FINANCIAL PERFORMANCE OF INDIAN COMMERCIAL BANKS- A STUDY OF THE IMPACT OF SELECTED DETERMINANTS WITH EMPHASIS ON BUSINESS CYCLE

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ACRONYMS AND ABBREVIATIONS

ARC	Asset Reconstruction Company.
ATM	Automated Teller Machine.
BCBS	Basel Committee on Banking Supervision.
BIS	Bank for International Settlements.
CAGR	Compounded Annual Growth Rate.
CAMELS	Capital adequacy, Asset Quality, Management, Earnings, Liquidity and Systems, and Systems and Internal Control.
CBEC	Central Banking Enquiry Committee.
CBS	Core Banking Solutions.
CEE	Central Eastern and European
CEO	Chief Executive Officer.
CII	Confederation of Indian Industry.
CO	Cyclical Output.
CPI	Consumer Price Index.
CRAR	Capital to Risk Adjusted Ratio.
CRILC	Central Repository of Information on Large Credits.
CRR	Cash Reserve Ratio.
DEA	Data Envelopment Analysis.
DFA	Distribution Free Approach.
DMU	Decision Making Unit.
DSGE	Dynamic Stochastic General Equilibrium.
DVR	Income Diversification Ratio.
ECS	Electronic Clearing Service.
EFF	Technical Efficiency Scores.
EFT	Electronic Fund Transfer.
EU	European Union.
FDH	Free Disposal Hull.
FDIC	Federal Deposit Insurance Corporation, USA.
GDR	Annual Growth rate of Deposits.

GMM	Generalized Method of Moments.
GOI	Government of India.
HHI	Herfindahl–Hirschman Index.
IBA	Indian Banks' Association.
IBBI	Insolvency and Bankruptcy Board of India.
IBC	Insolvency and Bankruptcy Code.
IBEF	India Brand Equity Foundation.
IDRBT	Institute for Development and Research in Banking Technology.
INFINET	Indian Financial Network.
MD	Managing Director.
MICR	Magnetic Ink Character Recognition.
NBFC	Non-Banking Financial Corporation.
NECS	National Electronic Clearing Service.
NEFT	National Electronic Fund Transfer.
NIM	Net Interest Margin.
NPA	Non-Performing Asset.
NPCI	National Payments Corporation of India.
OCC	Office of the Comptroller of the Currency, USA.
OTE	Overall Technical Efficiency.
OTIE	Overall Technical Inefficiency.
PTE	Pure Technical Efficiency.
PTIE	Pure Technical Inefficiency.
RBI	Reserve Bank of India.
ROA	Return on Assets.
ROE	Return on Equity.
RTGS	Real Time Gross Settlement.
RUPAY	Rupee plus Payment.
SFA	Stochastic Frontier Approach.
SIE	Scale Inefficiency.
SLR	Statutory Liquidity Ratio.

SMS	Short Message Service.
TFA	Thick Frontier Approach.
UCB	Urban Cooperative Banks.

CHAPTER I

INTRODUCTION

1.1. Conceptual Framework:

Banks are important for every economy as they deal with one of the most valuable material possessions of the nation, 'Money'. Banking sector performs the role of an intermediary through effective channelization of accepted deposits available with them towards profitable sectors thereby providing good returns on depositor's money (Sarkar & Rakshit, 2021; Schumpeter, 1911) . Like every other country, in India also, banking business is primarily engaged in three main functions i.e., operating the payment system of the economy, mobilization of savings in form of accepting depositor's money and allocation of such savings in investment projects as well as lending funds to borrowers. In this regard the role of banks in India is pivotal to promote greater number of investments that in turn will lead to achieve more rate of growth of the economy. In India due to lack of perfect capital market, majority of the lending and deposit acceptance activities are performed by the Commercial Banks (Public, Private and Foreign). The existing literatures of the recent past and those at present provides ample evidence about the varied nature of different banking activities. Such nature of banking operations tends to affect their financial performance in presence of certain internal factors and other external parameters. This motivates the policymakers and academicians to further study the impact different external or economic factors of banking domain, besides the bank specific factors, on their financial performance. These factors (internal and external) varies considerably across several geographical regions as well as among the developed and emerging economies, thereby motivating researchers to investigate the causes of variations in bank's financial performance across different nations (P. P. Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011).

The history of Indian Banking is all the same as mentioned in different earlier studies and thesis of the recent past. Since the establishment of the Bank of Bombay in Bombay 1770, to the Bank of Hindustan in Calcutta in the same year, most of the banks were small and had private shareholding contributed mostly by family and friends. Later, with intervention of East India Company three well-functioning individual units of banks were established that was collectively known as 'The Presidency Banks'[1]. These Presidency Banks were governed by the

[1] Comprising of The Bank of Bengal 1809, The Bank of Bombay 1840 and The Bank of Madras 1843.

Royal Charters and were entrusted with the powers of issuing currency notes till enactment of Paper Currency Act of 1861. After passing of this Act the power of printing notes was transferred to the British Government. Those three banking units were later merged to form the 'Imperial Bank of India' in 1920, that functioned as a central bank of the country. Later based on the recommendations of the Central Banking Enquiry Committee (Estd. 1929) a special act named the Reserve Bank of India Act 1934 was passed and Reserve Bank of India was established as the Central Bank of this country to act as the apex institution for banking in India.

Banking in India are mostly dominated by Public Sector banks from 1969 when major banks in India was brought under nationalization by Government of India. During 1950s the financial system of India has been liberal with very limited control over interest rates together with less statutory requirements. The dissatisfactory findings of the All-India Rural Credit Survey Committee, RBI (Reserve Bank of India, 1969) towards inequitable distribution of bank credit clearly pointed the inability of markets to efficiently allocate resources that led the government to tighten its control over banks to ensure proper credit flow to genuinely productive areas in conformity with prioritized plans and exercise its authority over such credit allocation process. As a result, controls were employed on lending rates and liquidity requirements were raised to cater the needs to various segments of economy. According to the Central Banking Enquiry Committee (1931) the activity of money lending is prevailing in India long since the Vedic period. Kautilya, a famous economist of ancient India in his book 'Arthasashtra' in 400 BC provides ample reference regarding the lending rates, creditors, lenders, and certain other norms for probable liquidation of banks. His ability to foresight turned into reality as professional banking gradually progressed in India. Such banks necessarily provide services for credit requirement of trade, agriculture, commercial activities as well as for credit need of individuals in the economy. In India, division in banking structure is mainly on their modes of operations and is based on specific areas to whom they cater. Among them the most important are those financial institutions that accepts deposits, offer accounts related services, and provide basic financial products together with making various loan arrangements (Bawa et al., 2019). These are known as Commercial Banks. These banks play a pivotal role for most of the lending activities to different priority sectors, infrastructure projects and serves the need of personal finance also. Our study mainly focuses on these Commercial Banking sectors operating in India. We also provide a short profile of the Indian banking system with the major reforms in Chapter II of this thesis.

The process of exercising Government control increased with the nationalization of 14 major commercial banks in 1969 followed by another phase of nationalization of 6 additional commercial banks in 1980. The old private sector banks, although evolved prior to nationalization of 1969 but such banks were either too small to be considered for nationalization or were specialist to any specific area. Thus, such private banks enjoy their freedom but are under the mandate to procure a license from RBI as per provisions of Banking Regulation Act 1949. New Private Sector banks are those banks that got their banking license post liberalization of Indian economy in 1991. Subsequently RBI included those old and new private banks also into the list of Scheduled Commercial Banks in India.

In the nutshell the history of Indian Banking can be summarized into four different phases namely: Evolution Phase (Prior to 1947)[2]; Foundation Phase (1947 to 1969)[3]; Expansion Phase (1969-1991) and Liberalization Phase and Beyond (1991 onwards). Among these the Liberalization phase marked the most significant events in history of Indian banking. During this phase, based on recommendations of Narsimham Committee private and foreign players were invited into banking business in India. Accordingly, 10 new private sector banks and 22 foreign banks were established till 31st March 1998. During the said period the government also decided to liberalize foreign direct investments to banking sector. Later in September 2005, Reserve Bank of India liberalized the bank branch authorization policy to grant freedom to banks to rationalize policies for setting up new branch offices in India.

However, to cope up with the ever-changing dynamic environment in banking in coming days, RBI initiated the process computerization of banks in 1993 and established a committee to study the challenges of such implementation. During this phase banks gradually started providing internet and phone banking services to their clients as per the guidelines specified by RBI for use of technology. Table-1 (Appendix I) shows a summary of evolution and development of technology infrastructure introduced and subsequently implemented in Indian banking sector. With the development and gradual advancement of technology the ability to deliver financial services also started gaining pace among the Indian banks (Public banks and Private banks of Indian origin) and those of representative branches of foreign banks. For instance, the RBI report of 2008 (Reserve Bank of India, 2008), highlights the fact that increase

[2] That marked the establishment of Allahabad Bank in 1865, Punjab National Bank in 1895 in Lahore and Bank of India in 1906. Later, during the Swadeshi Movement Punjab National Bank Ltd, Bank of India Ltd, Canara Bank Ltd, Indian Bank Ltd etc. were established as private sector banks.

[3] Marked the nationalization of banks and establishment of Banking Regulation Act of 1949, amended in 1965.

in bank performance due to introduction of state-of-the-art technologies is a driving force towards higher efficiency in bank performance vis-à-vis its peer group. At present in India, public, private and foreign banks operate simultaneously but the amount of technology upgradation of the public banks is still low as compared to private and foreign banks. Such development in technology has brought flexibility in banking activities and has contributed towards enhancing their financial performance as well as their productive efficiency. Thus, there is an emerging question of efficiency in banking activities that is very important to analyze, to study the financial performance of different categories of commercial banks vis-a-vis its peer group in India.

Banks always play an important role in economy of every country (Schumpeter, 1911) and India is no exception. A well-functioning financial system leads to effective intermediation of financial resources. The more effectively a financial system generates and allocates resources, the more is its contribution towards economic growth. This simultaneously mitigates the risk in a nation's economy. However, the economy of every country is exposed to certain shocks at present and over the past years, either due to price fluctuations or due to financial profligacy of government or due to terror strike or due to crash in financial system of country having spiral effects on economy of other nations. The very recent shock due to an ongoing global health crisis of 2020 has also affected the economy of our nation. Since banks form an important part of the economy, the study of such economic fluctuations due to shocks is necessary to analyze the real picture of banking operations in India. The evidence of such economic shocks on Indian banking is available in different past studies and also from the aftermath of the latest Global Financial Crisis of 2007. For instance, Dées & Brinca, (2011) highlights that an adverse effect of the financial crisis of 2006-07 led to the most severe global recession inducing policymakers to believe its long term impact on real economy. In another study, Duca, (2013) explains how the subprime lending crisis of 2007 due extended form of risky mortgages and rising house prices had spiral effects across several economies across the globe. Borio et al., (2018) states that booms in economic cycle tends to end the crisis or otherwise weakens the growth of the nation. Similarly, Iacoviello, (2015) uses a DSGE model to estimate the recession losses suffered by banks and how far such loss is exacerbated due to inability of banks to extend credit to real sector. Such fluctuations in the economy hampers the output, employment, income of the economy of every nation. These fluctuations occur cyclically and results in subsequent upswing and downswing in broad measures of the aggregate economy. Such a situation is known as the movement of business cycle in the economy and studying the effects of such

cyclical fluctuations on bank's financial performance has been the growing interest of many policymakers and academicians.

Indian economy is too badly hit by different shocks in the past and in present. The need of a resilient mechanism to safeguard against such shocks has always been felt. But such mechanism should also provide a safety net to the daily banking operations during the period of such shocks. For instance, the downfall of Bretton Woods in 1973 was responsible for serious financial causalities in 1974 era. Following that year in 1975 the governors of Central banks of G-10 countries took initiatives to establish a committee on Banking Regulation and Supervision practices. This committee was later named as Basel Committee on Banking Supervision under Bank for International Settlements headquartered in Basel, Switzerland. As a resolution of the committee the regulators of different central banks agreed to set a minimum capital requirement base to be maintained by banking sector of different countries under the supervision of the Central bank of that country. Such a requirement was thought to serve the major trends in banking industry. During 1985-86, the RBI advised all Indian Commercial Banks to introduce a Health Code System[4], to incorporate and provide for health of individual advances, quality of credit portfolio and extent of such advances that might cause problems in future vis-à-vis total advances. On December 1987, the 'International Convergence of Capital Measure and Capital Standards' was finally achieved and was later renamed as BASEL Accord. Initially it was meant for G-10 countries but over 130 countries across the globe agreed to adhere to these norms. Following this, later in July 1988 the BASEL I norms was created. Accordingly, RBI also decided to follow these international guidelines and implement it suitable to Indian banking industry. In April 1992, RBI also introduced a capital to risk weighted ratio of at around 9 percent that was higher than international standards of 8 percent. All Scheduled banks operating in India was under the mandate to comply with these norms. However, owing to certain loopholes in the BASEL I and its subsequent amendments in 1996, the BASEL II norms were launched in June 2004[5], thereby mandating for full implementation across the globe by March 2007. RBI mandated all commercial banks except the Regional

[4] This mechanism was introduced by Reserve Bank of India during 1985-86 era and all Commercial Banks in India were required to represent themselves in terms of managing their credit risk, forex and liquidity risk from 7th November 1985 onwards. Such Health Codes mandated the banks to disclose the quality of individual advances under eight different categories, with a health code assigned corresponding to each borrower's account.

[5] In 1999 the BCBS released a draft, inviting comments for improvement in the BASEL I norms. Following the different suggestions received, the BIS released the final version of BASEL II Capital Accord on 26th June 2004 that would replace the BASEL I norms of 1988.

