5.113561396	2016	67.20	6.2
INDIAN OVERSEAS BANK	0.99	1.901600215	10.49	121960.0563	2471674.874	80	2.49	0.140605968	-23.23	1.99	4.652701462	2017	65.12	5.3
ORIENTAL BANK OF COMMERCE	1	1.579440483	12.54	47908.46	1374309.933	67	12.11	0.008669614	14.51	2.33	5.884254945	2010	45.73	-2
ORIENTAL BANK OF COMMERCE	1	1.543310904	14.23	52823.841	1613433.732	68	8.87	0.009781748	15.55	2.80	5.897443206	2011	46.67	1.3
ORIENTAL BANK OF COMMERCE	1	1.511300164	12.69	87363.28711	1775345.827	69	9.3	0.021959999	9.91	2.49	4.766227555	2012	53.44	2.5
ORIENTAL BANK OF COMMERCE	1	1.48245449	12.04	92130.16662	2006972.027	70	10.92	0.022509081	10.74	2.49	4.071773326	2013	58.60	3.9
ORIENTAL BANK OF COMMERCE	1	2.267491368	11.01	98013.69876	2203025.038	71	6.37	0.028073227	8.70	2.44	4.530658054	2014	61.03	6.7
ORIENTAL BANK OF COMMERCE	1	2.162531259	11.41	105276.7363	2305136	72	5.88	0.033155699	3.65	2.26	4.419862397	2015	64.15	7.6
ORIENTAL BANK OF COMMERCE	0.995	2.069969629	11.76	113861.4489	2397680.025	73	4.97	0.066712458	1.09	2.29	3.934170574	2016	67.20	6.2

ORIENTAL BANK OF COMMERCE	1	1.973552763	11.64	121960.0563	2530647.25	74	2.49	0.089519928	-7.53	1.99	4.272856559	2017	65.12	5.3
PUNJAB AND SIND BANK	0.916	0.645593627	13.10	47908.46	566648.788	102	12.11	0.003573321	21.40	2.42	6.68538009	2010	45.73	-2
PUNJAB AND SIND BANK	1	0.662845268	12.94	52823.841	685501.412	103	8.87	0.005580488	16.39	2.49	6.680949415	2011	46.67	1.3
PUNJAB AND SIND BANK	1	0.611671379	13.26	87363.28711	729052.651	104	9.3	0.011864427	11.21	2.12	4.992990257	2012	53.44	2.5
PUNJAB AND SIND BANK	1	0.595362629	12.91	92130.16662	804779.033	105	10.92	0.021589793	7.66	2.14	4.03703358	2013	58.60	3.9
PUNJAB AND SIND BANK	1	0.992950279	11.04	98013.69876	945091.547	106	6.37	0.033519065	6.25	1.85	5.115367448	2014	61.03	6.7
PUNJAB AND SIND BANK	1	0.919188097	11.24	105276.7363	977534	107	5.88	0.035478217	2.29	1.75	3.842430795	2015	64.15	7.6
PUNJAB AND SIND BANK	1	0.904122823	10.91	113861.4489	1025814.186	108	4.97	0.046145982	5.81	2.17	3.726365898	2016	67.20	6.2
PUNJAB AND SIND BANK	1	0.769665787	11.05	121960.0563	966434.371	109	2.49	0.074999828	3.32	2.17	4.516268596	2017	65.12	5.3
PUNJAB NATIONAL BANK	1	3.274650627	14.16	47908.46	2966327.772	116	12.11	0.005260898	24.12	3.12	6.178540299	2010	45.73	-2
PUNJAB NATIONAL BANK	1	3.472745293	12.42	52823.841	3783252.402	117	8.87	0.008420379	22.60	3.50	6.284776457	2011	46.67	1.3
PUNJAB NATIONAL BANK	1	3.678212521	12.63	87363.28711	4581923.472	118	9.3	0.015162058	19.80	3.21	4.036055578	2012	53.44	2.5
PUNJAB NATIONAL BANK	1	3.300046297	12.72	92130.16662	4789477.339	119	10.92	0.023434572	15.70	3.17	3.734488581	2013	58.60	3.9
PUNJAB NATIONAL BANK	1	5.289905036	11.52	98013.69876	5504199.153	120	6.37	0.028393549	9.75	3.14	4.041565429	2014	61.03	6.7
PUNJAB NATIONAL BANK	1	5.314683576	12.21	105276.7363	6033336	121	5.88	0.040460205	8.17	2.87	4.015181896	2015	64.15	7.6
PUNJAB NATIONAL BANK	0.973	5.479740768	11.28	113861.4489	6673904.554	122	4.97	0.085909152	-10.27	2.41	3.967552665	2016	67.20	6.2

PUNJAB NATIONAL BANK	1	5.593914061	11.66	121960.0563	7203305.484	123	2.49	0.077956219	3.30	2.16	3.499781559	2017	65.12	5.3
SYNDICATE BANK	0.999	1.536994725	12.70	47908.46	1390509.487	85	12.11	0.010654118	15.29	2.03	5.170136545	2010	45.73	-2
SYNDICATE BANK	1	1.504929908	13.04	52823.841	1565387.876	86	8.87	0.009653694	16.53	2.97	6.671264541	2011	46.67	1.3
SYNDICATE BANK	0.994	1.530448906	12.24	87363.28711	1824680.675	87	9.3	0.009589292	16.32	3.00	4.827489615	2012	53.44	2.5
SYNDICATE BANK	1	1.562169039	12.59	92130.16662	2151223.251	88	10.92	0.007621993	20.47	2.74	3.76312156	2013	58.60	3.9
SYNDICATE BANK	1	2.488444864	11.41	98013.69876	2518614.738	89	6.37	0.015643507	15.29	2.37	5.047215536	2014	61.03	6.7
SYNDICATE BANK	1	2.707149487	10.54	105276.7363	3031353	90	5.88	0.018960406	12.23	1.99	3.950229285	2015	64.15	7.6
SYNDICATE BANK	0.945	2.593325937	11.16	113861.4489	3079674.448	91	4.97	0.044768027	-12.94	1.96	4.331158252	2016	67.20	6.2
SYNDICATE BANK	1	2.344451764	12.03	121960.0563	2990733.357	92	2.49	0.052141102	2.71	2.07	4.383188448	2017	65.12	5.3
UCO BANK	1	1.607782762	13.21	47908.46	1373194.902	67	12.11	0.011711841	22.08	1.87	5.274363839	2010	45.73	-2
UCO BANK	0.984	1.612381467	13.71	52823.841	1633984.532	68	8.87	0.018416625	14.36	2.56	6.367273515	2011	46.67	1.3
UCO BANK	1	1.492293879	12.35	87363.28711	1804983.991	69	9.3	0.019594424	13.83	2.27	4.327755736	2012	53.44	2.5
UCO BANK	1	1.461667145	14.15	92130.16662	1986513.993	70	10.92	0.031721384	6.76	2.42	2.872046761	2013	58.60	3.9
UCO BANK	1	2.33832771	12.68	98013.69876	2391247.535	71	6.37	0.02377537	14.45	2.77	3.366114593	2014	61.03	6.7
UCO BANK	1	2.27199903	12.17	105276.7363	2459169	72	5.88	0.042962625	9.57	2.29	3.361916819	2015	64.15	7.6
UCO BANK	1	2.052168803	9.63	113861.4489	2448825.314	73	4.97	0.090890406	-22.33	1.98	3.246436508	2016	67.20	6.2
UCO BANK	1	1.811100182	10.93	121960.0563	2313397.065	74	2.49	0.089400199	-14.64	1.60	3.799715117	2017	65.12	5.3
UNION BANK OF INDIA	0.965	2.233269907	12.51	47908.46	1951618.43	91	12.11	0.00809058	21.65	2.35	6.38866892	2010	45.73	-2
UNION BANK OF INDIA	0.976	2.247041665	12.95	52823.841	2359844.47	92	8.87	0.011944412	17.96	2.88	7.462548175	2011	46.67	1.3
UNION BANK OF INDIA	1	2.159600176	11.85	87363.28711	2622114.375	93	9.3	0.017005816	13.05	2.73	4.436709812	2012	53.44	2.5
UNION BANK OF INDIA	0.999	2.222967774	11.45	92130.16662	3121337.676	94	10.92	0.016114055	13.52	2.63	3.448174704	2013	58.60	3.9