Rural Banks to comply with such accord by 31st March 2009. But the sub-prime lending crisis of 2007 that shook the financial system of many countries across the globe, called for some major changes to be made in the BASEL II Capital Accord. Accordingly, the BCBS released the BASEL III[6] norms in December 2010 and was later revised in June 2011. Initially the projected implementation date was extended from 2013 till March 2018 and was later changed to January 2019 for full implementation in India. However, in their 7th Bi-monthly Monetary Policy Statement, RBI decided to defer the full implementation of BASEL III till 30th September 2020[7]. But very recently amid the surge in global pandemic and its adverse effects in India, such full implementation of BASEL III is further deferred to 1st October 2021[8]. The implementation and requirement of such a minimum capital requirement for banks in India has segregated the bank's regulatory capital from its owned capital. To continue their normal course of business operations smoothly and to safeguard themselves during times of economic difficulties banks must rely in strengthening their owned capital to continue their uninterrupted services. This is more because, banks having more strengthened capital base can remain safer and sound during difficult economic scenarios. Moreover, such banks have to depend less on external funding too (Dietrich & Wanzenried, 2011).

Today the Indian banking has come a long way since the liberalisation of Indian economy, 1991 onwards. With the increase in scope of banking activities the banks have been providing many additional services like mutual funds, insurance products, merchant banking facilities, forex services to their clients besides their primary activities of accepting deposits and lending funds. Besides the impact of simultaneous cyclical upswing and downswing in Indian economy banks are also exposed to Non-Performing Loans (hereafter termed as NPA) because of their traditional banking activities. The main source of bank's income should be the interest earned on loans given together with timely receipt of the principal lent and/or interest on such principal but owing to the growing nature of NPAs banks are forced to diversify their activities to mitigate their risk of loss arising from such NPA. This in turn has affected the profitability of Indian banks at large. Generally, the capacity of the banks to generate loans depends on their ability to transform the deposit liability (accepted from their clients) into value creating loans.

[6] BASEL III: A Global Regulatory Framework for more Resilient Banks and Banking System.

[7] Owning to the last trance of Capital Conservation Buffer for 0.625% to reach to the target level of 2.5% (*https://www.rbi.org.in/Scripts/NotificationUser.aspx?Id=11970&Mode=0*).

[8] *https://www.rbi.org.in/Scripts/NotificationUser.aspx?Id=12025&Mode=0*.

Such loans tend to generate returns to the banks in the form of interest earned and principal repayment received. According to a report by the RBI (Reserve Bank of India, 2020), on 'Operations and Performance of Commercial Banks' it appears that out of the large borrowable accounts that comprises 53 percent of gross loans and advances disbursed, has 82 percent of Gross NPAs. Such a scenario is badly affecting the earnings of Indian commercial banks. Further, another report from RBI reveals that unlike the private and foreign banks the public sector banks reported a massive 148 percent drop in their profits (RBI, 2016). Such a situation marks poor asset quality of the Indian commercial banks and indicates their inability to transform their deposit liabilities into value creating loans.

Over the years the study of the impact of different domestic and certain external factors on financial performance of banks is a growing area of interest for various academicians and policy makers. The fact that banking sector operates in a well-diversified environment and studying only the bank-related parameters will only result in partly capturing the effects in bank's financial performance. Prior to the introduction of BASEL I norms, in 1970 three federal banking supervision authorities of the United States of America (U.S.A or U.S.) (the Federal Reserve, the FDIC and the OCC) introduced a model for rating of financial institutions including banks. This model is known as CAMELS and was developed for the first time by the regulators of U.S as "Uniform Financial Institutions Rating System" to depict a complete summary of an individual bank's condition at the time of its on-site examination. Under this mechanism banks are judged based on five different parameters as stated by the acronym C-A-M-E-L-S[9] (Capital Adequacy, Asset Quality, Management, Earnings, Liquidity and Systems and Control) and are allotted a score ranging between 1 to 5. A final CAMELS measure representing the composite scores across different components gives a clear picture of an individual bank's overall condition. The final report is an internal document that is shared only with the MD and CEO of respective banks[10]. However, with the introduction of BASEL II in India during 2004, the CAMELS rating is replaced mostly by the Risk Based Supervision and Risk Based Internal Audit in RBI for commercial banks. We also find that very recently RBI is focusing on risk-based supervision of banks and annual inspection of UCBs and NBFCs.

[9] The full form of the acronym is as per the Reserve Bank of India reports and press releases pertaining to RBI. However, in some of the past literatures the alphabet 'S' in the acronym is termed as Sensitivity also and there still exist ambiguity as to the naming of the alphabet 'S' in the CAMELS acronym.

[10] *https://m.rbi.org.in//Scripts/PublicationReportDetails.aspx?UrlPage=&ID=825*

Such annual supervision of UCBs and NBFCs is largely based on CAMELS model[11]. The financial performance of banks that could be represented through the CAMELS rating system thus only considers key financial ratios in banking industry thereby ignoring other external factors that are primarily important in knowing the changes in financial performance of banks. Also, as the CAMELS report is shared as an internal document, it is very difficult to draw a comparative analysis based on the same. Moreover, over the years RBI has declared different steps to preserve the sustainability of Indian banking industry specially of the Public Sector banks. These includes capital infusion, enhancing provisioning norms, the very recent decision of bank mergers etc. But the effectiveness of these steps will again depend on the efficiency analysis of the sub-sectors in Indian Commercial banking industry only to provide a clearer picture of their performance vis-à-vis the industry best performer. In banking literature analyzing such bank-level efficiencies can be best represented by using the DEA technique that is popularly represented by technical efficiency (explained in detail in Chapter IV). However, drawing conclusive results based on the sole analysis of CAMELS framework will only provide contemporaneous outcome due to several weaknesses in the said framework (RBI, 2012). Therefore, we draw a representative measure by constructing CAMELS rating index based on financial ratios and evaluate the validity of such results in comparison to our results based on DEA technique. Thus, we compute the bank level efficiency that is represented in Chapter IV of the thesis and argue that higher efficiency contributes to increased financial performance of banks.

The landscape of Indian Banking sector has transformed much over the past decades owing to financial liberalization, deregulation, technological change as well as globalization of goods and financial markets. Such developments have considerably impacted upon the operating efficiency, productivity, margins, and financial performance of banking sectors in India. The structure of Indian Commercial Banks is exposed to major transformational changes in the recent past, be it due to the mandate on maintaining a regulated capital base or the situation post demonetization or due to recent policy of bank mergers across the nation. Like other nations in India also different domestic as well as external factors impacts the bank structure and their performance. Despite the increasing trend towards bank mergers together with other policy implications, the primary functions of Indian Commercial Banks remain focused in financing economic activity and effective channelisation of idle funds in general to different segments of market. Over the years different literatures points out various measures to

[11] *https://www.magzter.com/news/1060/3332/052021/6u1lc*

understand financial performance of banks. However, the scope of such literatures to address the contemporary issues prevailing in Indian commercial banking sector are not dealt sufficiently. One of the most threating issues now a days in Indian Commercial Banking sector has been the growing effects of Non-Performing Asset that takes a heavy toll on financial performance of Indian banks.

Financial performance of commercial banks is an interesting area that is explored by different academicians in the past across developed and emerging economies and have attracted policymakers to investigate the various factors that impact such performance. Since loans and advances together with other current and non-current assets generate most of the returns for banks by way of interest or with other income, this study focuses on the profitability aspect of banks, as an indicator of its financial performance. Further, we also find ample evidence by our analysis of a gamut of 223 banking literatures since 1979, that financial performance of banks are best represented by means of their profit earnings measures. Again, considering only the individual bank specific factors as available in most of the past studies only, partly captures the causes of variations in bank's financial performance. Thus, based on the different internal as well external factors this study intends to examine the financial performance of Indian Commercial banks (in terms of its profitability) in presence of certain bank-specific (internal) and selected external factors (industry-specific and macroeconomic).

In reference to the pioneering works of Goddard et al., (2004) and very recent work by Bawa et al., (2019), besides other past studies, the practice has been to employ a linear framework with bank-specific variables thereby partly capturing effects of fluctuations in bank's financial performance. This study moves a step ahead to examine that whether the domestic bank-specific factors in Indian banking sector and effects of certain macroeconomic drivers have any significant impact on financial performance of commercial banks, based on a single equation framework. The presence of a good capital ratio, growth rate of deposits, efficiency in handling performing loans, bank-size, diversification mechanism (to mitigate the losses arising from NPA) etc., are important parameters as highlighted in different past studies. All these factors are expected to have considerable influence on bank's financial performance in terms of their profitability. Also, coupled with the factors of financial performance of commercial banks this study analyzes the effect of efficiency of Indian Commercial banks on their financial performance. There has been a long existing argument among the academicians to view the banks as an intermediary given the nature of their activity in channelisation of idle funds effectively to different profitable market segments. However, on the other contrary few

academicians view this concept of efficiency as being related to operations research. Efficiency refers to the potential of banks to transform their available resources consistently and creating values for their customers. A detail description of efficiency is given in Chapter IV of this study.

We also focus on certain other macroeconomic drivers, like the inflation expectation of consumers and the effects of business cycle component on financial performance of banks. Of these the business cycle component is treated as a matter of key importance due to lack of evidence available in Indian context so far. To the best of our knowledge this is the first work in Indian context to analyze the predictability of certain bank-specific and external parameters on the financial performance of Indian commercial banks. Evidence of such work is available only for foreign countries and worth mentioning among them is the works of Athanasoglou et al., (2008) and that of Dietrich & Wanzenried, (2011).

Finally, we argue that profitability in Indian banking can be best represented by 2 variables: ROA (Return on Asset) and ROE (Return on Equity). While ROA indicates the ability of a bank to generate profits through employment of its earning assets, ROE on the other hand denotes returns available to the shareholders on their equity and often equals to ROA times equity to assets ratio. Thus, it can be said that banks with lower leverage (higher equity)[12] will report higher ROA but lower ROE and as analysis of ROE alone ignores the risk associated with high leverage and as financial leverage is at times determined by regulation, ROA emerges as an important indicator of financial performance of Indian Banks in terms of profitability. Given the nature of ROA, since profits are a kind of flow variable generated during the year since realization of principal as well as interest on loans disbursed is a continuous process the ROA of current year might be significantly affected by the ROA of the immediately preceding year thereby indicating a dynamic nature of our dependent variable. In the presence of such dynamic specification the traditional regression tools cannot be employed to evaluate the causal relationship between the dependent and independent variables. Therefore, we employ a dynamic estimation technique in this study. A detail description of such dynamic specification along with all the variables used in this study is mentioned in detail in Chapter V of this thesis.

Thus, in this study we empirically try to evaluate the predictability of certain bank-specific, an industry-specific and key macroeconomic variables on financial performance of Indian

[12] Leverage is the strategy of using borrowed money in the form of fixed interest based financial instruments or borrowed capital to increase potential of an investment.

commercial banks in terms of their profitability. We also examine the efficiency among different banking sectors (Public, Private and Foreign) in India and try to highlight the reasons of difference among such efficiency scores across the commercial banking sector by employing DEA technique. Thereafter we also draw a comparative analysis and highlight the key weaknesses of CAMELS rating system vis-à-vis the DEA based efficiency results. Further, we also extend our study to investigate the impact of these computed efficiency scores on indices of financial performance of our sample banks.

However, from April 2017, onwards the process of bank merges has commenced with the aim of merging the different public sector banks in this country in order to retain a few but healthier banks. Such process of bank consolidation mainly focuses on the domain of public banking sector that started with merger of State Bank of India with its associates. Besides this, the merger of other key players in public banking domain are also executed vide the announcement in the Financial Budget of 2019 by our Honourable Finance Minister Smt. Nirmala Sitharaman. Therefore, there is a drastic change in asset size, market share, ownership, and asset quality of such merged banks. Thus, to ignore such banks that once happened to be the dominant players of Indian banking sector would be illogical. Further, moving ahead of 2017, to include such merged banks in our analysis might also yield inconsistent estimates as it might be too early to comment on the performance of such merged banks. Again, going backwards beyond 2005-06 will not be prudent as most of the data that we consider in this study are either not available or inapplicable. Hence, the entire study considers a sample of 71 Indian Commercial banks[13] over a period of 12 years from 2005-2006 to 2016-2017. A detail description of the sample size is also provided in Chapter V of the thesis.

1.2. Importance of the study:

We expect the outcome of this study to provide key insights regarding the financial performance of Indian commercial banks vis-à-vis the scenario of accepting deposits and ability of banks to transform these deposits into value creating loans. This study is important as it tend to inspect the fact that whether banks are deviating from their primary activity of accepting deposits and providing value creating loans. Also, this study provides the economic

[13] We use sample of Scheduled Indian Commercial Banks as these banks constitutes major part of the lending and deposit acceptance related activity for the nation. (Bawa et al., 2019).

based efficiency for different categories of banks based on certain augmented parameters and approaches, following the Data Envelopment Analysis.

We also perform robustness checks to provide further statistical insights of our preliminary outcome from this study. The main aim of this thesis is to examine the impact of selected determinants on the financial performance[14] of Indian Commercial banks with emphasis on business cycles in India, within the time frame, 2006 to 2017.

This thesis applies empirical study. Based on the research objectives the data related to bank and industry specific variables are collected from Statistical Table related to Banks in India published by Reserve Bank of India. Data on macroeconomic variables are collected from CMIE Economic Outlook[15] and from World Development Indicators published by World Bank. To address the study objectives, this study applies appropriate econometric tools related to data envelopment and panel data analysis.

1.3. Structure of the Thesis:

The entire thesis is divided into six broad categories whereby,

Chapter one, titled, *'Introduction'* explains the context and background of the study. It also specifies the brief objectives of this study.

Chapter two, titled, *'A Profile of Indian Banking System'* gives an overview of the Indian Commercial banking sectors and the important reforms that has taken place in the domain of Indian banking. Further this chapter also states the importance of industry concentration and financial performance of Indian banks.