UNION BANK OF INDIA	0.985	3.48845196	10.80	98013.69876	3537809.023	95	6.37	0.02330924	9.48	2.37	5.206521098	2014	61.03	6.7
UNION BANK OF INDIA	1	3.358865364	10.22	105276.7363	3816159	96	5.88	0.027063745	9.32	2.30	3.947182441	2015	64.15	7.6
UNION BANK OF INDIA	1	3.395738135	10.56	113861.4489	4046959.024	97	4.97	0.052462054	6.34	2.11	3.85591275	2016	67.20	6.2
UNION BANK OF INDIA	1	3.404658646	11.79	121960.0563	4527044.402	98	2.49	0.065739257	2.37	2.08	3.649278852	2017	65.12	5.3
STATE BANK OF HYDERABAD	1	0.95838372	14.90	47908.46	883860.163	69	12.11	0.005469586	22.02	2.26	5.777036109	2010	45.73	-2
STATE BANK OF HYDERABAD	1	0.983647349	14.25	52823.841	1066980.408	70	8.87	0.008694643	24.35	2.92	7.531789126	2011	46.67	1.3
STATE BANK OF HYDERABAD	1	0.956712264	13.56	87363.28711	1183154.466	71	9.3	0.013003504	21.98	2.99	4.849191843	2012	53.44	2.5
STATE BANK OF HYDERABAD	1	0.955090503	12.36	92130.16662	1360780.614	72	10.92	0.016121814	17.70	3.08	4.685522664	2013	58.60	3.9
STATE BANK OF HYDERABAD	1	1.400530672	12.00	98013.69876	1414890.538	73	6.37	0.031205137	12.74	2.86	4.691242105	2014	61.03	6.7
STATE BANK OF HYDERABAD	1	1.379779759	11.26	105276.7363	1545028	74	5.88	0.02235545	14.66	2.97	3.748593943	2015	64.15	7.6
STATE BANK OF HYDERABAD	1	1.35914797	11.62	113861.4489	1645967.81	75	4.97	0.033702321	10.65	2.88	3.959588128	2016	67.20	6.2
STATE BANK OF HYDERABAD	0.991	1.276765833	11.72	121960.0563	1631898.8	76	2.49	0.128425288	-28.62	2.32	4.490874557	2017	65.12	5.3
STATE BANK OF INDIA	1	10.56111093	13.39	47908.46	10534137.31	204	12.11	0.017201973	14.80	2.35	5.818308891	2010	45.73	-2
STATE BANK OF INDIA	1	10.36536906	11.98	52823.841	12237362.01	205	8.87	0.016316351	12.62	2.86	7.713713432	2011	46.67	1.3
STATE BANK OF INDIA	1	10.11294337	13.86	87363.28711	13355192.31	206	9.3	0.018233327	15.72	3.38	4.049057472	2012	53.44	2.5
STATE BANK OF INDIA	1	10.13662181	12.92	92130.16662	15662112.74	207	10.92	0.020998596	15.43	3.06	4.203162893	2013	58.60	3.9
STATE BANK OF INDIA	1	16.34103176	12.44	98013.69876	17927482.91	208	6.37	0.02570287	10.03	2.93	4.73885061	2014	61.03	6.7
STATE BANK OF INDIA	1	16.71422855	12.00	105276.7363	20480798	209	5.88	0.021223092	10.62	2.86	5.658170627	2015	64.15	7.6
STATE BANK OF INDIA	1	17.14834273	13.12	113861.4489	23576175.39	210	4.97	0.038127351	7.30	2.6	5.498318669	2016	67.20	6.2
STATE BANK OF INDIA	1	18.39808539	13.11	121960.0563	27059663.04	211	2.49	0.037093872	6.31	2.44	4.730199985	2017	65.12	5.3

STATE BANK OF MYSORE	1	0.510642632	12.42	47908.46	454089.364	97	12.11	0.010150035	18.06	2.88	6.090475538	2010	45.73	-2
STATE BANK OF MYSORE	1	0.479743203	13.76	52823.841	520324.601	98	8.87	0.013749121	15.77	3.36	5.199992182	2011	46.67	1.3
STATE BANK OF MYSORE	0.984	0.48630527	12.55	87363.28711	604035.677	99	9.3	0.019289923	9.62	2.82	5.009381169	2012	53.44	2.5
STATE BANK OF MYSORE	1	0.480131905	11.79	92130.16662	672327.57	100	10.92	0.026901419	10.00	2.88	3.57662963	2013	58.60	3.9
STATE BANK OF MYSORE	0.999	0.721423608	11.08	98013.69876	739763.459	101	6.37	0.032946762	6.18	2.73	3.864535785	2014	61.03	6.7
STATE BANK OF MYSORE	0.965	0.700285131	11.42	105276.7363	794689	102	5.88	0.021558124	8.62	2.72	4.89741374	2015	64.15	7.6
STATE BANK OF MYSORE	1	0.699204675	12.43	113861.4489	829750.038	103	4.97	0.041835129	7.03	2.6	4.417696815	2016	67.20	6.2
STATE BANK OF MYSORE	0.883	0.706088483	12.41	121960.0563	889957.545	104	2.49	0.168945694	-44.37	2.18	5.247368176	2017	65.12	5.3
STATE BANK OF PATIALA	1	0.847812992	13.26	47908.46	760769.671	93	12.11	0.010415294	16.01	2.11	5.237358148	2010	45.73	-2
STATE BANK OF PATIALA	0.984	0.755439504	13.41	52823.841	812862.46	94	8.87	0.012069442	16.65	2.97	4.933099869	2011	46.67	1.3
STATE BANK OF PATIALA	0.973	0.769546898	12.30	87363.28711	985270.726	95	9.3	0.013481002	17.95	2.60	7.241468867	2012	53.44	2.5
STATE BANK OF PATIALA	1	0.747323359	11.12	92130.16662	1085506.268	96	10.92	0.016181753	13.17	2.37	3.691592356	2013	58.60	3.9
STATE BANK OF PATIALA	1	1.050877049	10.38	98013.69876	1141207.339	97	6.37	0.031664853	7.80	2.33	7.137853218	2014	61.03	6.7
STATE BANK OF PATIALA	1	0.969037536	12.06	105276.7363	1167091	98	5.88	0.03877349	5.41	2.25	4.491054853	2015	64.15	7.6
STATE BANK OF PATIALA	1	1.059718184	10.88	113861.4489	1316622.936	99	4.97	0.039765552	-12.85	2.11	3.899668432	2016	67.20	6.2
STATE BANK OF PATIALA	1	0.906921126	11.18	121960.0563	1228291.649	100	2.49	0.154819878	-43.75	1.78	4.268496822	2017	65.12	5.3
STATE BANK OF TRAVANCORE	1	0.668292803	13.74	47908.46	594547.045	65	12.11	0.009110466	26.88	2.60	5.833081967	2010	45.73	-2
STATE BANK OF TRAVANCORE	1	0.64547289	12.54	52823.841	709767.534	66	8.87	0.009794713	23.09	2.42	6.635372564	2011	46.67	1.3
STATE BANK OF TRAVANCORE	0.971	0.692542664	13.55	87363.28711	859866.883	67	9.3	0.015422447	13.93	2.27	5.555100167	2012	53.44	2.5
STATE BANK OF TRAVANCORE	1	0.713203985	11.70	92130.16662	1015793.258	68	10.92	0.014649185	14.94	2.3	4.473355546	2013	58.60	3.9

STATE BANK OF TRAVANCORE	1	1.046933915	10.79	98013.69876	1052854.179	69	6.37	0.027786337	6.81	2.32	4.234744702	2014	61.03	6.7
STATE BANK OF TRAVANCORE	0.993	0.965428227	10.89	105276.7363	1055954	70	5.88	0.020352846	6.83	2.17	5.056967867	2015	64.15	7.6
STATE BANK OF TRAVANCORE	1	1.001905216	11.60	113861.4489	1145067.799	71	4.97	0.027703884	5.99	2.32	4.649325398	2016	67.20	6.2
STATE BANK OF TRAVANCORE	0.945	1.031937792	12.19	121960.0563	1259166.088	72	2.49	0.102157299	-41.25	2.03	5.44716298	2017	65.12	5.3
UNITED BANK OF INDIA	1	0.895467494	12.80	47908.46	770049.896	92	12.11	0.018392376	9.24	2.00	6.112614361	2010	45.73	-2
UNITED BANK OF INDIA	0.974	0.863970164	13.05	52823.841	900405.256	93	8.87	0.014156551	11.74	2.60	6.600530497	2011	46.67	1.3
UNITED BANK OF INDIA	0.968	0.86353662	12.69	87363.28711	1020103.927	94	9.3	0.017060498	11.93	2.58	4.991441979	2012	53.44	2.5
UNITED BANK OF INDIA	1	0.848285574	11.66	92130.16662	1146151.131	95	10.92	0.028588278	6.84	2.30	3.356113361	2013	58.60	3.9
UNITED BANK OF INDIA	1	1.306778956	9.81	98013.69876	1251049.502	96	6.37	0.070918146	-21.73	2.14	5.011614027	2014	61.03	6.7
UNITED BANK OF INDIA	1	1.153481742	10.57	105276.7363	1230276	97	5.88	0.061132331	4.61	2.01	4.72707094	2015	64.15	7.6
UNITED BANK OF INDIA	1	1.153327039	10.08	113861.4489	1294317.504	98	4.97	0.089783897	-4.83	1.81	4.690075334	2016	67.20	6.2
UNITED BANK OF INDIA	1	1.142162898	11.14	121960.0563	1410531.124	99	2.49	0.099666167	3.33	1.43	4.703518403	2017	65.12	5.3
VIJAYA BANK	0.927	0.81339987	12.50	47908.46	702070.409	79	12.11	0.014017745	15.32	2.19	5.839267386	2010	45.73	-2
VIJAYA BANK	1	0.812955546	13.88	52823.841	820133.707	80	8.87	0.015213073	12.63	2.56	5.952491075	2011	46.67	1.3
VIJAYA BANK	1	0.804807929	13.06	87363.28711	957640.12	81	9.3	0.017235673	11.54	2.14	4.743466931	2012	53.44	2.5
VIJAYA BANK	0.99	0.817655842	11.32	92130.16662	1109817.502	82	10.92	0.013039204	10.83	1.82	3.530037759	2013	58.60	3.9
VIJAYA BANK	1	1.456622991	10.56	98013.69876	1373586.128	83	6.37	0.015488436	7.27	1.68	4.03338956	2014	61.03	6.7
VIJAYA BANK	1	1.339257157	11.43	105276.7363	1425922	84	5.88	0.019144051	7.29	1.64	4.582505056	2015	64.15	7.6
VIJAYA BANK	1	1.242891676	12.58	113861.4489	1454087.409	85	4.97	0.048061198	5.54	1.92	4.31084807	2016	67.20	6.2
VIJAYA BANK	1	1.196803317	12.73	121960.0563	1548815.759	86	2.49	0.04355588	9.51	2.34	3.72569892	2017	65.12	5.3
STATE BANK OF BIKANER AND JAIPUR	1	0.604928169	13.30	47908.46	541435.16	47	12.11	0.00768072	20.39	2.41	6.828043002	2010	45.73	-2

STATE BANK OF BIKANER AND JAIPUR	1	0.597686704	11.68	52823.841	629544.917	48	8.87	0.008283372	20.91	3.02	8.540838097	2011	46.67	1.3
STATE BANK OF BIKANER AND JAIPUR	1	0.596633593	13.76	87363.28711	725281.333	49	9.3	0.019198354	18.59	3.28	5.979907584	2012	53.44	2.5
STATE BANK OF BIKANER AND JAIPUR	1	0.60779148	12.16	92130.16662	860168.252	50	10.92	0.022665521	16.36	3.24	7.156576783	2013	58.60	3.9
STATE BANK OF BIKANER AND JAIPUR	1	0.865735731	11.55	98013.69876	908769.736	51	6.37	0.027595329	14.46	3.19	7.423662311	2014	61.03	6.7
STATE BANK OF BIKANER AND JAIPUR	1	0.892948063	11.57	105276.7363	1023015	52	5.88	0.02543796	13.67	3.05	7.612005432	2015	64.15	7.6
STATE BANK OF BIKANER AND JAIPUR	1	0.931418748	10.44	113861.4489	1102880.804	53	4.97	0.027495677	13.34	3.11	8.808918303	2016	67.20	6.2
STATE BANK OF BIKANER AND JAIPUR	1	0.935840616	9.00	121960.0563	1162933.423	54	2.49	0.10534781	-20.90	2.54	7.392222401	2017	65.12	5.3

Source: Compiled by the author using Reserve Bank of India database

Appendix 3. Results of data stationarity tests for research variables

Appendix 3.1. Results of data stationarity tests for research variables before the financial crisis

Table 5.28. Summary of results of Unit root tests for ROE before the crisis

Panel unit root test: Summary

Series: ROE Date: 10/06/20 Time: 15:39 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.16014	0.0000	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.02064	0.4918	25	125
ADF - Fisher Chi-square	50.3725	0.4586	25	125
PP - Fisher Chi-square	97.8757	0.0001	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.29. Summary of results of Unit root tests for EFF before the crisis

Panel unit root test: Summary

Series: EFF Date: 10/06/20 Time: 15:50 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.4970	0.0000	16	80
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.69671	0.0449	16	80
ADF - Fisher Chi-square	48.0404	0.0341	16	80
PP - Fisher Chi-square	58.5326	0.0029	16	80

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.30. Summary of results of Unit root tests for CAPAD before the crisis

Panel unit root test: Summary

Series: CAPAD Date: 10/06/20 Time: 15:40 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-15.8085	0.0000	25	80
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.85186	0.0022	25	125
ADF - Fisher Chi-square	85.8492	0.0012	25	125
PP - Fisher Chi-square	114.578	0.0000	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.31. Summary of results of Unit root tests for LAGE before the crisis

Series: LAGE Date: 10/06/20 Time: 15:40 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-29.8833	0.00	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-782.028	0.00	25	125
ADF - Fisher Chi-square	460.517	0.00	25	125
PP - Fisher Chi-square	442.096	0.00	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

5.32. Summary of results of Unit root tests for SIZE before the crisis

Series: SIZE Date: 10/06/20 Time: 15:40 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	9.92825	1.00	25	119
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	9.55762	1.00	22	110
ADF - Fisher Chi-square	6.05563	1.00	25	119
PP - Fisher Chi-square	8.34529	1.00	25	119

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.33. Summary of results of Unit root tests for MSHARE before the crisis

Series: MSHARE Date: 10/06/20 Time: 15:41 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.57951	0.00	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.29247	0.6150	25	125
ADF - Fisher Chi-square	52.3089	0.3844	25	125
PP - Fisher Chi-square	70.5389	0.0294	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.34. Smmary of results of unit root tests for LIQ before the crisis

Series: LIQ Date: 10/06/20 Time: 15:42 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-10.7238	0.00	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.86443	0.0021	25	125
ADF - Fisher Chi-square	90.5650	0.0004	25	125
PP - Fisher Chi-square	116.791	0.00	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.35. Summary of results of Unit root tests for NIM before the crisis

Series: NIM Date: 10/06/20 Time: 15:43 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.66371	0.00	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.04087	0.5163	25	125
ADF - Fisher Chi-square	51.9202	0.3989	25	125
PP - Fisher Chi-square	72.3848	0.0209	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.36. Summary of results of Unit root tests for NPA before the crisis