Chapter three, titled, *'Review of Literature'* aims to summarize the different theoretical and empirical works done so far on relationship between financial performance of banks and selected determinants. This chapter also highlights the research gap and objectives of the study.

Chapter four, titled, *'Empirical Evidence on Question of Efficiency in Banking'* explains the need of efficiency in banking operations. In this chapter we provide empirical analysis of efficiency for the sample of Indian Commercial Banks considered in this study based on non-

[14] By financial performance in this thesis, we refer to a bank's financial performance in terms of their profitability.

[15] Centre for Monitoring Indian Economy.

parametric approach by employing Data Envelopment Analysis technique[16]. This chapter will also focus on the importance of efficiency parameters across different sectors of commercial banking in India, namely Public, Private and Foreign in contrast with CAMELS rating system.

Chapter five, titled, *'Empirical Evidence on Financial Performance of Indian Commercial Banks'* attempts to provide the empirical treatment of financial performance for sample of Indian commercial banks in terms of their profitability indicators, based on selected internal and external determinants. Bank profitability is a flow variable that is generated throughout the year through different banking activities, like acceptance of deposits, receiving payments for loans granted along with interest accrued in the same. Thus, the profits of current year may have certain relationship with profits of the previous year. This chapter thus intends to investigate such relationship by employing dynamic panel data technique. The findings from this chapter will point the issue of either positive, negative, or neutral impact of the internal and external variables considered in this study.

Based on the findings arrived at in Chapter four, the Chapter six titled *'Conclusions and Policy Recommendations'* concludes our study in this thesis. This part highlights the important findings of this study and tries to suggest suitable policy implications along with scope for future research.

[16] This study is limited to the computation of Technical Efficiency scores for analyzing the economic efficiency of sample of Indian Commercial Banks.

APPENDIX-I

A-I.1-Table 1: Introduction and Advancement of Technology in Banking Operations:

Year	Event
1988	A committee was set up by RBI on 'Computerization in banks' headed by Dr. C. Rangarajan.
1986 to 1988	Introduction of MICR based cheque processing system to increase in efficiency and enable more seamless processing of cheque.
1993	Based on recommendations of Dr. C. Rangarajan Committee banks initiated computerized online transaction work with settlement between IBA and bank employee's association.
1994	Formation of committee on 'Technology Upgradation in Banking Sector' by RBI and based on the recommendations of said committee the IDRBT was established and later granted the autonomous status in 1996. IDRBT operates the Indian Financial Network (INFINET).
1995	Introduction of Electronic Clearing Service (ECS).
1999	Introduction of SMS Banking system.
2000	Electronic Fund Transfer mechanism launched.
2004	RTGS facility introduced in banking system.
2004	Use of ATM services brought in banking sector for welfare of customers.
2005	Launch of NEFT to replace EFT mechanism.
2008	Launch of National Electronic Clearing Service and development of CBS.
2008	Cheque Truncation System was introduced.
2010	Mobile based banking transactions system.
2012	Launch of RuPay Debit/Credit cards as a part of Indian domestic card payment network set up by NPCI.
2014	Enabling system of withdrawal of money by using ATM card of one bank from ATM of another bank.

**Source: Own compilation.*

Note: Technology developments mentioned in the above table only relates to the mainstream of banking operations. However, other app based third party applications like Paytm, Phone Pe and specific applications of individual Commercial Banks also gained much popularity in the years to come.

CHAPTER II

A PROFILE OF INDIAN BANKING SYSTEM

2.1. Banking System in India:

Banking sector of every nation plays a vital role in the development of that country (Schumpeter, 1911). Apart from effective channelization of idle resources from at the hand of people, banks also acts as an financial intermediary in both developed as well as in developing nations (Aluko & Ajayi, 2018). Therefore, a sound and profitable banking system can resist the adverse impact of economic shocks, maintain their own stability and contribute towards the development of a nation's economy (Almaqtari et al., 2019; P. P. Athanasoglou et al., 2008). On one hand a developed banking industry plays a pivotal part in the growth and subsequent improvement of a country (Beck et al., 2000; Hassan et al., 2011), while on the other hand an inefficient and wobbly banking system is likely to push the economy towards a slump (Caprio & Honohan, 2002). Satisfactory outcome towards the vital macroeconomic factors of any country depends mostly on the efficiency and soundness of the banking industry and India is no exception. Indian banks provide key services to its clients in the form of liquidity facilities, facilitating payment services to real sectors and account facilities in the form of intermediation process. Besides Indian banks also act a substantial source of credit at household levels, Governments (Centre and States), business enterprises and to economically weaker sections like villagers, small scale industries and individuals engaged in agricultural operations.

Global banking system has witnessed drastic changes over the past decades that are not only confined to developed nations but have also extended its spiral effect on developing nations like India. Apart from the adverse impacts of the 1997-98 Asian financial crisis, the global economies were exposed to a challenging time phase over the span from 2007 to 2011. The occurrence of Sub-Prime lending crisis of 2007-08 due to sudden collapse of the Layman Brothers highlighted the importance of a strong, resilient, and efficient banking industry in restoring adequate macroeconomic stability in India. Indian banking industry is mainly represented by the Scheduled Commercial banks[17] that undertakes most of the lending and

[17] Included in the Second Schedule of the Reserve Bank of India Act, 1934 as per the conditions laid under section 42(60) of the RBI Act. These scheduled commercial banks are engaged with the task of accepting deposits, granting loans and rendering different banking services.

borrowing operations. These Commercial banks are of three types, Public Sector banks, Private Sector banks and Foreign banks. Over the years the Indian banking industry has grown a manifold and has the potential to become the third largest banking system by 2025 (KPMG and CII, 2013). Over a 12-year period (2006-2017) the total deposits registered a compound annual growth rate of 12.03% and by 2017 it stood at USD 1.54 trillion (IBEF, 2017). Moreover, the total credit facilities provided till the end of the said period reached USD 1016 billion due to a significant uptick in consumption and an comfortable access to credit (IBEF, 2017). However, despite the significant progress of the Indian banking system over the years the Indian banking industry is constantly threatened by the rising NPAs that has been affecting the performance of the entire banking industry at large. The Asset Quality Review of Indian banks is also undertaken during 2015-16 to tackle the concerns of rising NPAs. The Report on Trend and Progress of Banking in India (RBI, 2016) also highlights that provisioning for NPAs rose to almost double the usual amount and as a result the net profits of banks went down by more than 60 percent. All these has impacted the efficiency of Indian banks specially of those belonging to public sector group and accordingly induced the Government of India in consultation with RBI to merge most of the public banks among themselves to retain a few but healthier banks. Presently there are 12 Public Sector banks, 21 Private Sector banks and 45 Foreign banks together with some Small Finance and Payments banks as recognized by Reserve Bank of India (10 Small Finance banks and 2 Payments banks).

The Indian banking industry is governed and supervised by the Reserve Bank of India. In India majority of the banking activities is undertaken by the Commercial banks. Among the entire banking structure of the country the Commercial banks (Public, Private and Foreign) account for approximately 80 percent of the lending business in India whereas the foreign banks along with the urban co-operative banks account for less than 15 percent of lending and deposit business (Bawa et al., 2019). We present a snap of Indian banking sector in Figure-1 of this Chapter.

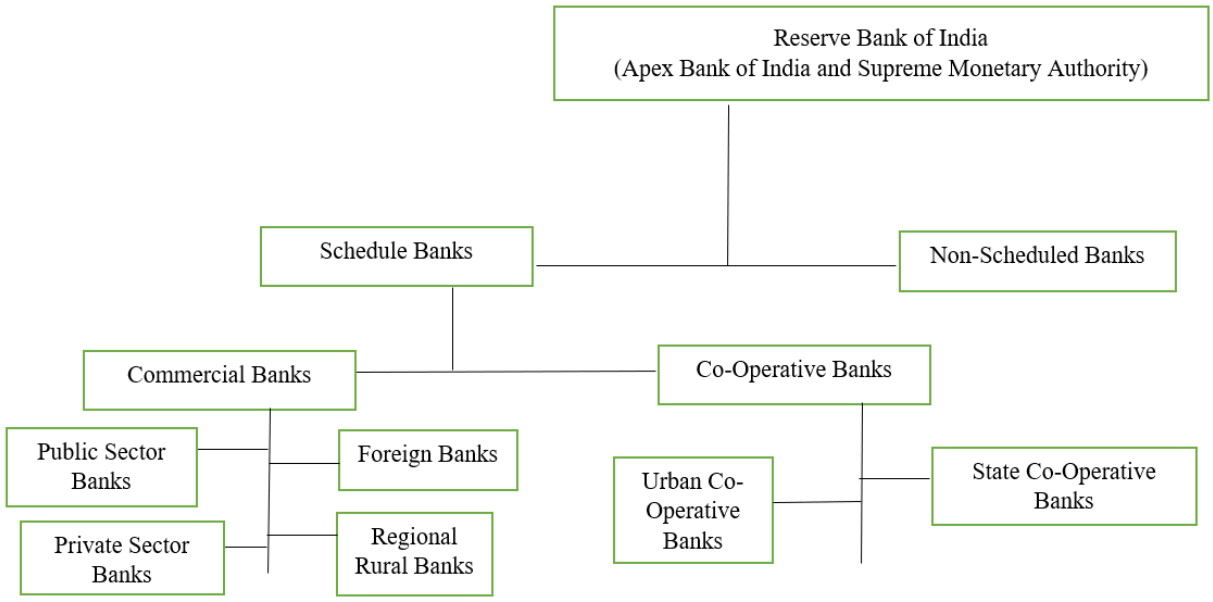

Figure 1- Structure of Indian Banking Industry

2.2. Evolution of Indian Banking over the years:

The evolution of Indian banking is characterized into different phases starting from a closed market system to a highly competitive and diversified mechanism. In short the evolution and gradual advancement of Indian baking can be represented in the following manner:

1921- Evidence of closed banking market with monopoly of Imperial bank of India. 1935- The Reserve Bank of India is established to function as the ultimate authority of Indian banking and all powers of a central bank is entrusted with RBI.

1936 to 1955- The Imperial Bank of India is renamed as the State Bank of India (SBI) with the simultaneous emergence of Associate banks under the State Bank Group.

1956 to 2000- 14 banks were nationalized in 1969 followed by further nationalisation of 6 other banks in 1980s. Also, during the said phase the entry of ICICI bank induced competition and led to development of technology among the Public Sector banks.

Year 2000 onwards- As per the objective of liberalisation policy of Government of India, the foreign banks are allowed to participate in Indian banking business. This initiative aimed at offering a level playing field to the Private and Foreign participants to take part in Indian banking business alongside the public banks.

2016 onwards – Merger of State Bank of India with its associate banks happened on April 2017 and in the subsequent year budget speech (2019) further merger of several other Public Sector banks were announced to retain a few but healthier banks in the economy. Also, Government of India (GOI) introduced various special schemes whereas RBI issued license to payments banks. Such an initiative by the GOI, has significantly paved the way towards financial inclusion since the payments banks contributes mainly for remittance services, purchases, and transfers as well as third party fund transfer etc.

2.3. Pre- and Post-Independence Scenario:

Indian banking holds its presence since the establishment of Union Bank in Calcutta during 1839 that although was formed by a group of Indian merchants but soon became futile due to the economic crisis of 1848-49. Subsequently, The Bank of Upper India that initiated its operations during 1863 sustained till 1913 after which majority of its assets and liabilities were transferred to Alliance Bank located in Shimla. Following this, in 1865 Allahabad Bank was set up and was marked as the oldest bank in India with a joint stock stake. During this phase most of the banking business was formed by promoters with the objective of financing trading of Indian cotton. However, most of such banks that were established during the said phase collapsed since they were set up with some speculative purpose. Besides the domestic initiatives, we also find evidence of foreign players that tried to set up banking business in India and accordingly the Comptoire d'Escompte de Paris opened its divisions in Calcutta and Bombay during 1860 and 1862, respectively. During the British era Calcutta has been most popular traded port in India and the need for banking institutions was immensely felt owing to the growing trade activities. Consequently, Oudh Commercial Bank was established in 1881 (as a first fully Indian joint stock institution) in Faizabad but it succumbed in the 1958s. During the same era in 1895 the Punjab National Bank that was established in Lahore, emerged as one of the important commercial banks of India, post-independence. Thereafter during the pre-independence era several small banks were formed to serve indigenous and religious societies.

Post-Independence: The partition of 1947, significantly affected the economies of Bengal and Punjab, hampering banking activities for a prolonged period. To deal out with the challenges, the GOI rolled out various methods through implementation of a mixed economic policy and several industrial policies from 1948 onwards. This ensured the tendency of different states to tale interest in different domains of economy especially the banking and finance industry. Some

of the subsequent major initiatives of GOI to supervise and regulate the Indian banking included the nationalization of the central bank of the nation (Reserve Bank of India) on 1st January 1949, to examine, control and regulate the banking activities in India. Accordingly, RBI was granted the power to issue banking license to banks to start new branches or to new banks to set-up their business in India.

Further to control the unequal allocation of credit and to ensure uniform access to credit facilities the GOI nationalized 14 major commercial banks as on 19th July 1969. Following the similar process in 1980, the Government with the objective of exercising more regulation on credit delivery, nationalized 6 more commercial banks to bring almost 91 percent of banking business in India under the Government supervision.