Series: NPA Date: 10/06/20 Time: 15:44 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-11.856	0.00	25	124
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.62494	0.0043	25	124
ADF - Fisher Chi-square	84.3636	0.0017	25	124
PP - Fisher Chi-square	172.077	0.00	25	124

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.37. Summary of results of Unit root tests for INF before the crisis

Series: LIQ Date: 10/06/20 Time: 15:42 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	8.38718	1.00	26	130
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	5.75035	1.00	26	130
ADF - Fisher Chi-square	3.12816	1.00	26	130
PP - Fisher Chi-square	4.36821	1.00	26	130

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.38. Summary of results of Unit root tests for LGDP before the crisis

Series: LGDP Date: 10/06/20 Time: 15:42 Sample: 2002 2007 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	17.1723	1.00	25	125
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	11.7605	1.00	25	125
ADF - Fisher Chi-square	0.12160	1.00	25	125
PP - Fisher Chi-square	0.00804	1.00	25	125

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Appendix 3.2. Results of data stationarity tests for research variables after the financial crisis

Table 5.39. Summary of results of Unit root tests for ROE after the crisis

Series: ROE Date: 10/13/20 Time: 15:57 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	4.86501	1.00	26	171
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	6.51922	1.00	26	171
ADF - Fisher Chi-square	-3.07757	0.0299	26	171
PP - Fisher Chi-square	26.5266	0.9987	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.40. Summary of results of unit root tests for EFF after the crisis

Series: EFF Date: 10/13/20 Time: 15:58 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.62343	0.00	13	86
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.02020	0.1538	13	86
ADF - Fisher Chi-square	55.3227	0.0007	13	86
PP - Fisher Chi-square	93.4641	0.00	13	86

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.41. Summary results of Unit root tests for CAPAD after the crisis

Series: CAPAD Date: 10/13/20 Time: 15:59 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-29.4005	0.00	26	169
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.42811	0.00	26	169
ADF - Fisher Chi-square	91.6300	0.0006	26	169
PP - Fisher Chi-square	57.5213	0.2782	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.42. Summary results of Unit root tests for LAGE after the crisis

Series: LAGE Date: 10/13/20 Time: 15:59 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-29.0583	0.00	2	13
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-8.90162	0.00	2	13
ADF - Fisher Chi-square	22.9974	0.0001	2	13
PP - Fisher Chi-square	21.7534	0.0002	2	14

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.43. Summary results of Unit root tests for SIZE after the crisis

Series: SIZE Date: 10/13/20 Time: 15:59 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-11.5384	0.00	26	172
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.25578	0.00	26	172
ADF - Fisher Chi-square	138.214	0.00	26	172
PP - Fisher Chi-square	318.690	0.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.44. Summary results of Unit root tests for MSHARE after the crisis

Series: MSHARE Date: 10/13/20 Time: 16.00 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.36237	0.0004	26	182
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.42196	0.9225	26	182
ADF - Fisher Chi-square	25.5780	0.9992	26	182
PP - Fisher Chi-square	22.9569	0.9998	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.45. Summary of results of Unit root tests for LIQ after the crisis

Series: LIQ Date: 10/13/20 Time: 16:01 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-13.8125	0.00	26	173
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.05548	0.0011	26	173
ADF - Fisher Chi-square	98.6088	0.0001	26	173
PP - Fisher Chi-square	86.2177	0.0020	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.46. Summary of results of Unit root tests for NIM after the crisis

Series: NIM Date: 10/13/20 Time: 16:00 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 to 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-13.2596	0.00	26	168
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.18861	0.0007	26	168
ADF - Fisher Chi-square	106.154	0.00	26	168
PP - Fisher Chi-square	56.1451	0.3223	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

5.47. Summary of results of Unit root tests for NPA after the crisis

Series: NPA

Date: 10/13/20 Time: 16:00

Sample: 2010 2017

Exogenous variables: Individual effects

Automatic selection of maximum lags

Automatic lag length selection based on SIC: 0 to 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	22.1742	1.00	26	173
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	14.1551	1.00	26	173
ADF - Fisher Chi-square	2.97200	1.00	26	173
PP - Fisher Chi-square	1.30637	1.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.48. Summary of results of Unit root tests for INF after the crisis

Series: INF Date: 10/13/20 Time: 16:01 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 0 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.01813	0.0218	26	182
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	2.96538	0.9985	26	182
ADF - Fisher Chi-square	12.9763	1.00	26	182
PP - Fisher Chi-square	4.60322	1.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

5.49. Summary of results of Unit root tests for LGDP after the crisis

Series: LGDP Date: 10/13/20 Time: 16:01 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags Automatic lag length selection based on SIC: 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-41.2080	0.00	26	156
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-13.9544	0.00	26	156
ADF - Fisher Chi-square	268.296	0.00	26	156
PP - Fisher Chi-square	165.597	0.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.50. Summary of results of Unit root tests for LEXR after the crisis

Series: LEXR Date: 06/25/22 Time: 06:00 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags User specified lags: 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-30.8887	0.00	26	156
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-9.23954	0.00	26	156
ADF - Fisher Chi-square	199.838	0.00	26	156
PP - Fisher Chi-square	111.582	0.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Table 5.51. Summary of results of Unit root tests for RIR after the crisis

Series: RIR Date: 06/25/22 Time: 06:04 Sample: 2010 2017 Exogenous variables: Individual effects Automatic selection of maximum lags User specified lags: 1 Newey-West automatic bandwidth selection and Bartlett kernel				
Balanced observations for each test			Cross	
Method	Statistic	Prob.**	sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.66264	0.0001	26	156
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.11106	0.8667	26	156
ADF - Fisher Chi-square	27.1799	0.9982	26	156
PP - Fisher Chi-square	241.466	0.00	26	182

Source: Panel unit root test statistics generated by the author using E-Views 11.0

Appendix 4. Spearman's Rank-Order Correlation coefficient calculations

Table 5.69. Spearman's Rank-Order Correlation coefficient calculations before the financial crisis

2002-2007			Ranks							
EFF	**ROE**		EFF	ROE		(eff-μ)	(roe-μ)	(eff-μ)*(roe-μ)	(eff-μ)^2	(roe-μ)^2
0.922	8.45		25	20		-21.54	-56.98	1227.3492	463.9716	3246.72
1	15.44		57	52		10.46	-24.98	-261.2908	109.4116	624.0004
1	34.04		57	149		10.46	72.02	753.3292	109.4116	5186.88
0.979	27.93		49	136		2.46	59.02	145.1892	6.0516	3483.36
1	23.67		57	109		10.46	32.02	334.9292	109.4116	1025.28
1	18.49		57	71		10.46	-5.98	-62.5508	109.4116	35.7604
0.973	24.66		45	117		-1.54	40.02	-61.6308	2.3716	1601.6
0.926	40.31		28	153		-18.54	76.02	-1409.4108	343.7316	5779.04
0.871	36.1		15	151		-31.54	74.02	-2334.5908	994.7716	5478.96
1	31.62		57	147		10.46	70.02	732.4092	109.4116	4902.8
0.968	20.52		39	89		-7.54	12.02	-90.6308	56.8516	144.4804
1	17.78		57	67		10.46	-9.98	-104.3908	109.4116	99.6004
0.972	15.2		43	48		-3.54	-28.98	102.5892	12.5316	839.8404
1	18.81		57	74		10.46	-2.98	-31.1708	109.4116	8.8804
1	20.32		57	87		10.46	10.02	104.8092	109.4116	100.4004
0.943	12.58		30	35		-16.54	-41.98	694.3492	273.5716	1762.32
0.903	12.28		23	32		-23.54	-44.98	1058.8292	554.1316	2023.2
0.976	12.45		47	34		0.46	-42.98	-19.7708	0.2116	1847.28
1	18.4		57	70		10.46	-6.98	-73.0108	109.4116	48.7204
0.837	26.65		10	128		-36.54	51.02	-1864.2708	1335.172	2603.04
1	26.71		57	130		10.46	53.02	554.5892	109.4116	2811.12
1	8.03		57	19		10.46	-57.98	-606.4708	109.4116	3361.68
0.944	14.85		31	45		-15.54	-31.98	496.9692	241.4916	1022.72
0.971	20.65		42	90		-4.54	13.02	-59.1108	20.6116	169.5204
0.972	22.8		43	103		-3.54	26.02	-92.1108	12.5316	677.0404
0.786	26.46		4	127		-42.54	50.02	-2127.8508	1809.652	2502
0.999	25.21		56	120		9.46	43.02	406.9692	89.4916	1850.72