2.4. Major Reforms:

During the beginning of 90s the Indian economy was characterized with several weaknesses, specifically in the domain of Indian financial sector and banking industry at large. The Indian financial system during that time suffered due to loss of productivity and efficiency in banking, reduced profitability, financial weakness of various public sector banks, dearth on technological development in banking activities, subsequent losses by public sector banks year after year and inability of the banks to sustain in the competitive environment. To deal out with these issues and with the aim of achieving a resilient banking system, the GOI introduced reforms in the domain of financial and economic sector of India including the banking system at large. The main objective behind this has been to encourage rapid economic growth and solidity of the banking system through the procedure of liberalization, privatization and globalization to transform the financial system into a more competitive environment to move closer to international standards. Thus, in response to the growing need for reforms in the domain of Indian baking system, the Government formed two committees:

1. Narasimham Committee on Financial System in 1991 (Narasimham Committee, 1991), and;

2. Narasimham Committee on the Banking Sector Reforms in 1998.

During August 1991, an expert level committee was assigned by the GOI under the stewardship of Shri M. Narasimham to investigate into the organisational structure, functionalities, and procedures of Indian financial system. Accordingly, the committee submitted its report that was placed in the Parliament on December, 1991. In line with the recommendations of this

report a series of reforms were taken up by the Government. Some of the noteworthy recommendations included the change in shift of banking supervision from micro-level control on credit-decisions to prudential norms and more effective supervision, reduction in levels of CRR and SLR , deregulation of interest rates and encouraging new entrants as well as adoption of prudential regulations.

The 1991 Committee report laid foundation for the first phase of reforms in Indian financial system. During the period from 1992-1997 the Indian banking sector witnessed many radical changes. At the same time the world economy also experienced numerous changes in line with the shift towards a globally integrated financial system. Against this backdrop the GOI appointed the Narasimham Committee (NC-II) for further recommendations focusing mainly on banking sector reforms, on December 26, 1997 (Reserve Bank of India, 2001a). Based on their earlier suggestions of the 1991 report the NC-II aimed at providing more efficient measures to strengthen the Indian banking sector. Subsequently, the NC-II prepared its complete report on 23rd April 1998 that provides blueprint for the second-generation reform procedures. The main objective of the findings from the NC-II report is to establish a strong, sound, efficient and profitable banking system in India corresponding to the global standard. The report illustrated the second-generation reforms in banking based on three broad measures, namely:

- ✓ Measures to strengthen the base of Indian banking system.
- ✓ Enhancing the service and functional procedures as well as upgrading of technology, and,
- ✓ Implementing structured changes in the system.

These measures extend to various aspects like, policy design in banking system, supervision of institutions and other legislative disclosures. Further the recommendations of NC-II also warranted resilience in banking system, improving process and methods in banking, integration of financial markets, organizational issues, more vigilant supervision and control and introducing of broad measures for credit decisions in context of rural and small-scale industrial credit. Because of such initiatives the number of banks in India increased steadily. During the period from January 1993 and March 1998, 9 private banks and 15 foreign banks entered the Indian banking system, and the total Scheduled Commercial Banks (excluding the RRBs) increased from 75 during 1991-92 to 99 in 1997-98.

However, the introduction of private and foreign banks has posed considerable competitive challenges for the public banks in India. The entrance of private banks (Indian private plus foreign banks) paved the way for advanced banking technology through launch of alternative service delivery avenues like phone banking, ATMs, internet banking etc. The 1998 reforms in Indian banking successfully helped in emergence of new banks in the Indian financial sector. For instance, ICICI, HDFC, UTI (Later known as Axis bank) etc. have brought about significant competition to the public sector banks. Moving further ahead banks also started to launch new products and services to give themselves an edge over other players in the banking industry. Most of the banks have successfully diversified on their own or through the establishment of subsidiary, in insurance, different mutual fund products, merchant banking services, factoring services, providing venture capital funds etc. All these also serves banks as an additional source of income besides their traditional banking activities.

This second phase of reforms gives much stress on modernization and advancement in technology. More emphasis is given on other augmented services like issue of credit cards as well as serving as merchant bankers. Therefore, the major reforms in Indian Banking industry during this phase that enabled Indian banking industry to thrive close towards the global standards in its future years can be listed as follows:

- ✓ Reduction in CRR and SLR.
- ✓ Deregulation of interest rates and providing subsidy on such rates for priority sector lending.
- ✓ Introduction of prudential norms on capital base (adequacy), asset classification, income recognition and provisioning.
- ✓ Opening doors for private sector banks as well as foreign players (as a subsidiary to their parent branch) to increase competition in Indian banking industry.
- ✓ Establishment of Debt Recovery Tribunals, Lok Adalats, ARCs, Settlement Advisory Committee, Corporate Debt Restructuring Mechanisms etc., for restricting or recovering backlog advances disbursed by banks.
- ✓ Constituting the Board for Financial Supervision as an executive authority for commercial banks, NBFCs and other financial institutions as prescribed.
- ✓ Introducing CAMELS rating system for supervisory mechanisms.
- ✓ Restating the functions of statutory auditors.
- ✓ Establishing the INFINET as the commutation sphere-head for Indian financial sector.

Therefore, the reforms pertaining to financial sector as proposed by the Narasimham Committee in 1991 and 1998, fully revolutionized the Indian banking system starting from 1991. Private and Foreign players are allowed to operate in common level playing field along with the Public banks in India, thereby making the Indian banking business environment more competitive. These above-mentioned measures infused high degree of competition in Indian banking industry, that in turn also impacted the market structure of Indian banking sector.

2.5. Market Structure, Concentration and Financial Performance:

2.5.1: Market Structure and Concentration:

The major reforms that took place in the Indian banking industry has transformed the banking sector ever since 1991. In line with the transformation of banking system globally, India too is now included in the ambit of several structural changes to move close to the international standards. Banking sector in India became more competitive since the entry of private and foreign participants as per the recommendations of NC-II report that paved the way for a liberalization approach towards private and foreign players. Accordingly during the said period, the Reserve Bank of India also highlighted the significance of competition in Indian banking whereby the determining issue is arguably the type of competition (Reddy, 1996; Reserve Bank of India, 2001b). The lack of perfect capital market structure in India has encouraged banks to step up into the lending activities more prominently. On one hand the monopoly nature of banking activities is not suitably optimal for India and thus led to reforms. On the contrary the gradual entrance of private and foreign banks has resulted in subsequent fall in share of deposits, assets holding and credit components amongst the public bank group due to more streamline offerings of private and foreign players. Moreover, these private and foreign banks use such technologies that considerably differs from the public banks enhancing more efficient service delivery to their clients. The reduction in market share among the public sector banks has considerably increased the sense of competitiveness in Indian banking sector. Effective competitive environment leads to competitiveness that induces firms to perform in a better way than their rival counterparts.

Competitiveness is often perceived to be a multidimensional, relative, and complex concept. In accordance with Webster's English Dictionary the word 'competitiveness' is derived from the Latin word 'competer' that refers to absorption in any business enmity in the context of market condition. Moreover, in business terminology the term competitiveness refers to the

'ability to compete'. Further, the World Bank defines competitiveness as, the components of productivity, efficiency, and profitability, that is perceived to be a powerful avenue to achieve increased living standards and elevated social welfare or an instrument for achieving goal. However, the meaning of the term differs significantly in practice and academics. While policymakers at the national level prefer to view the term as the capacity of a firm to reflect a positive balance of payment, the officers from ministry (trade and commerce) as well as across different industries, analysts, institutional experts, various industrial consortiums seem to view competitiveness as the combined ability of all firms in an industry to increase their forex reserves through exports by way of competition with other industries of foreign origin. To ensure effective competition among the firms, development of specialization is an important criterion. Further, the competitiveness of the firms also acts as an important catalyst for policymakers to ensure systematic implementation of policies. The Financial System Report, 2013 (Bank of Japan, 2013) highlights different factors (Size, Efficiency, Information Technology and Resource Management) that can be useful to measure the competitiveness of individual firms.

In our study we therefore represent competitiveness in terms of market concentration that indicate the degree to which an individual firm or industry (in our case banks) holds the market share. Market share for banking industry can be represented by way of the assets, amount of advances disbursed or deposits accumulated by an individual banking unit (P. P. Athanasoglou et al., 2008; Bourke, 1989; Delechat et al., 2012; Dietrich & Wanzenried, 2011, 2014; Flamini et al., 2009; Molyneux & Thornton, 1992). A close analysis of the past studies on the impact of industry concentration reveals that in most cases the impact of market concentration shows an insignificant impact (whether positive or negative) on bank profitability. However, it is perceived that a one unit increase in the market share of an individual firm elevates the concentration that lessens competitiveness of that industry. Further, market concentration can be reliably proxied using various quantitative and/or statistical measures i.e., K-bank concentration ratio, Herfindahl-Hirschman index (HHI), H-statistics. Based on the approach used to represent industry concentration of banks in different existing studies, we resort to the HHI in our study to measure the impact of market concentration on bank's financial performance.

2.5.2: Financial Performance:

The word performance is often argued to be the efficient and effective efforts made to reach the target objective. In the present era of dynamically changing competitive environment, it is necessary for the financial institutions to attain sound financial stability that reflects their operational efficiency. Financial performance acts as an important parameter to take effective planning and control decisions. While the performance of banking sector is perceived to be an effective measure to gauge to evaluate the efficiency of any economy (Goyal et al., 2019), financial performance acts as a vital tool for taking fruitful financial decisions. Indian banking sector have emerged over the years as a vital sponsor for scheduled economic growth of the nation. In their pioneering works, Levine & Zervos, (1998), highlights that growth in financial system significantly elevates the economic growth by way of various channels. Therefore, the growth phase of Indian banking industry can reflect the economic development of the nation. Since banks perform as an important financial intermediary of the nation through activities of acceptance of deposits, lending advances to customers and providing other third-party activities, hence banks also qualify as an economic unit. Moreover, Caprio & Honohan, (2002) opines that an inefficient banking industry may result in collapse of the economy, hence assessing the soundness and financial performance of banks serves as a useful indicator to determine their stability.

The financial performance of banks can be judged by use of a series of financial ratios whereby the most popularly used are the profitability indicators i.e., Return on Asset and Return on Equity (ROA and ROE). In our study we also use these two profitability indicators to proxy the financial performance of Indian Commercial Banks over a sample period of 12 years (2005-06 to 2016-17).

2.6. Impact of Information Technology in Indian Banking industry:

The banks (both public and private) of Indian origin are constantly upgrading themselves to sustain the global competition from their foreign counterparts operating in India. Through the introduction of information technology Indian banking witnessed extensive development in sophisticated product or service delivery system, employing reliable tools in place to control risks, reaching their clients to geographically challenged locations of the nation etc. use of technology enables swift flow of information more accurately and thereby makes the decision-making process more efficient. Through the introduction of technology based allied services, like phone banking, internet banking, app-based banking services, third party application-based

services, UPI enabled transfer systems has also resulted in reduction of transaction and delivery costs for banks. The report of the Department of Payment and Settlement Systems (Reserve Bank of India, 2020a) highlights that despite being a cash predominant economy the role of innovative ideas to take India close to a digital economy cannot be ignored. The vision of RBI for 2019-2021 envisages a bundle of plans that are gradually materializing. In order to achieve this RBI has taken few steps too, like (a) making the NEFT available 24X7 (with half hourly settlements) from 16th December 2019, (b) allowing all digital payments instruments and systems that are duly authorized (including non-bank PPIs, cards and UPI) to link with the National Electric Tool Collection (NETC), popularly known as FASTags so as to ensure more smooth traffic at different toll plaza in India and saving time in transportation of goods carries, (c) compulsory mandate for all banks not to charge customers for online transactions in NEFT system from January 2020, (d) enabling the different third party payment apps to allow customers to link their bank accounts together with a low cost Bharat-QR code based payment platform, (e) allowing certain mobile companies to launch their handsets in India with built-in digital payment platform facility like the Samsung Pay and Samsung Pay-Mini (under trial in India), (f) providing a new era in the digital payments system in India whereby an individual can also make payment at the POS terminal by tapping their wrist watches, brought in together by Titan and SBI-YONO called the Titan-Pay.

Importance of the use of information technology in banking activities, are of growing importance and is actively studied in Indian context (Rooj & Sengupta, 2020, 2021) too. The gradual implementation of information technology among the Indian banks have also lead to the question of their efficiency vis-à-vis their foreign counterparts operating in India. Moreover, in the recent times compared to the public banks in India the private banks (of Indian origin) as well as the foreign banks operating in India appear to be more successful due to various reasons of which the most arguable fact is the availability of technology at their disposal. Thus, we represent a comparative measure between the efficiency evaluation measures of accounting and economic techniques in Chapter IV of this study.

Finally, we conclude this section of our study with the idea that analysis of the selected determinants of financial performance for Indian commercial banks along with their efficiency evaluation can highlight the significant avenues of improvement, indicate the causes of variations in their financial performance and pave the way for future research opportunities.

CHAPTER III
REVIEW OF LITERATURE

3.1. Introduction:

In this chapter we discuss the different studies over the past years and certain recent studies that significantly describes the various aspects of financial performance of banking sectors across several countries including India. Besides the literatures related to the main theme of our study, we also present sufficient evidence of studies that discuss the importance of business cycles and its measures. Further we also review the growing body of active literatures on the evidence of efficiency in banking.

Banks acts as a financial intermediary and play a vital role in healthy functioning in most of the economies across the globe (Demirgui-Kunt & Huizinga, 1999; Schumpeter, 1911). A research survey by Levine, (1997) shows that efficiency of financial intermediation is capable of contributing towards a stable economic growth. In their pioneering work Demirgui-Kunt & Huizinga, (1999) opines that different channels in a financial system impacts the net return on savings and simultaneously affects gross return on investments. The difference between these two values reflects through interest margins of banks in the presence of transaction costs and taxes that are directly borne by investors as well as savers. Given this point of view the urge to investigate the determining factors of bank's financial performance in terms of their earnings have grown significantly over the years. In another study Hanson & Rocha, (1986) presents an extensive review of the factors that determine the interest spreads of banks. Using data from 29 countries over a period of 1975 to 1983 the authors highlight the role of explicit and implicit taxes that elevates bank's interest spreads. Moreover, they also find that significant degree of correlation exists between interest margins and inflation. Similarly, Barth et al., (1997), uses data on 19 industrial nations for 1993 and finds no significant impact of banking powers, concentration and deposit insurance on return on equity of banks.