0.923	11.9		27	30		-19.54	-46.98	917.9892	381.8116	2207.12
1	3.26		57	6		10.46	-70.98	-742.4508	109.4116	5038.16
1	16.41		57	59		10.46	-17.98	-188.0708	109.4116	323.2804
1	23.59		57	107		10.46	30.02	314.0092	109.4116	901.2004
1	26.74		57	131		10.46	54.02	565.0492	109.4116	2918.16
1	28.47		57	139		10.46	62.02	648.7292	109.4116	3846.48
1	19.53		57	79		10.46	2.02	21.1292	109.4116	4.0804
1	20.29		57	86		10.46	9.02	94.3492	109.4116	81.3604
1	16.25		57	58		10.46	-18.98	-198.5308	109.4116	360.2404
1	7.2		57	15		10.46	-61.98	-648.3108	109.4116	3841.52
1	13.82		57	41		10.46	-35.98	-376.3508	109.4116	1294.56
1	22.9		57	104		10.46	27.02	282.6292	109.4116	730.0804
1	11.46		57	28		10.46	-48.98	-512.3308	109.4116	2399.04
1	7.68		57	17		10.46	-59.98	-627.3908	109.4116	3597.6
0.954	13.77		34	39		-12.54	-37.98	476.2692	157.2516	1442.48
1	18.16		57	69		10.46	-7.98	-83.4708	109.4116	63.6804
0.873	18.84		16	75		-30.54	-1.98	60.4692	932.6916	3.9204
1	19.62		57	80		10.46	3.02	31.5892	109.4116	9.1204
1	13.81		57	40		10.46	-36.98	-386.8108	109.4116	1367.52
1	13.82		57	41		10.46	-35.98	-376.3508	109.4116	1294.56
1	15.02		57	46		10.46	-30.98	-324.0508	109.4116	959.7604
0.956	1.29		35	4		-11.54	-72.98	842.1892	133.1716	5326.08
0.963	11.56		37	29		-9.54	-47.98	457.7292	91.0116	2302.08
1	19.89		57	83		10.46	6.02	62.9692	109.4116	36.2404
0.948	5.65		33	10		-13.54	-66.98	906.9092	183.3316	4486.32
1	5.98		57	11		10.46	-65.98	-690.1508	109.4116	4353.36
1	14.22		57	44		10.46	-32.98	-344.9708	109.4116	1087.68
1	5.18		57	8		10.46	-68.98	-721.5308	109.4116	4758.24
1	9.12		57	23		10.46	-53.98	-564.6308	109.4116	2913.84
1	8.59		57	21		10.46	-55.98	-585.5508	109.4116	3133.76
0.926	0.94		28	2		-18.54	-74.98	1390.1292	343.7316	5622
0.777	4.05		3	7		-43.54	-69.98	3046.9292	1895.732	4897.2
0.802	7.61		5	16		-41.54	-60.98	2533.1092	1725.572	3718.56
0.993	7.12		54	14		7.46	-62.98	-469.8308	55.6516	3966.48
1	11.97		57	31		10.46	-45.98	-480.9508	109.4116	2114.16

1	24		57	110		10.46	33.02	345.3892	109.4116	1090.32
1	22.29		57	101		10.46	24.02	251.2492	109.4116	576.9604
0.851	32.1		11	148		-35.54	71.02	-2524.0508	1263.092	5043.84
0.86	28.96		13	141		-33.54	64.02	-2147.2308	1124.932	4098.56
1	27.98		57	137		10.46	60.02	627.8092	109.4116	3602.4
1	27.23		57	134		10.46	57.02	596.4292	109.4116	3251.28
1	28.14		57	138		10.46	61.02	638.2692	109.4116	3723.44
1	20.23		57	85		10.46	8.02	83.8892	109.4116	64.3204
0.822	24.51		8	114		-38.54	37.02	-1426.7508	1485.332	1370.48
1	28.67		57	140		10.46	63.02	659.1892	109.4116	3971.52
1	25.34		57	122		10.46	45.02	470.9092	109.4116	2026.8
1	13.11		57	38		10.46	-38.98	-407.7308	109.4116	1519.44
1	10.78		57	26		10.46	-50.98	-533.2508	109.4116	2598.96
0.863	5.27		14	9		-32.54	-67.98	2212.0692	1058.852	4621.28
1	0.98		57	3		10.46	-73.98	-773.8308	109.4116	5473.04
1	1.92		57	5		10.46	-71.98	-752.9108	109.4116	5181.12
1	-15.67		57	1		10.46	-75.98	-794.7508	109.4116	5772.96
1	13.03		57	37		10.46	-39.98	-418.1908	109.4116	1598.4
1	16.63		57	62		10.46	-14.98	-156.6908	109.4116	224.4004
0.946	18.59		32	73		-14.54	-3.98	57.8692	211.4116	15.8404
1	23.14		57	106		10.46	29.02	303.5492	109.4116	842.1604
0.9	24.52		21	115		-25.54	38.02	-971.0308	652.2916	1445.52
1	21.41		57	94		10.46	17.02	178.0292	109.4116	289.6804
1	16.41		57	59		10.46	-17.98	-188.0708	109.4116	323.2804
1	15.55		57	54		10.46	-22.98	-240.3708	109.4116	528.0804
1	19.06		57	76		10.46	-0.98	-10.2508	109.4116	0.9604
1	23.02		57	105		10.46	28.02	293.0892	109.4116	785.1204
0.975	24.92		46	118		-0.54	41.02	-22.1508	0.2916	1682.64
0.969	19.64		40	81		-6.54	4.02	-26.2908	42.7716	16.1604
0.998	21.32		55	93		8.46	16.02	135.5292	71.5716	256.6404
0.964	22.18		38	99		-8.54	22.02	-188.0508	72.9316	484.8804
0.897	6.11		19	13		-27.54	-63.98	1762.0092	758.4516	4093.44
0.745	10.5		1	24		-45.54	-52.98	2412.7092	2073.892	2806.88

0.978	29.14		48	142		1.46	65.02	94.9292	2.1316	4227.6
0.902	18.04		22	68		-24.54	-8.98	220.3692	602.2116	80.6404
0.986	8.68		51	22		4.46	-54.98	-245.2108	19.8916	3022.8
0.97	12.34		41	33		-5.54	-43.98	243.6492	30.6916	1934.24
1	15.88		57	56		10.46	-20.98	-219.4508	109.4116	440.1604
0.896	23.65		18	108		-28.54	31.02	-885.3108	814.5316	962.2404
0.979	25.19		49	119		2.46	42.02	103.3692	6.0516	1765.68
1	21.46		57	95		10.46	18.02	188.4892	109.4116	324.7204
1	16.52		57	61		10.46	-15.98	-167.1508	109.4116	255.3604
1	17.34		57	66		10.46	-10.98	-114.8508	109.4116	120.5604
1	6.06		57	12		10.46	-64.98	-679.6908	109.4116	4222.4
1	15.6		57	55		10.46	-21.98	-229.9108	109.4116	483.1204
1	16.07		57	57		10.46	-19.98	-208.9908	109.4116	399.2004
1	15.33		57	50		10.46	-26.98	-282.2108	109.4116	727.9204
1	10.81		57	27		10.46	-49.98	-522.7908	109.4116	2498
1	12.6		57	36		10.46	-40.98	-428.6508	109.4116	1679.36
0.916	20.74		24	91		-22.54	14.02	-316.0108	508.0516	196.5604
0.776	26.67		2	129		-44.54	52.02	-2316.9708	1983.812	2706.08
0.988	38.32		52	152		5.46	75.02	409.6092	29.8116	5628
1	26.02		57	126		10.46	49.02	512.7492	109.4116	2402.96
1	7.79		57	18		10.46	-58.98	-616.9308	109.4116	3478.64
1	18.58		57	72		10.46	-4.98	-52.0908	109.4116	24.8004
1	24.17		57	113		10.46	36.02	376.7692	109.4116	1297.44
0.82	24.56		7	116		-39.54	39.02	-1542.8508	1563.412	1522.56
0.922	29.39		25	143		-21.54	66.02	-1422.0708	463.9716	4358.64
1	16.81		57	63		10.46	-13.98	-146.2308	109.4116	195.4404
1	10.73		57	25		10.46	-51.98	-543.7108	109.4116	2701.92
0.99	19.99		53	84		6.46	7.02	45.3492	41.7316	49.2804
1	25.74		57	125		10.46	48.02	502.2892	109.4116	2305.92
0.834	26.8		9	132		-37.54	55.02	-2065.4508	1409.252	3027.2
1	26.99		57	133		10.46	56.02	585.9692	109.4116	3138.24
1	15.03		57	47		10.46	-29.98	-313.5908	109.4116	898.8004
1	22.01		57	98		10.46	21.02	219.8692	109.4116	441.8404
1	21.72		57	97		10.46	20.02	209.4092	109.4116	400.8004
0.959	16.95		36	64		-10.54	-12.98	136.8092	111.0916	168.4804
1	19.15		57	77		10.46	0.02	0.2092	109.4116	0.0004