A sound and stable banking system can safeguard itself from negative shocks and simultaneously play a vital role in maintaining stability of the financial system of any country, thereby boosting up the economic growth and development of the nation (Almaqtari et al., 2019; P. P. Athanasoglou et al., 2008; Beck et al., 2000; Hassan et al., 2011). If the banking system of any nation become inefficient then it may gradually push that nation's economy towards a slump (Caprio & Honohan, 2002; Goyal et al., 2019). Therefore, accomplishment in

major macroeconomic objectives of a nation effectively depends on the efficiency and soundness of banking industry, at large, and India is no exception. Post reforms of 1991 the Indian banking industry accounts for serving as an important catalyst towards the development of certain other key industries (Almaqtari et al., 2019; Singh et al., 2016). However, with gradual passage of time India's financial system is characterized by an extensive network of diversified financial institutions (A. Ghosh, 2016) of which banking sector is the most important. Hence the need for assessing the performance of banking is emerging gradually across a growing body of active literatures. Furthermore, in accessing the performance of banking sector, besides the several internal or domestic factors, certain other external factors also prove to have significant impact on bank performance, like inflation (P. P. Athanasoglou et al., 2008; Flamini et al., 2009; Robin et al., 2018; Sarkar & Rakshit, 2021), GDP (Al-Homaidi et al., 2018; Almaqtari et al., 2019; Caporale et al., 2017; Tan, 2016b; Yahya et al., 2017; Yao et al., 2018), lending interest rates (Alper & Anbar, 2011; Lutf & Omarkhil, 2018; Rashid & Jabeen, 2016), industry concentration (Abdullah et al., 2014; Curak et al., 2012; Demirgui-Kunt & Huizinga, 1999) and others.

This chapter thus, provides a critical review of literature based on the different aspects of performance determinants of banking sectors in developed and developing economies and also highlight the studies that are undertaken in Indian context. Also, as we talk of performance of Indian banking sectors, the concept of efficiency cannot be overlooked. We, therefore, incorporate the computed values of technical efficiency (discussed in detail in Chapter IV) as an additional control variable in our study and present the different existing study in support of the efficiency variable, in later section of this chapter. The rest of the chapter is arranged in the following manner: *Section 3.2* describes the different past studies and those conducted recently related to the main theme of our thesis; *Section 3.3* states the importance of movement in business cycle, different measures represented across several studies and its relationship with bank profits; *Section 3.4* presents the evidence on efficiency in banking sector and *Section 3.5* sums up the discussion of this chapter.

3.2. Empirical evidence on determinants of bank profitability:

3.2.1. Evidence on traditional regression techniques: Bank profitability is often refereed as the primary objective of banking business (Robin et al., 2018; Sarkar & Rakshit, 2021). Different studies of the past and present that examines the determinants of bank profitability in terms of

both bank-specific and external factors, focuses on different regions across the world. The economics of literature available on evaluating the determinants of bank profitability is still growing in terms of different aspect. The notion that profitability is a flow variable and shares a dynamic relationship with its own lagged value is represented alongside other studies that totally ignores this logic. In the former case the widely applied methodology is the dynamic panel estimation technique of either Arellano & Bond, (1991) or Arellano & Bover, (1995) or that of Anderson & Hsiao, (1982) while in the latter case authors resort to the traditional OLS techniques, like Weighted Least Squares, Fixed or Random effects model as validated by Hausman test (Hausman, 1978). For instance, Pasiouras & Kosmidou, (2007) uses a sample of 15 EU-state based banks over a period from 1995-2001 and finds that besides the bank specific factors, the industry (or market) structure as well as selected macroeconomic conditions also appear to be significant in impacting profitability of domestic and foreign commercial banks. Their finding also indicates that capital ratio and efficacy in expense management appear to be the prime determinants of bank's ROA. However, the authors do not find any statistical significance of concentration on bank profitability although the impact of size is negative and significant for all bank groups. Besides, their study shows ample evidence of mixed response about the impact of inflation on ROA (negative for foreign banks and positive for domestic banks) and highlights the positive impact of economic growth on financial sector performance. In a similar study Demirgui-Kunt & Huizinga, (1999), uses a sample across 80 countries over a period from 1988-1995 and examines the determinants of bank's earnings in terms of their Net Interest Margin (NIM). Their results indicate that percentage change in GDP deflator as well as inflation have a positive impact (although of lower magnitude in significance) on bank earnings, while a higher ratio of assets to GDP corresponding to a low market share tends to lower bank profits. We find evidence of similar finding in works of Căpraru & Ihnatov, (2014). Moreover, foreign banks perform good in terms of profitability compared to domestic banks in developing countries than in industrially concentrated nations. Finally, the authors also find that the burden of corporate tax is totally transferred by banks to their customers rather than higher reserve requirements especially for developing nations. On the other hand, Alper & Anbar, (2011) employs a sample of 26 listed Bangladesh banks over a period of 4 years (2008-2011), and finds that inflation is significantly related to NIM and not with ROA, besides other selected factors. Further, their finding also enumerates that diversification into non-traditional activities yields a positive impact on bank profitability. In a similar approach, Căpraru &

Ihnatov, (2014), uses a sample of 143 banks across selected CEE countries[18] over a sample period from 2004-2011, but finds no consistent statistical evidence on diversification activities of banks. Their finding also indicates that capital ratio is an important determinant of bank profits (ROA, ROE and NIM) while there is no statistical significance of industry concentration (measured by HHI is positive but insignificant). In an identical study Petria et al., (2015), uses a sample of EU27 countries over a sample period of 8 years and finds a negative and significant impact of HHI on bank profitability, besides evidence of statistical significance of other bank-specific and macroeconomic factors considered in the study. Also, the adverse impact of global financial crisis has resulted in considerable shrinkage of bank profits in both developed and developing nations (Albulescu, 2015). In line with the above studies, using a monthly sample from IMF across selected emerging countries in Central and South America over a period from 2005 to 2013 Albulescu, (2015) finds that capitalization, liquidity and interest rate margins positively impacts bank profits while non-interest expense and NPLs[19] negatively affects bank profits. Similarly, Caporale et al., (2017) uses a sample of 515 banks across MENA region countries from 2000-2012 and finds that domestic banks tends to perform better than foreign banks. Their result does not indicate any significant impact of bank size, however, reveals that GDP and net interest income positively impact profitability of domestic banks only, while liquidity ratio turns out to be negative and significant. Again, Ebenezer et al., (2017) uses a sample of 16 commercial banks from Nigeria over a period from 2010 to 2015 and finds that capital adequacy as well as liquidity positively impact bank profits while the ratio of total operating expenses to total assets turns out to be negative. Moreover, growth rate in GDP is positive and significant to ROA only. Likewise, Robin et al., (2018), also finds that capital strength and asset quality are important determinants of bank profitability (ROA, ROE and NIM) in Bangladesh across a sample of 12 major commercial banks over a 30 year period. However, the authors provide very limited evidence on impact of external factors (as GDP growth rate and inflation show inconsistent statistical significance). On the other hand, Srinivasan & Britto, (2017), uses a financial ratio-based sample of 16 Indian commercial banks over a period from 2013 to 2017 and finds that private sector banks perform better than public banks. Their finds also revealed that liquidity ratio, solvency ratio and turnover ratio appear to be positive and significant to bank profits represented by ROA.

[18] Romania, Hungary, Poland, Czech Republic and Bulgaria
[19] Non-Performing Loans

Contrary to the evidence on the impact of external factors (or macroeconomic determinates) on bank profits, Ali, (2015) uses a sample of 26 banks over a period of 5 years (2009-2013) from Pakistan and finds no statistical significance of GDP and inflation on either of ROA or ROE, thereby highlighting the management efficacy of Pakistani banks to safeguard themselves from impact of external factors but increase in management efficiency is needed to elevate the impact of internal factors on bank profits. In a different study, Titko et al., (2015) uses bank data over a period of 7 years (2008-2014) and highlights the key determining factors of bank profitability based on correlation analysis, for the newly emerged member of EU states, Latvia and Lithuania. On the other hand, rather than examining the determinants of bank profitability, Kamarudin et al., (2016) uses a sample of 31 commercial banks (state-owned and private banks together) from Bangladesh across a sample period of 8 years (2004-2011) and examines the determinants of profits efficiency of by employing DEA (data envelopment analysis) technique and OLS models (Fixed and Random Effects). The findings point out that bank size, liquidity, economic growth, and market concentration have a negative but significant impact for state-owned banks while, they are positive for private banks. However, capitalization, credit risk and inflation turn out to be significant for state-owned banks post financial crisis only. In another study Antoun et al., (2018), investigates the financial performance of 128 banks across nine Central and Eastern European countries over a period of 6 years (2009-2014). Their study involves the construction of a financial performance index based on financial ratios as per the CAMEL framework. Thereafter the said index is regressed against the bank-specific, industry and macroeconomic determinants of bank performance. The empirical results indicate that bank size negatively and significantly impacts asset quality, capital adequacy, liquidity and bank earnings while business mix and inflation have a positive statistical significance. Furthermore, economic growth and bank concentration have a positive and statistically significant impact on capital adequacy and liquidity. Also, certain other studies by Almaqtari et al., (2019); Brahmaiah & Ranajee, (2018); Serwadda, (2018); Subbarayan & Jothikumar, (2017); Yahya et al., (2017) indicate similar findings as regards to the determinants of bank performance across several other economies.

Therefore, from the above discussion it is clearly evident that most of these study that examine the determinants of bank performance uses profitability factor as a popular proxy. But the studies discussed so far relies only on traditional OLS regression techniques (Pooled OLS or Multiple regression or Fixed Effect and Random Effect model as validated by Hausman test). However, in the presence of a flow variable like profitability there is likely to be a relationship

prevailing with its own past year value as in case of banks, earnings in the form of principal repayment received and/or interest is received entirely around the year against the loans disbursed and thus employing the traditional OLS technique may tend to give inconclusive results and leads to the problem of endogeneity (P. P. Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011, 2014) and that is popularly known as Nickell's bias (Nickell, 1981). Hence the use of a more robust technique known as dynamic panel regression technique (Arellano & Bond, 1991 or Arellano & Bover, 1995) is employed by a growing body of active literatures. In the next section we focus on such literatures.

3.2.2. Evidence on factors affecting bank profitability:

The most popular studies on banking literature that still now forms an important reference to carry research on bank performance is that of Athanasoglou et al., (2008) and Dietrich & Wanzenried, (2011, 2014). Under both cases the authors highlight the importance of dynamic panel methodology and provides evidence as regards to the robustness in their model estimates. Evidence of performance analysis of banks through examination of their profitability is a popular approach as for cross-country sample or that of any focused country or region. While studies by Short, (1979); Bourke, (1989); Molyneux & Thornton, (1992); Kunt & Huizinga, (2000); Abreu & Mendes, (2002); Goddard et al., (2004); P. Athanasoglou et al., (2006); Micco et al., (2007) and Pasiouras & Kosmidou, (2007) focus on cross country analysis of determinants of bank performance through analysis of a panel data[20], the study by Bikker & Hu, (2002) although conducts a cross-country analysis but studies the correlation between bank profitability and business cycles. On the flip side, other studies like Berger et al., (1987), Berger, (1995), Neely & Wheelock, (1997) focus on US banking system, Barajas et al., (1999) focus on Columbian banking sector, Mamatzakis & Remoundos, (2003), Athanasoglou et al., (2008) focuses on Greek banking sector, Naceur & Goaied, (2008) focus on Tunisian banks, García-Herrero et al., (2009) examine the Chinese banks and Dietrich & Wanzenried, (2011) focus on banks in Switzerland. Most of these studies (whether based on cross-countries or otherwise) investigates a combination of internal or bank specific and external (industry specific and macroeconomic) factors that impacts bank profitability. Although the result outcome from these studies significantly differs due to difference in datasets and financial

[20] Either Fixed and Random effects model or using Dynamic Panel Estimation techniques.

environment across various countries, but there co-exists some common factors that are used by all the past studies.

Financial performance of banks is popularly represented through their profitability measures of which the widely used is their return on average assets of (ROA) that is expressed as a function of bank's internal and external factors.

In most cases the studies use bank risk, ratio of equity to total assets, size and operating efficiency as the popular variables for internal determinants. For instance, Pasiouras & Kosmidou, (2007) finds a negative relationship of bank size on ROA while Flamini et al., (2009) finds a mixed response of bank size[21] on profitability on a sample of 41 Sub-Saharan African countries over a period of 9 years. However, Micco et al., (2007) finds no statistical significant impact of bank size on bank profits. Again, Berger et al., (1987) argues that increased costs can be mitigated up to a certain level after which they tend to increase and this holds true for large banks since they encounter scale inefficiencies. Demirgui-Kunt & Huizinga, (1999) opines that the extent of impact from different financial, legal and certain additional factors (e.g., corruption) impacts bank profitability is often linked with bank size. On the other hand, Short, (1979) finds that increase in bank size is associated with capital adequacy of banks since larger banks are better able to raise capital at a lower cost and therefore are more profitable. In a similar approach, [22]Bikker & Hu, (2002) and [23]Goddard et al., (2004) also argues that bank size is significantly linked to capital especially for small and medium-sized banks that in turn impacts their profitability.