0.814	19.67		6	82		-40.54	5.02	-203.5108	1643.492	25.2004
1	19.43		57	78		10.46	1.02	10.6692	109.4116	1.0404
1	17.04		57	65		10.46	-11.98	-125.3108	109.4116	143.5204
1	15.41		57	51		10.46	-25.98	-271.7508	109.4116	674.9604
1	20.49		57	88		10.46	11.02	115.2692	109.4116	121.4404
0.874	29.63		17	144		-29.54	67.02	-1979.7708	872.6116	4491.68
0.853	34.83		12	150		-34.54	73.02	-2522.1108	1193.012	5331.92
1	30.82		57	146		10.46	69.02	721.9492	109.4116	4763.76
1	25.62		57	123		10.46	46.02	481.3692	109.4116	2117.84
1	24		57	110		10.46	33.02	345.3892	109.4116	1090.32
1	22.48		57	102		10.46	25.02	261.7092	109.4116	626.0004
0.898	25.22		20	121		-26.54	44.02	-1168.2908	704.3716	1937.76
1	27.39		57	135		10.46	58.02	606.8892	109.4116	3366.32
1	15.21		57	49		10.46	-27.98	-292.6708	109.4116	782.8804
1	14.17		57	43		10.46	-33.98	-355.4308	109.4116	1154.64
1	15.52		57	53		10.46	-23.98	-250.8308	109.4116	575.0404
1	21.5		57	96		10.46	19.02	198.9492	109.4116	361.7604
1	25.66		57	124		10.46	47.02	491.8292	109.4116	2210.88
1	29.68		57	145		10.46	68.02	711.4892	109.4116	4626.72
1	24.05		57	112		10.46	35.02	366.3092	109.4116	1226.4
1	21.02		57	92		10.46	15.02	157.1092	109.4116	225.6004
1	22.26		57	100		10.46	23.02	240.7892	109.4116	529.9204
		mean	46.54248	76.98039			sum	-10739.3724	43545.97	298490.9
							rho=		**-0.0942**	

Source: Calculated by the author using Microsoft Excel

Table 5.70. Spearman's Rank-Order Correlation coefficient calculations after the financial crisis

2010-2017			Ranks							
EFF	**ROE**		EFF	ROE	d^2	(effμ)	(roeμ)	(eff-μ)*(roeμ)	(eff-μ)^2	(roe-μ)^2
1	19.14		57	177	14400	7.79	72.5	564.775	60.6841	5256.25
0.976	18.65		30	176	21316	-19.21	71.5	-1373.515	369.024 1	5112.25
1	19.6359 3		57	182	15625	7.79	77.5	603.725	60.6841	6006.25
0.977	10.8440 9		32	114	6724	-17.21	9.5	-163.495	296.184 1	90.25
1	10.1240 4		57	107	2500	7.79	2.5	19.475	60.6841	6.25
1	5.08032 1		57	55	4	7.79	-49.5	-385.605	60.6841	2450.25
0.959	-5.56643		15	26	121	-34.21	-78.5	2685.485	1170.32 4	6162.25
1	-2.21094		57	31	676	7.79	-73.5	-572.565	60.6841	5402.25
0.963	25.96		17	207	36100	-32.21	102.5	-3301.525	1037.48 4	10506.2 5
1	23.24		57	203	21316	7.79	98.5	767.315	60.6841	9702.25
1	19.2483 6		57	178	14641	7.79	73.5	572.565	60.6841	5402.25
1	16.1945 6		57	163	11236	7.79	58.5	455.715	60.6841	3422.25
0.974	5.07114 9		28	54	676	-21.21	-50.5	1071.105	449.864 1	2550.25
1	6.79133 8		57	71	196	7.79	-33.5	-260.965	60.6841	1122.25
1	5.12702 5		57	56	1	7.79	-48.5	-377.815	60.6841	2352.25
1	1.55924 8		57	34	529	7.79	-70.5	-549.195	60.6841	4970.25
0.985	21.86		41	193	23104	-8.21	88.5	-726.585	67.4041	7832.25
1	23.5		57	204	21609	7.79	99.5	775.105	60.6841	9900.25
1	20.6385 7		57	188	17161	7.79	83.5	650.465	60.6841	6972.25
1	15.0748 5		57	149	8464	7.79	44.5	346.655	60.6841	1980.25
1	13.3649 5		57	132	5625	7.79	27.5	214.225	60.6841	756.25

1	8.96436 2		57	90	1089	7.79	-14.5	-112.955	60.6841	210.25
0.947	-13.4831		11	16	25	-38.21	-88.5	3381.585	1460.00 4	7832.25
0.979	3.43626 7		34	41	49	-15.21	-63.5	965.835	231.344 1	4032.25
0.963	12.56		17	123	1123 6	-32.21	18.5	-595.885	1037.48 4	342.25
0.954	15.79		14	159	2102 5	-35.21	54.5	-1918.945	1239.74 4	2970.25
0.997	13.9991 8		52	140	7744	2.79	35.5	99.045	7.7841	1260.25
1	12.2520 1		57	122	4225	7.79	17.5	136.325	60.6841	306.25
1	10.1382 2		57	108	2601	7.79	3.5	27.265	60.6841	12.25
1	5.56926		57	59	4	7.79	-45.5	-354.445	60.6841	2070.25
0.884	-19.4979		3	10	49	-46.21	-94.5	4366.845	2135.36 4	8930.25
0.947	-5.04483		11	27	256	-38.21	-77.5	2961.275	1460.00 4	6006.25
0.866	16.35		1	165	2689 6	-48.21	60.5	-2916.705	2324.20 4	3660.25
0.997	9.68		52	100	2304	2.79	-4.5	-12.555	7.7841	20.25
1	9.91141 9		57	104	2209	7.79	-0.5	-3.895	60.6841	0.25
1	13.6609 2		57	135	6084	7.79	30.5	237.595	60.6841	930.25
1	5.60793 1		57	60	9	7.79	-44.5	-346.655	60.6841	1980.25
1	5.83968 8		57	64	49	7.79	-40.5	-315.495	60.6841	1640.25
0.993	1.19475 5		47	33	196	-2.21	-71.5	158.015	4.8841	5112.25
0.94	-16.9795		8	12	16	-41.21	-92.5	3811.925	1698.26 4	8556.25
1	22.48		57	199	2016 4	7.79	94.5	736.155	60.6841	8930.25
1	23.2		57	202	2102 5	7.79	97.5	759.525	60.6841	9506.25
1	15.3649 9		57	153	9216	7.79	48.5	377.815	60.6841	2352.25
1	12.0758 4		57	120	3969	7.79	15.5	120.745	60.6841	240.25