Bank profits may also depend on the behaviour of credit and liquidity risk. Different studies use various proxies to study the impact of such phenomenon on bank profits. Poor asset quality and inadequate liquidity levels are often responsible for bank collapse (P. P. Athanasoglou et al., 2008). For instance, while results from Abreu & Mendes, (2002) based on a sample of 477 banks from four EU nations[24] shows a negative relation between loan to assets ratio and bank profitability, findings of Bourke, (1989) shows a contrary outcome. However, Molyneux & Thornton, (1992), Miller & Noulas, (1997), P. P. Athanasoglou et al., (2008), Dietrich &

[21] Size when represented with log of total assets has a positive impact on bank profitability while it has a negative impact when represented by log of total assets square.
[22] Uses data on 26 OECD countries on different macroeconomic variables like GDP, differential in interest rate and unemployment rate to find the relationships between cyclical patterns of bank profits, provisioning, lending capacity of banks and procyclicality of BASEL norms.
[23] Uses account data on 665 banks from 6 European countries (Denmark, France, Germany, Italy and Spain) and for UK over a sample period of 1992 to 1998.
[24] Portugal, Spain, France and Germany.

Wanzenried, (2011, 2014) argues that relationship of credit risk and bank profitability is always negative. This is so because, if financial institutions are exposed to high-risk loans they tend to pile up large amount of unobtained principal and/or interest on their disbursed loans, thereby lowering bank profits.

Existing empirical findings of Bourke, (1989), Demirgui-Kunt & Huizinga, (1999), Abreu & Mendes, (2002), Goddard et al., (2004), Naceur & Goaied, (2001, 2008), Pasiouras & Kosmidou, (2007) and García-Herrero et al., (2009) indicates that banks that maintain considerable level of capital (ratio of equity to total assets) perform better than others. The most common findings of the authors indicate that banks having higher capital ratio enjoys less expensive funding because of lower probability of bankruptcy.

Financial performance of banks may also depend much in their ability to diversify from their traditional banking businesses. During the phases of increased uncertainty and simultaneous decreased profits from normal course of business operations, financial institutions may decide to expand their portfolio through diversification activities and/or increase their liquidity base to mitigate their losses (P. P. Athanasoglou et al., 2008). In their pioneering works, Goddard et al., (2004) uses data on 6 major European countries[25] and UK over a period of 1992-98 and finds that alongside increasing competition there is ample evidence of persistence of profits from one year to the next. Their findings also reveal that efficiency acts as an important determinant of profitability as compared to bank size, whereas diversification activities are more significant for UK but neutral for other countries. In a similar study Demsetz & Strahan, (1997), examines the aspect of diversification in banking business in US banking system. their finding highlights that large bank have less capital reserves and participate more actively in risky business lines like derivative vis-à-vis their specialized counterparts. Likewise Klein & Saidenberg, (2005) argues that well diversified banks are less profitable, whereas Hughes et al., (1999) finds that although product growth and geographic diversification reduces the risk in US banking, such geographical diversification helps in improving the efficiency of banks.

Furthermore, Dietrich & Wanzenried, (2011) opines that an increase in market share results yields in monopoly profits. This argument is based on the structure-conduct-performance (SCP) hypothesis. The SCP paradigm affirms that market structure of an industry tends to determine the operations of an induvial firm that in turn determines its performance (Tan, 2016a). The market share of the banking industry can be represented either by total assets or

[25] Denmark, France, Germany, Italy, Spain.

amount of advances disbursed or deposits received by an individual banking unit (P. P. Athanasoglou et al., 2008; Bourke, 1989; Delechat et al., 2012; Dietrich & Wanzenried, 2011, 2014; Flamini et al., 2009; Molyneux & Thornton, 1992). A close analysis of the past studies shows that in most cases the impact of market concentration has an insignificant impact (whether positive or negative) on bank profitability, although it is perceived that a one unit rise in market share of an individual firm increases the industry concentration (of the industry to where the firm belongs) lessening the competitiveness of that industry. While Bourke, (1989) as well as Molyneux & Thornton, (1992) shows a positive and statistically significant impact of bank concentration on profitability and is in line with the SCP hypotheses, in contrast the findings from Demirgui-Kunt & Huizinga, (1999) and Staikouras & Wood, (2011) reveal a negative but insignificant impact on bank profits. Similarly, Berger, (1995) and Mamatzakis & Remoundos, (2003) refute the SCP paradigm. Although the very recent study of Le & Ngo, (2020) shows a negative and significant impact of bank concentration on bank profitability.

The final group of factors that determines bank profitability comes from the macroeconomic variables that are often used as control variables. The most common ones used are inflation, growth rate in money supply, annual growth rate in GDP, exchange rates and lending interest rates. For instance, the idea of linking the impact of inflation on profitability is introduced by Revell, (1979) in his study. The author finds that such impact of inflation on bank profits will depend on the situation if the wages and operating costs of banks increase at a faster rate vis-à-vis inflation. In another approach Perry, (1992) argues that the degree to which inflation impacts bank profitability depends on whether the expectations towards inflation are fully foreseen. Therefore, it depends on how much equipped an economy is so that it can accurately predict the future inflation and accordingly banks can control their operating costs. It also implies that a success in fully anticipating the inflation rate by the bank's management enables the banks to correctly adjust their interest rates to boost up their revenues rapidly than their costs, thereby generating greater economic profits (P. P. Athanasoglou et al., 2008). The active body of literatures provides a mixed outcome on the impact of inflation on bank profits. For instance, while Bourke, (1989), Molyneux & Thornton, (1992), P. P. Athanasoglou et al., (2008), Flamini et al., (2009) and Dietrich & Wanzenried, (2014) finds a positive impact of inflation on bank profits, Abel & Roux, (2016), Caporale et al., (2017), Al-Homaidi et al., (2018) and Yao et al., (2018) shows negative impact of inflation on bank profits. In a similar recent study pertaining to Indian context, Sarkar & Rakshit, (2021) finds a mixed response of the impact of inflation on determinants of bank profitability (ROA, ROE and NIM). However,

in a different study Desalegn & Zhu, (2021) finds a negative impact of inflation on bank's earnings opacity (measured by the discretionary provisions against bad loans at the hands of the banks) using a sample on Chinese banking sector over a period from 2011 to 2018.

In Indian context we find limited evidence of works on financial performance of banks based on profitability. Most of the studies (Almaqtari et al., 2019; Brahmaiah & Ranajee, 2018; Srinivasan & Britto, 2017; Subbarayan & Jothikumar, 2017) uses traditional OLS techniques (Pooled OLS, Fixed and Random effects Model as validated by Hausman Test). Hence the results arrived at from such studies may not be much reliable more due to the existence of an endogeneity problem in the model outcome, as stated in section 3.2.1. However, among the noteworthy studies on bank profitability only a few (Al-Homaidi et al., 2018; Sarkar & Rakshit, 2021) employ the idea of dynamic relationship for dependent variable to deal out with the endogeneity problem. For instance, Al-Homaidi et al., (2018) uses a panel of 60 Indian commercial banks over a period of 10 years (2008-2017) and examines the internal and external factors affecting bank profitability (in terms of ROA, ROE and NIM). Their findings indicate that while size, number of bank branches, ratio of proportion of total debts to total assets and operating income to total assets are significant internal determinants of ROA, ROE and NIM, the macroeconomic factors (GDP, exchange rate, inflation, and lending interest rate) negatively impacts bank profits. Despite these findings their analysis seems to represent some missing information as regards to the model diagnostics like, stationarity of the dataset, validity of the instrumental variables used in the model (Sargan test results), comparison between the number of cross-sections and number of observations and robustness checks about their model. These drawbacks were to some extent dealt with in a much similar study by Sarkar & Rakshit, (2021). The authors use a panel of 33 Indian commercial banks (20 public and 13 private banks) over a sample from 2000 to 2017. Their findings after running necessary pre-regression diagnostic checks (correlation, descriptive statistics, and unit root tests) indicate mixed response for both internal and external factors on bank profitability (ROA, ROE and NIM).

However, it is important to note that among the various studies on determinants of bank profitability, ROA emerges as the prime variable to proxy bank profitability. Besides, almost no study so far examined the impact of relative efficiency of banks on their financial performance. To the best of our knowledge this study is the first of its kind to analyze the impact of movement in business cycles on one hand and effect of relative efficiency on the other hand to understand the impact of their changes on the financial performance of Indian

commercial banks in terms of their profitability. In the next section, we therefore, present our discussion on the importance of business cycles and relative efficiency of banks.

3.3. Importance of Business Cycles:

A growing body of active literatures study the different aspects of business cycles. Studies that provide evidence of business cycles are of varied nature. While some studies show the impact of negative shocks using unit level observations on movement in business cycles, others focus on measuring the business cycle phenomenon using various approaches or filter-based techniques or represents computed index-based measures to proxy the business cycles. For instance, in their pioneering work Bry & Boschan, (1971), provides a computer-based algorithm technique to analyze monthly series that became a widely admired approach of NBER[26]. Their approach identifies the extreme lengths of simultaneous peak and trough and is popularly referred as turning point technique. The said technique qualifies itself, if there is an opposite movement for a minimum period of five months and subsequent peak (or trough) has a gap of not less than fifteen months. However, if there is no fluctuation at the turning point then the latest period is selected as turning point. Evidence of such a mechanism is available in past studies of Burns and Mitchell (1946) (Shaw, 1947) and other subsequent studies (Chitre, 2001; Drehmann et al., 2012; Dua & Banerji, 2000). Some studies examine the association between business cycles and certain disaggregated parameters from unit level observations. For instance, Dees, (2017) examine the impact of patterns of consumer confidence shocks on business cycles based on several disaggregated parameters. The author opines that studying the impact of such shocks on business cycle is useful to understand a large proportion of errors in predicting real economic activities. His work also shows that fluctuations in consumer sentiments acts as an important transmission channel whereby a sentiment shock arising in U.S considerably affects real economic activities of other nations. Similarly, using survey data across U.S over 1979-2013, Lahiri & Zhao, (2016) argues that macroeconomic aggregates drive household sentiments and households' perceptions and outlook towards economic conditions, such as their financial and employment probability.

In Indian context we find evidence of works that focuses mainly on measuring business cycles. For instance, Dua & Banerji, (2000) presents an index based measure by using monthly

[26] National Bureau of Economic Research

seasonally adjusted time series of five key measures to proxy the fluctuations in Indian economy over a period of about 40 years. Their findings provide significant insights to capture the timely occurrence of recessions and expansions as well as the resulting speedup and downturns in Indian economy. In a similar study, Dua & Banerji, (2007) evaluates the efficacy of the DSE-ECRI's (Delhi School of Economics- Economic Cycle Research Institute) leading index to predict the impact of cyclical movement on growth rate of Indian exports. Further, Dua & Banerji, (2012) uses a composite index of the leading macroeconomic indicators to describe the business and growth rate cycles similar to the approach followed by NBER (National Bureau of Economic Research). The authors initially describe the growth rates in business or economic cycles in the context of Indian economy. Their findings highlight the phases of occurrence of simultaneous expansion and contraction in the economy based on broad measures of certain economic indicators viz, output, employment, domestic trade and income that best represents the cyclical movements. Finally, they propose an indicator-based measurement to proxy the cyclical upswing and downswings in Indian economy, by using a composite index of key economic indicators.

In line with the above discussion, evidence on the nature and behaviour of business cycles that shows existence of co-movement of simultaneous cyclical peak and trough with bank performance, is also available across various active literatures. An important aspect to study the key determinants of bank performance in terms of its profitability involves studying the linkages between the cyclical fluctuations in the economy and bank profitability. Literatures that examine the impact of business cycle measures on bank performance are scarce, especially in Indian context. Although a limited body of existing literature provides some significant insights into the relationship between bank profitability and business cycles, yet the evidence of such work is very little in India. Economy is usually characterized by simultaneous upswing and downswings across broad measures of activities like output, employment, income etc. While period of downswings reduces the quality of loan portfolio among the financial institutions resulting in credit losses that adversely affects the lender's profits, phases of cyclical upswings in the economy tends to increase the profits of financial institutions (banks in our case) as rise in GDP growth increases the net interest income for banks due to significant surge in lending operations and notable uptick in stock market transactions (P. P. Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011). Evidence of such a phenomenon is available across several existing literatures. For instance, in their pioneering works Albertazzi & Gambacorta, (2009) uses yearly data from 1981 to 2003 across 10 industrialized countries (Austria, Belgium,

France, Germany, Italy, Netherlands, Portugal, Spain, United Kingdom and the United States) and analyzes the impact of business cycles on bank profitability. Using data from financial statements of banks alongside certain other macroeconomic indicators the authors find the determinants of bank profitability. Further, the authors use the changes in real GDP rates to proxy the impact of business cycle on bank profitability. Besides impact of other variables their findings hint that bank profits are procyclical in nature and GDP significantly influences both net interest income and loan loss provisions of banks via channels of lending operations and quality of loan portfolio respectively of banks. Likewise, Borio et al., (2018) argues that booms in financial cycles may weaken the economic growth of a nation even if they do not lead to crisis situation. The authors examine the predictive power of three variables (a composite financial cycle[27], debt service ratio and term spread[28]) over a sample period from 1985 to 2017 initially for 16 advanced economies. They also extend their analysis to include nine emerging economies (based on quarterly data from 1996) and mainly compared the financial cycles measures with that of the term spread through in-sample and out of sample exercise. Their analysis reveals that although business cycles do not become inactive over time but in case financial booms develop they tend to become fragile. Also, indicators of financial cycles can act as a useful tool for policymakers as well as for professional forecasters across other nations. Demirgui-Kunt & Huizinga, (1999) argues that besides bank-specific and other external factors, macroeconomic factors significantly affect bank profitability and ultimately their financial performance. Using bank level data across 80 countries over a period of seven years (1988-95) the authors show the bank-specific and external determinants of bank's Net Interest Margin (NIM). Their findings reveal that for countries where a larger proportion of GDP is represented through banking assets, tend to reflect a lower margin and therefore are more prone to become less profitable. Their findings also highlight that a higher stock market capitalization to GDP ratio elevates bank's interest margin, although the evidence of business cycle is limited. In a similar approach Demirguc-Kunt & Huizinga, (2000) and Bikker & Hu, (2002) also attempts to examine the potential correlation between the co-movement in cyclical phenomenon and bank profitability. Although their findings (Bikker & Hu, 2002; Demirguc-Kunt & Huizinga, 2000) evidences the existence of such association between the two variables

[27] The authors modified the approach of Drehmann et al., (2012) who applied bandpass filters over a time-series of 8 to 32 years to derive medium-term cyclical components from real credit (inflation adjusted), ratio of credit-to-GDP and real property prices. Thereafter, an average is computed to form a composite measure.

[28] Difference between the 10-year government bond yield rate and 3-month money market rate and is believed to be a strong measure of recession risk.

but the variables used are not the exact measures of business cycles[29]. In another study, Iacoviello, (2014), uses quarterly data on U.S over a period of 25 year (1985-2010) and investigate the interlinkages between banks and financially distressed firms and households in the backdrop of the Great Recession. The author uses Bayesian methods and employs a DSGE model to analyze a resulting recession due to the losses faced by banks that eventually amplifies their inabilities to extend credit facilities to real sectors. The author also highlight that a negative financial shock lessened about two-thirds of the contraction in output during the recession period. Also, the study reveals that if banks hold equity over and above their regulatory mandate, any loss drives them either towards recapitalization or deleveraging mechanisms. In the latter case, banks often find incentive by transforming a recession shock into a credit crunch and since certain firms are dependent on bank credit, such a negative financial shock gets amplified to the real sector as well. In an interesting study on credit procyclicality, Bouvatier et al., (2012) employs Vector Auto Regression (VAR) model to examine the power of bank structure in explaining credit cycle procyclicality across 17 OECD nations for a sample period from 1986 to 2010. Extending the study, the authors also represent the impact of a shock in GDP on bank credit, based on impulse-response function. Their final findings indicate that bank structure is not only the key factor and other factors like micro and macro prudential regulations should also be considered to reduce procyclicality in bank's lending behaviour. Again, Bucher et al., (2013) investigates the impact of volatility in business cycles and it subsequent effect on internal and external funding channels of banks. The authors argue that bank performance can improve only if there is stability in the real economy. Furthermore, Tsatsaronis, (2012) examines the relationship of bank stocks with that of business cycles and finds that there exists an inverse linkage between capital ratio and funding costs. The analysis further shows the importance of introduction of countercyclical capital buffers that adjusts with the cyclical phases (simultaneous boom and busts) in the economy.

Also, fluctuations in bank profitability may also arise as a result of bank capital channel (Albertazzi & Gambacorta, 2009; Van den Heuvel, 2002). Bikker & Hu, (2002) argues that during phases of cyclical downturns banks might be willing to curtail their lending activities due to increased credit risk leading to a situation of credit crunch. They also find that real GDP growth rate along with other variables used to proxy cyclical patterns (unemployment and inflation) show a significant impact on profits or profit margin. The authors also find that

[29] While Kunt & Huizinga, (2000) uses annual rate of GDP alongside per capita GNP, Bikker & Hu, (2002) uses certain macroeconomic variables like GDP, differential in interest rate and unemployment rate. For more details see, Chirinko & Elston, (2006) and Weinstein & Yafeh, (1998).

capital base and revenue reserves of banks show significant uptick over phases of multi-period cyclical upswings vis-à-vis adverse cyclical phases. Moreover, Albertazzi & Gambacorta, (2009) also opines that construction of an econometric model to link different bank specific variables and the business cycle is important in the view of success of Financial Sector Assessment Program (FASP)[30] that is a joint initiative of International Monetary Fund (IMF) and World Bank since 1999 to examine the strength and susceptibility of a nation's financial sector with the aim to safeguard any potential crisis (Hoggarth, 2003; IMF, 2005).

However, in a different study on European nations, Caporale et al., (2014) highlights that impact of a negative bad loan shock significantly to spreads to the firms unlike that households and Co-Operative banks, since such banks adopts more efficient policies towards lending.

Therefore, the evidence about the impact of business cycle on bank profitability is considerably warranted across various studies across different countries. However, linking such an idea to examine its impact on bank profitability (or financial performance) is growing in Indian context. Recently, in Indian context, there exist a few studies that examine such a co-movement in terms of changes in real GDP rates and bank profitability (Al-Homaidi et al., 2018; Sarkar & Rakshit, 2021). Unlike the growth rate of real GDP that is a common measure to proxy the effect of business cycles on bank's financial performance, in this study we move a step ahead and employ an alternative method of estimating the business cycles to analyze its impact on bank profitability. Finally, we also expect that bank profitability is pro-cyclical in nature and has positive relationship with movement in business cycles in Indian context.

3.4. Empirical evidence on efficiency:

Talking about financial performance of banking institutions, the aspect of relative efficiency is important and is discussed widely among the active body of literatures. The economics of literatures that investigates the relative efficiencies of financial institutions, witnesses a consistent expansion (A. Das & Ghosh, 2006a) and is still growing. The term efficiency is often associated with both operations research and economics, but mostly the neo-classical economic approach prefers efficiency to refer as a mechanism based on production economics (A. Das et al., 2005; Mohan & Ray, 2004; Mukherjee et al., 2001). The best possible way to examine the relative efficiency is by employing a frontier based non-parametric technique known as Data

[30] https://www.imf.org/en/About/Factsheets/Sheets/2016/08/01/16/14/Financial-Sector-Assessment-Program

Envelopment Analysis (DEA) (Goyal et al., 2019). However, we find ample evidence across several studies that examines the efficiencies of financial institutions or any specific industry across different nations, using a parametric and/or non-parametric technique. But, over the time a large section of authors and scholars have argued the superiority of DEA compared to its close rival SFA[31] (Stochastic Frontier Analysis) across different industries (Chandra et al., 1998; S. Kumar, 2008; S. Kumar & Arora, 2011; S. Kumar & Gulati, 2010; Prakash et al., 2019). In this section we therefore focus on different cross country as well as Indian studies and highlight the importance of efficiency as an important factor to judge the performance of Indian Commercial Banks.

For instance Berger & Humphrey, (1997)[32] in their pioneering work finds that banks or depository financial institutions shows an average technical efficiency[33] of 77% (or, 0.770) annually. The final efficiency results provide a frontier-based outcome whereby the firms operating on the frontier line are referred as technically efficient whereas those operating below the frontier line are known as inefficient units. This frontier inefficiency also known as X-inefficiency (A. Das & Ghosh, 2006a) accounts for significant uptick in operational costs and is a substantial source of performance difficulties vis-à-vis the inefficiencies arising due to scale or product mix (Bauer et al., 1998). Studies based on DEA focuses on banking sectors of developed as well as emerging economies. For instance, Elyasiani & Mehdian, (1995) investigates the shifts in technology as well as variations in technical efficiency across a sample of small and large commercial banks in US over a period of 7 years (1979-1986) using intermediation approach and finds that, despite the decline in efficiency estimates the small banks are more efficient. The authors also argue that such higher efficiency of small banks is witnessed during the deregulation period, although the difference in efficiency between large and small banks reduced considerably in post-deregulation phase. Afterwards, Mukherjee et al., (2001) followed a similar approach to examine the productivity growth over a sample of

[31] An alternative approach to DEA whereby a researcher is required to specify certain pre-determined weight criteria before running the model whereas in DEA models the weights are endogenously selected by the model itself. (Goyal et al., 2019).

[32] The paper provides a survey of literatures across 130 studies that uses frontier analysis framework out of which 116 papers were published between 1992-1997. Hence, the is ample evidence on studies using frontier analysis that enables to draw significant comparisons on average efficiency levels based on estimation techniques as well as across nations.

[33] Relative efficiency under DEA is represented by the component Technical Efficiency. Different models of DEA employ different production functions, approaches (intermediation approach, value added approach etc.) assumptions etc. (Charnes et al., 1978 or Banker et al., 1984) and provides us three popular components, the Overall Technical Efficiency, the Pure Technical Efficiency and Scale Efficiency. The efficiency scores are represented either with a value ranging from 0 to 1 or in terms of percentage. The highest efficient unit is represented as 1 or 100. Details is discussed in Chapter IV of this thesis.

201 large commercial banks in US. Their findings indicate that although productivity growth showed a significant decline during initial years of the sample period (1984-1990) but records an annual average growth rate of 4.5%. Also, banks having larger asset base are more prone to increased growth. In another study Barr et al., (2002) studies the productivity across a sample of US commercial banks over a 15 year period (1984-98) and indicates that efficiency is positively related to returns on average assets of banks (ROA) although there is no evidence of association of efficiency with interest income alone. Similarly, Berg et al., (1992) argues that productivity of Norwegian although showed a decline during the pre-deregulation phase, but grew significantly post 1987 indicating increased competition among the banks in deregulation phase. However, the authors highlight that one of the reasons behind low productivity during the pre-deregulation period might be due to the appearance in idle capacity in expectation of rise in competition because of deregulation process that started in 1984.

On the contrary, cross-country studies based on OECD and other developed economies reveal some different results. For instance, in their pioneering work Fecher & Pestieau, (1993) reports that efficiency estimates for financial service rendering institutions (insurance companies and banking institutions) across 11 OECD countries over a period 16 years (1971-1986) show an efficiency score of 0.82 on an average with span of 0.67 (in case of Denmark) to 0.98 (for Japan). Likewise the cost and profit efficiency estimates across 14 EU nations together with Japan and US reveals significant difference in profits among these countries, that can be substantially mitigated through the elimination of inefficiency (Maudos & Pastor, 2001). Further, using a sample of 427 banks across eight developing nations Pastor et al., (1997) highlights that the mean efficiency showed a value of 0.86 with values ranging from 0.55 for UK to 0.95 in case of France.

Evidence on the efficiency estimates of Asian banking industry is still growing, including Indian context. However, among some of the earlier studies, Leightner, (1997) argues that despite enjoying havoc growth and profitability during 1990-94, the Thai finance and securities companies did not show signs of being fully efficient i.e., these firms could have enjoyed enhanced profits by altering their input-output bundle. Additionally, the study also evidences in support of economies of scale which indicate that the larger banking entities outperform these finance and security companies since the latter is too small. Thereafter, Gilbert & Wilson, (1998) used linear programming mechanism to examine the impact of privatization and deregulation on the productivity of banks in Korea over a period of 15 years (1980-94). Their findings suggest that Korean banks witnessed a mixed impact of privatization and deregulation

that induced them to vary their mix of input-output bundle resulting in increased productivity. In a disaggregated analysis, Shyu, (1998) investigates the operating efficiency of Taiwan banking industry for both pre and post-deregulation period from 1986-89 to 1992-95 respectively. The findings indicate that efficiency improved among most banks in the post-deregulation period, and they were close to scale efficient, although the major source of inefficiency emerged as allocative in nature. Subsequently, using a stochastic frontier approach Hao et al., (1999) attempts to elucidate the variations in efficiency scores for a sample of 19 Korean banks over a period of 1985-95. Their results indicate banks that are growing faster, have developed sizeable network of branches and uses ample amount of their accepted deposits to fund their assets base, emerge as most efficient units. Besides, other studies (Berg et al., 1993; Charles & Kumar, 2012; Favero & Papi, 1995; Mester, 1996; Miller & Noulas, 1996; Resti, 1997; Wheelock & Wilson, 1995; Yue, 1992) also evidences the analysis of relative efficiencies in banking industry across the globe using either DEA or SFA techniques.

In Indian context the evidence of literatures on efficiency pertaining to different aspects are ample and is still growing. For instance, in their study on Indian banking, Bhattacharyya et al., (1997) uses a sample of 70 Indian commercial banks over a period of 1986-91 and finds that public banks performed best under a deregulated environment. The authors employed both DEA and SFA techniques. Although this study focuses on the pre-deregulated era, it observed a temporal improvement and a simultaneous decline in the performance of foreign and public banks respectively. Since the deregulation in Indian banking started in 1991-92, it is plausible that the impact of deregulation on efficiency is felt on a later date. Following similar idea, Das, (1997) studies the technical and allocative efficiency (using DEA) of Indian banking sector over a sample period from 1990 to 1996 and finds an improvement in allocative efficiency among the public sector banks but observes a decline in their technical efficiency. In contrast Saha & Ravisankar, (2000) reports an increase in efficiency (based on DEA) of public banks over the period from 1992 to 1995 apart from few exceptions. In an interesting approach Rajaraman et al., (1999) comments on the association of geographical regions with bank's operating efficiency. Their findings reveal that there is a significant positive correlation for the cluster of three eastern and seven north eastern states with bank's operating efficiency while those for southern and northern states show a negative relationship. Such a finding supports the outcome arrived at by Demirguc-Kunt & Huizinga, (2000) that also argues that improvement in operating environment in regions with geographical difficulties has an impact on bank efficiency. In another study Rajaraman & Vasishtha, (2002) investigates the

relationship between NPAs for a sample of 27 public banks with their operating efficiency over a period of five years ending 1999-2000. Their findings hint that bank with poor operating efficiencies records higher NPAs. Moving ahead, the drawbacks in the study by Bhattacharyya et al., (1997) is addressed by conducting the analysis of productivity separately for pre and post-liberalization era (Kumbhakar & Sarkar, 2003) over a sample period from 1986 to 2000. The authors use a generalized shadow cost function[34] to investigate that if regulations give rise to distortions in choices of input for public and private banks in India. Further their findings suggested that cost efficiency of public banks were lower than private banks and there was no evidence of difference in performance across ownership. However, this study focused mainly on public and old private banks. Moreover, Das & Ghosh, (2006a) argues that since the objective of reforms in Indian banking has been to provide the banks with a common playing platform in the presence of foreign participants by setting prudential norms for capital adequacy, the assets category as well as the income recognition may also have significant impact on efficiency of Indian banks and this has not been sufficiently addressed by Kumbhakar & Sarkar, (2003, 2005).