1	8.94784 8		57	89	1024	7.79	-15.5	-120.745	60.6841	240.25
1	8.79197 5		57	88	961	7.79	-16.5	-128.535	60.6841	272.25
1	-8.86453		57	22	1225	7.79	-82.5	-642.675	60.6841	6806.25
1	3.43680 2		57	42	225	7.79	-62.5	-486.875	60.6841	3906.25
1	15.01		57	148	8281	7.79	43.5	338.865	60.6841	1892.25
1	13.49		57	133	5776	7.79	28.5	222.015	60.6841	812.25
0.971	4.57055 3		23	50	729	-26.21	-54.5	1428.445	686.964 1	2970.25
0.98	7.31123 6		35	80	2025	-14.21	-24.5	348.145	201.924 1	600.25
1	-8.1208		57	23	1156	7.79	-81.5	-634.885	60.6841	6642.25
1	3.64830 6		57	45	144	7.79	-59.5	-463.505	60.6841	3540.25
0.995	-8.07256		50	24	676	0.79	-80.5	-63.595	0.6241	6480.25
0.887	-13.9587		4	15	121	-45.21	-89.5	4046.295	2043.94 4	8010.25
1	21.93		57	195	1904 4	7.79	90.5	704.995	60.6841	8190.25
1	21.89		57	194	1876 9	7.79	89.5	697.205	60.6841	8010.25
1	19.5415 7		57	180	1512 9	7.79	75.5	588.145	60.6841	5700.25
1	16.0823 3		57	162	1102 5	7.79	57.5	447.925	60.6841	3306.25
1	5.71700 4		57	62	25	7.79	-42.5	-331.075	60.6841	1806.25
1	5.68077 3		57	61	16	7.79	-43.5	-338.865	60.6841	1892.25
1	-4.6359		57	29	784	7.79	-75.5	-588.145	60.6841	5700.25
1	4.6616		57	52	25	7.79	-52.5	-408.975	60.6841	2756.25
1	21.43		57	191	1795 6	7.79	86.5	673.835	60.6841	7482.25
1	19.55		57	181	1537 6	7.79	76.5	595.935	60.6841	5852.25
1	19.7495 6		57	183	1587 6	7.79	78.5	611.515	60.6841	6162.25
1	15.8257 1		57	160	1060 9	7.79	55.5	432.345	60.6841	3080.25
1	8.54856 2		57	85	784	7.79	-19.5	-151.905	60.6841	380.25
1	3.64107 5		57	43	196	7.79	-61.5	-479.085	60.6841	3782.25
0.951	-12.8287		13	19	36	-36.21	-85.5	3095.955	1311.16 4	7310.25

0.969	-11.6497		22	20	4	-27.21	-84.5	2299.245	740.384 1	7140.25
1	10.53		57	109	2704	7.79	4.5	35.055	60.6841	20.25
1	13.35		57	131	5476	7.79	26.5	206.435	60.6841	702.25
1	11.9522 4		57	119	3844	7.79	14.5	112.955	60.6841	210.25
1	9.25677		57	93	1296	7.79	-11.5	-89.585	60.6841	132.25
1	4.99785 8		57	53	16	7.79	-51.5	-401.185	60.6841	2652.25
1	3.64242 6		57	44	169	7.79	-60.5	-471.295	60.6841	3660.25
1	-14.0849		57	14	1849	7.79	-90.5	-704.995	60.6841	8190.25
0.987	-20.5154		43	9	1156	-6.21	-95.5	593.055	38.5641	9120.25
1	20.18		57	185	1638 4	7.79	80.5	627.095	60.6841	6480.25
1	19.27		57	179	1488 4	7.79	74.5	580.355	60.6841	5550.25
1	17.1924 1		57	170	1276 9	7.79	65.5	510.245	60.6841	4290.25
1	13.8855 3		57	138	6561	7.79	33.5	260.965	60.6841	1122.25
1	8.96895 9		57	91	1156	7.79	-13.5	-105.165	60.6841	182.25
1	6.94025 1		57	75	324	7.79	-29.5	-229.805	60.6841	870.25
1	4.53757 1		57	49	64	7.79	-55.5	-432.345	60.6841	3080.25
1	8.41174 2		57	84	729	7.79	-20.5	-159.695	60.6841	420.25
0.928	9.63		7	99	8464	-42.21	-5.5	232.155	1781.68 4	30.25
0.978	12.73		33	126	8649	-16.21	21.5	-348.515	262.764 1	462.25
0.961	9.88234		16	102	7396	-33.21	-2.5	83.025	1102.90 4	6.25
0.98	4.46899 7		35	48	169	-14.21	-56.5	802.865	201.924 1	3192.25
0.973	4.06204 2		25	47	484	-24.21	-57.5	1392.075	586.124 1	3306.25
1	-2.85639		57	30	729	7.79	-74.5	-580.355	60.6841	5550.25
0.98	-18.5092		35	11	576	-14.21	-93.5	1328.635	201.924 1	8742.25
0.99	-23.2349		44	5	1521	-5.21	-99.5	518.395	27.1441	9900.25

1	14.51		57	144	7569	7.79	39.5	307.705	60.6841	1560.25
1	15.55		57	155	9604	7.79	50.5	393.395	60.6841	2550.25
1	9.90955 7		57	103	2116	7.79	-1.5	-11.685	60.6841	2.25
1	10.7447 6		57	112	3025	7.79	7.5	58.425	60.6841	56.25
1	8.69574 3		57	87	900	7.79	-17.5	-136.325	60.6841	306.25
1	3.65362		57	46	121	7.79	-58.5	-455.715	60.6841	3422.25
0.995	1.08687 7		50	32	324	0.79	-72.5	-57.275	0.6241	5256.25
1	-7.52909		57	25	1024	7.79	-79.5	-619.305	60.6841	6320.25
0.916	21.4		5	190	3422 5	-44.21	85.5	-3779.955	1954.52 4	7310.25
1	16.39		57	167	1210 0	7.79	62.5	486.875	60.6841	3906.25
1	11.2088 1		57	115	3364	7.79	10.5	81.795	60.6841	110.25
1	7.66335 3		57	81	576	7.79	-23.5	-183.065	60.6841	552.25
1	6.25302 6		57	67	100	7.79	-37.5	-292.125	60.6841	1406.25
1	2.28798		57	35	484	7.79	-69.5	-541.405	60.6841	4830.25
1	5.80945 9		57	63	36	7.79	-41.5	-323.285	60.6841	1722.25
1	3.32022 5		57	39	324	7.79	-65.5	-510.245	60.6841	4290.25
1	24.12		57	205	2190 4	7.79	100.5	782.895	60.6841	10100.2 5
1	22.6		57	200	2044 9	7.79	95.5	743.945	60.6841	9120.25
1	19.8045 9		57	184	1612 9	7.79	79.5	619.305	60.6841	6320.25
1	15.6967 7		57	156	9801	7.79	51.5	401.185	60.6841	2652.25
1	9.74905		57	101	1936	7.79	-3.5	-27.265	60.6841	12.25
1	8.16696 5		57	83	676	7.79	-21.5	-167.485	60.6841	462.25
0.973	-10.2711		25	21	16	-24.21	-83.5	2021.535	586.124 1	6972.25
1	3.29521 5		57	38	361	7.79	-66.5	-518.035	60.6841	4422.25
0.999	15.29		54	150	9216	4.79	45.5	217.945	22.9441	2070.25
1	16.53		57	168	1232 1	7.79	63.5	494.665	60.6841	4032.25
0.994	16.3235 7		49	164	1322 5	-0.21	59.5	-12.495	0.0441	3540.25

1	20.4715 7		57	187	1690 0	7.79	82.5	642.675	60.6841	6806.25
1	15.2907 5		57	151	8836	7.79	46.5	362.235	60.6841	2162.25
1	12.2309 2		57	121	4096	7.79	16.5	128.535	60.6841	272.25
0.945	-12.9425		9	17	64	-40.21	-87.5	3518.375	1616.84 4	7656.25
1	2.70678 8		57	37	400	7.79	-67.5	-525.825	60.6841	4556.25
1	22.08		57	198	1988 1	7.79	93.5	728.365	60.6841	8742.25
0.984	14.36		38	141	1060 9	-11.21	36.5	-409.165	125.664 1	1332.25
1	13.8302		57	137	6400	7.79	32.5	253.175	60.6841	1056.25
1	6.75777 3		57	70	169	7.79	-34.5	-268.755	60.6841	1190.25
1	14.4489 5		57	142	7225	7.79	37.5	292.125	60.6841	1406.25
1	9.57129 6		57	97	1600	7.79	-7.5	-58.425	60.6841	56.25
1	-22.3307		57	6	2601	7.79	-98.5	-767.315	60.6841	9702.25
1	-14.644		57	13	1936	7.79	-91.5	-712.785	60.6841	8372.25
0.965	21.65		19	192	2992 9	-30.21	87.5	-2643.375	912.644 1	7656.25
0.976	17.96		30	173	2044 9	-19.21	68.5	-1315.885	369.024 1	4692.25
1	13.0459 4		57	128	5041	7.79	23.5	183.065	60.6841	552.25
0.999	13.5169 4		54	134	6400	4.79	29.5	141.305	22.9441	870.25
0.985	9.48353 3		41	95	2916	-8.21	-9.5	77.995	67.4041	90.25
1	9.31911 5		57	94	1369	7.79	-10.5	-81.795	60.6841	110.25
1	6.33780 1		57	69	144	7.79	-35.5	-276.545	60.6841	1260.25
1	2.36929 3		57	36	441	7.79	-68.5	-533.615	60.6841	4692.25
1	22.02		57	197	1960 0	7.79	92.5	720.575	60.6841	8556.25
1	24.35		57	206	2220 1	7.79	101.5	790.685	60.6841	10302.2 5

1	21.9806 1		57	196	1932 1	7.79	91.5	712.785	60.6841	8372.25
1	17.6967 7		57	171	1299 6	7.79	66.5	518.035	60.6841	4422.25
1	12.7430 9		57	127	4900	7.79	22.5	175.275	60.6841	506.25
1	14.6624 6		57	145	7744	7.79	40.5	315.495	60.6841	1640.25
1	10.6512 7		57	111	2916	7.79	6.5	50.635	60.6841	42.25
0.991	-28.6223		46	4	1764	-3.21	-100.5	322.605	10.3041	10100.2 5
1	14.8		57	146	7921	7.79	41.5	323.285	60.6841	1722.25
1	12.62		57	124	4489	7.79	19.5	151.905	60.6841	380.25
1	15.7211		57	157	1000 0	7.79	52.5	408.975	60.6841	2756.25
1	15.4292 1		57	154	9409	7.79	49.5	385.605	60.6841	2450.25
1	10.0302 8		57	106	2401	7.79	1.5	11.685	60.6841	2.25
1	10.6205 8		57	110	2809	7.79	5.5	42.845	60.6841	30.25
1	7.29753 7		57	79	484	7.79	-25.5	-198.645	60.6841	650.25
1	6.30508		57	68	121	7.79	-36.5	-284.335	60.6841	1332.25
1	18.06		57	174	1368 9	7.79	69.5	541.405	60.6841	4830.25
1	15.77		57	158	1020 1	7.79	53.5	416.765	60.6841	2862.25
0.984	9.62344 2		38	98	3600	-11.21	-6.5	72.865	125.664 1	42.25
1	10.0010 4		57	105	2304	7.79	0.5	3.895	60.6841	0.25
0.999	6.17590 3		54	66	144	4.79	-38.5	-184.415	22.9441	1482.25
0.965	8.62351 1		19	86	4489	-30.21	-18.5	558.885	912.644 1	342.25
1	7.03445 9		57	76	361	7.79	-28.5	-222.015	60.6841	812.25
0.883	-44.3729		2	1	1	-47.21	-103.5	4886.235	2228.78 4	10712.2 5
1	16.01		57	161	1081 6	7.79	56.5	440.135	60.6841	3192.25
0.984	16.65		38	169	1716 1	-11.21	64.5	-723.045	125.664 1	4160.25
0.973	17.9456 3		25	172	2160 9	-24.21	67.5	-1634.175	586.124 1	4556.25
1	13.1732 1		57	129	5184	7.79	24.5	190.855	60.6841	600.25

1	7.80249 7		57	82	625	7.79	-22.5	-175.275	60.6841	506.25
1	5.41365 4		57	57	0	7.79	-47.5	-370.025	60.6841	2256.25
1	-12.8529		57	18	1521	7.79	-86.5	-673.835	60.6841	7482.25
1	-43.745		57	2	3025	7.79	-102.5	-798.475	60.6841	10506.2 5
1	26.88		57	208	2280 1	7.79	103.5	806.265	60.6841	10712.2 5
1	23.09		57	201	2073 6	7.79	96.5	751.735	60.6841	9312.25
0.971	13.9284 2		23	139	1345 6	-26.21	34.5	-904.245	686.964 1	1190.25
1	14.9442 9		57	147	8100	7.79	42.5	331.075	60.6841	1806.25
1	6.80871 5		57	72	225	7.79	-32.5	-253.175	60.6841	1056.25
0.993	6.82857 8		47	73	676	-2.21	-31.5	69.615	4.8841	992.25
1	5.99162 7		57	65	64	7.79	-39.5	-307.705	60.6841	1560.25
0.945	-41.2511		9	3	36	-40.21	-101.5	4081.315	1616.84 4	10302.2 5
1	9.24		57	92	1225	7.79	-12.5	-97.375	60.6841	156.25
0.974	11.74		28	117	7921	-21.21	12.5	-265.125	449.864 1	156.25
0.968	11.933		21	118	9409	-28.21	13.5	-380.835	795.804 1	182.25
1	6.83748 4		57	74	289	7.79	-30.5	-237.595	60.6841	930.25
1	-21.7339		57	7	2500	7.79	-97.5	-759.525	60.6841	9506.25
1	4.60803 3		57	51	36	7.79	-53.5	-416.765	60.6841	2862.25
1	-4.83335		57	28	841	7.79	-76.5	-595.935	60.6841	5852.25
1	3.33469 4		57	40	289	7.79	-64.5	-502.455	60.6841	4160.25
0.927	15.32		6	152	2131 6	-43.21	47.5	-2052.475	1867.10 4	2256.25
1	12.63		57	125	4624	7.79	20.5	159.695	60.6841	420.25
1	11.5400 6		57	116	3481	7.79	11.5	89.585	60.6841	132.25
0.99	10.8337 1		44	113	4761	-5.21	8.5	-44.285	27.1441	72.25

1	7.26695 3		57	77	400	7.79	-27.5	-214.225	60.6841	756.25
1	7.29450 8		57	78	441	7.79	-26.5	-206.435	60.6841	702.25
1	5.53949 4		57	58	1	7.79	-46.5	-362.235	60.6841	2162.25
1	9.51413 6		57	96	1521	7.79	-8.5	-66.215	60.6841	72.25
1	20.39		57	186	1664 1	7.79	81.5	634.885	60.6841	6642.25
1	20.91		57	189	1742 4	7.79	84.5	658.255	60.6841	7140.25
1	18.5878 1		57	175	1392 4	7.79	70.5	549.195	60.6841	4970.25
1	16.3565 4		57	166	1188 1	7.79	61.5	479.085	60.6841	3782.25
1	14.4602 9		57	143	7396	7.79	38.5	299.915	60.6841	1482.25
1	13.6669 8		57	136	6241	7.79	31.5	245.385	60.6841	992.25
1	13.3370 2		57	130	5329	7.79	25.5	198.645	60.6841	650.25
1	-20.8989		57	8	2401	7.79	-96.5	-751.735	60.6841	9312.25
		sum	mean	49.2115 4	104.5		sum	33452	48548.6 9	749892
								rho	**0.17532 1**	

Source: Calculated by the author using Microsoft Excel