While studying the productive efficiency based on DEA for a sample of 94 Indian commercial banks (public, private and foreign) over a period of 1997-98, Sathye, (2003) argues that efficiency for banks of Indian origin are comparable with those of foreign banks operating in India. The author also opines that public sector banks emerged as most efficient units while foreign and private banks ranked second and third respectively. However, in their study using DEA technique, Sahoo et al., (2007) examines the efficiency of Indian banking industry (1998-2005) and suggest that private and foreign banks perform better than public banks. In another study, Shanmugam & Das, (2004) uses a sample of 94 Indian commercial banks under four ownership groups (SBI and associates, Other nationalized, Private and Foreign) and examines the efficiency using SFA approach. The findings suggest that out of the four outputs considered in the study (interest-margin, non-interest income, investments, and credit) deposits emerge as an important output determinant. The authors also argue that technical efficiency in increasing the level of interest margin varies significantly across ownership groups and there is no evidence of the impact of reforms (1992) on such interest margin. Mohan & Ray, (2004) examine the revenue and cost efficiencies for the group of public, private and foreign banks in

[34] Usually, estimation of cost function implies that decision makers are in the process of reducing the production cost in connection with the observed prices. However, under certain circumstances it is revealed that decision makers often follow an approach of choosing from a set of shadow prices that are not actually observed by econometricians. For details see (Parker, 1994).

India using DEA technique for a period from 1999 to 2000 and finds that variations in measures of cost efficiency is lower than that of revenue efficiency. Further, their findings indicate that public banks are better technically efficient than private and foreign banks than their allocative efficiency. Das et al., (2005) on the other hand employs DEA technique over a period from 1997 to 2003 on a sample of 71 banks during initial years and 68 banks in their terminal year and finds that there is no significant difference between either input or output oriented technical efficiency and cost efficiency. The authors further comment that Indian banks with respect to revenue as well as profit efficiency and certain factors like bank size, ownership category along with listing in stock exchange positively and significantly impacts revenue efficiency. Another study employs the SFA approach to examine the cost and profit efficiency of scheduled Indian commercial banks over a period from 1986-2003 (Sensarma, 2005). The findings highlight a decline in profit efficiency vis-à-vis cost efficiency for the entire banking industry and hints that foreign banks are less efficient compared to domestic banks. In his (Sensarma, 2006) another work the author uses SFA technique to model the bank behavior in India from 1986 to 2000 in terms of efficiency and productivity. This study also presents a comparative analysis of the foreign banks with that of state owned and private domestic banks. The findings indicate that has better cost efficiency than state-owned and foreign banks. On the contrary, the analysis of composite Total Factor Productivity (TFP) estimates indicates that TFP of public banks ranked the best followed by private and foreign banks. However, Sensarma, (2008) uses a sample of 83 Indian commercial banks over a period from 1986 to 2005 and make contrasting comments on the productivity and profit efficiency. The findings are in contrast with that of Kumbhakar & Sarkar, (2003, 2005) and indicate that although public banks perform better than private banks during pre-deregulation era but there is no difference between their performance in post-deregulation period. Further, foreign, and private banks also turn out to have the best profit productivity. Similarly, Mahesh & Bhide, (2008) uses an unbalanced panel of 94 Indian commercial banks over a period of 20 years (1985-2004) and employs SFA approach to investigate the impact of deregulation on bank-specific cost, profit as well as advance efficiencies. The findings indicate that the degree of competition significantly impacts all three measures of efficiency and with exception to loan efficiency cost and profit efficiencies displays considerable degree of variations across different bank group during post-deregulation era. However, in another approach, using DEA-type Malmquist TFP index (for changes in productivity) technique the authors (Zhao et al., 2008) finds that Indian banking achieved sustained productivity post deregulation phase steered by technological progress. Besides their results also indicate simultaneous increase in riskiness among the banks post deregulation. Das

& Ghosh, (2009) further investigates the impact of cost and profit efficiencies using DEA technique on a sample of Indian banks over the period from 1992 to 2004. The results indicate high levels of cost efficiency with low levels of profit efficiency highlighting inefficiency in revenue management by banks. Further, the study also highlights certain factors like size, ownership, prudential norms, and diversification in products as important sources behind such difference in efficiency. The study by Kumar & Gulati, (2010) also reinstates this finding indicating the positive impact of deregulation on bank's cost efficiency. Also, contrary to Das & Ghosh, (2009) who pin points that important cause of profit inefficiency is due to allocative inefficiency, the authors (S. Kumar & Gulati, 2010) opines that technical inefficiency and not allocative inefficiency is a major cause for cost inefficiency. Tabak & Tecles, (2010) employs a Bayesian SFA technique to investigate the cost and profit efficiencies of Indian banking sector using an unbalanced panel of 67 Indian banks over the period from 2000 to 2006. The findings hint that although public sector banks rank first in terms of efficiency, followed by private and foreign banks, towards the terminal phase of the sample period, foreign banks outperform the domestic banks (public and private) with respect to profit efficiency. Another important work by Bhatia & Mahendru, (2015) that uses a sample of Indian public sector banks over a period from 1990-91 to 2011-12, indicate that although inefficiency among public banks in pre-reform era attributes to PTE such inefficiency in post-reform phase occurs due to scale inefficiency. The study also extends to conduct a panel TOBIT analysis using various CAMEL parameters and finds that such parameters significantly impacts technical efficiency of public banks.

Certain studies also highlight that bank size can act as an important catalyst to improvement in efficiency. Using a sample of Indian commercial banks over a period from 1992-2002 Das & Ghosh, (2006a) comments on the efficiencies of Indian banks under three different approaches (intermediation, operating and value-added) by employing a non-parametric technique (DEA). Their findings highlight that medium-sized public banks appear to be more efficient than their larger counterparts and technically efficient banking units account for less amount of non-performing loans. Moreover, a multivariate Tobit analysis further reinstates these findings. Likewise, Das & Ghosh, (2006b) uses a sample of Indian state-owned banks across a period from 1995-96 to 2000-01 and investigates the interrelationships between capital, credit risk and changes in productivity. Their findings among others indicate that banks that are inadequately capitalized are prone to more regulatory pressure vis-à-vis the capitalized ones. Moreover, reduction in Government ownership leads to improved productivity especially for medium-

sized banks. Interestingly, Ray, (2007) uses a sample of Indian banks across a period from 2007 to 2013 and compares the size efficiency with that of scale efficiency. The author uses MPSS[35] as a benchmark to indicate the large size of a particular bank. The findings indicate large size of banks (SBI, Canara Bank, Punjab National Banks) and approximately 25 percent of Indian banks can be broken into smaller units to attain higher technical efficiency. Moreover, the author also suggests that SBI can be broken down into 25 smaller units to attain higher technical efficiencies. In his another work (Ray, 2014) comments on the branch efficiency for a single large Indian public sector bank (193 branches) within the city of Kolkata. The empirical findings based on DEA approach, shows that there exist evidence of 'over-branching' and suggests that reduction in total branches will increase the cost efficiency. In a different study recently, the authors (Goyal et al., 2019) investigates the meta-frontier, group-frontier and also the technology closeness ratio across a sample of 66 Indian commercial banks spread across different ownership groups for the year 2015-16 using DEA approach. The findings on one hand indicate the existence of different production function across the bank ownership groups and warrants the decision of Government of India in consultation with RBI towards merger of public sector banks.

However, litteratrices on evidence of linking bank profitability with efficiency is sparse. For instance in their study, Dietrich & Wanzenried, (2011) argues that banks can increase their profitability through increase in labor productivity. The authors further opines that the lack of increase in high quality of skilled employees for the public banks induces them to miss out the contributions of efficiency towards increased profits. In another study Lee & Kim, (2013) uses a sample of Korean banks and investigates the determinants of bank performance based on three factors (ROA, ROE and Malmquist index approach). Interestingly their findings indicate that there is no significant evidence of economies of scale in Korean banks and government control as well as foreign buyout funds adversely affects bank performance in Korea. In both cases the use of actual measures of efficiency approaches are scarce.

Therefore, in this study we empirically attempt to fill this gap by linking efficiency with bank profitability using DEA technique. We measure the Overall Technical Efficiency (OTE) under the CCR model (Charnes et al., 1978) and extend our study to decompose this OTE into mutually exclusive non-additive components using the BCC model (Banker et al., 1984), Pure

[35] Most Productive Scale Size. In case if it happens that it is required for a bank to reduce its input mix in order to attain the MPSS then such banks are termed as "too large" and breaking such a banking unit into smaller input bundle will be optimal. For details see (Ray, 2007).

Technical Efficiency (PTE) and Scale Efficiency (SE), with the same dataset. Finally, we introduce the OTE and PTE scores in our analysis model in Chapter V of this thesis to comment on their impact on bank profitability. Details of the same is available in the following chapters.

We also present a summarized view of all these literatures reviewed in this section in Appendix III.1 of this chapter as 'Literature Review Checklist'.

3.5. Summing Up:

In this chapter we highlight three different aspects as regards to the existing studies on linking the internal and external determinants of Indian commercial banks with their financial performance in terms of their profitability. We also present a thorough idea about the types of variables that are used over the past and the importance of ROA as a major proxy for bank earnings as well as the inconsistent results from other proxies like ROE and NIM. Thereafter, we also point out the weaknesses in reliability of results among certain existing studies already done using traditional regression techniques (Fixed and Random effects model). In the presence of a dynamic relationship of the dependent variable the traditional techniques are unable to address the deal out the problem of endogeneity and hence such results arrived at are more prone to biasness (Nickell, 1981). Therefore, to deal out such problem besides others the use of dynamic panel estimation technique is proposed by several authors in different cross-country studies. In this connection we mention some of the pioneering works of utmost importance that uses dynamic panel estimation process and comments on internal as well as external determinants of bank profitability. We also find that besides the internal factors that are commonly used across different studies, there also exists a group of external factors that are macroeconomic in nature like GDP, inflation expectations, lending interest rates, unemployment, exchange rate and others. Very few cross-country as well as Indian studies are able to provide a single equation framework to link these macroeconomic factors alongside the bank-specific or internal factors to investigate the variations in bank profits. Although there are many commonly used internal and macroeconomic factors that affects bank profits but due to differential regulations, Government norms, law and infrastructure as well as operating environment available to banks the results across these variables tends to vary considerably. Hence, an examination into the same is essential in Indian context given the fact that not much work has been done in this regard. Further, instead of the commonly used macroeconomic factor GDP that links the impact of national income on bank performance, we move a step

ahead to test the impact of business cycles on bank profits and try to analyze the nature of procyclicality in bank profits for India.

Finally, we also incorporate the arguments on the impacts of relative efficiency that cannot be overlooked (as a vital measure of performance indicator) in Indian banking industry and extend our analysis to present the outcome of impact of computed value of OTE and PTE scores using DEA technique, on bank's financial performance with respect to their profits. Such a measure of relative efficiency holds immense importance in the backdrop of public bank mergers concluded recently as per the recommendations of Government of India in consultation with RBI. Thus, in this context also, we present a thorough and critical review of works on relative efficiency across the globe and also those on Indian perspective.

All these discussions motivates us to investigate three key questions in Indian context. Firstly, do external factors are simultaneously important in affecting the financial performance of Indian commercial banks? Secondly, whether linking of relative efficiency of Indian commercial banks with their financial performance can provide a significant insight? Lastly, whether the movement of earnings of Indian commercial banks are procyclical in nature in the light of simultaneous swings in business cycles for India?

Therefore, to address these research questions we frame the key research objectives of this study in the following manner:

1) To identify whether, the key bank-specific, industry specific and macroeconomic variables, has significant impact on the variations in the financial performance of the Indian Commercial Banks.

2) To analyze the effects of technical efficiency (economic) measures in the different sectors of the banking operations; and,

3) To examine that if the overall cyclical component and their changes, has any significant impact on the financial performance of the banks in India.

We intend to examine these objectives using Data Envelopment Analysis and Regression technique in the following chapters.

APPENDIX III.1

Literature Review Checklist:

A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Short, 1979)	--	Uses a sample of 60 banks to investigate the relationship between profit rates and concentration across Canada, Western Europe and Japan covering a heterogeneous sample period. Variables used: average discount rate, average long-term bond rate, ownership dummy, leverage ratio, bank size, rate of growth in total assets, H concentration index.	OLS regression technique	Increase in bank concentration leads to higher profits, however, a considerably large change in concentration is needed to reduce the profitability of banks.
(Berger et al., 1987)	--	Uses a sample of 1983 Functional Cost Analysis data across 413 state bank branches and 214-unit state banks for USA. Variables used: Total non-interest operating overhead expenses for deposits and loans, number of account types (demand deposits, time and savings deposits, real estate loans, commercial and installment loans, average annual salary including fringe benefits for all employees, rental cost of office, number of full-service and limited-service banking offices, dummy variable for multi-bank company.	Develops two new methodologies: The Functional Cost Approach and Seemingly Unrelated Regression	The results differ in terms of cost as well as output specifications, organizational levels and competitive environments. Further, there is evidence of variations scope economies contrary to other studies in similar domain.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Bourke, 1989)	--	Uses a sample of 90 banks in each year from 12 cross countries (Australia, California, Massachusetts, New York, Canada, Ireland, England and Wales, Belgium, Holland, Denmark, Norway and Spain) over a sample period from 1972 to 1981. Variables used: Return on capital, return on assets, Value added return on assets, government dummy, three bank concentration ratio, long-term bond rate for each country, growth rate in money supply, capital reserves as a percentage of total assets, cash and bank deposits plus investments as a percentage of total assets, percentage increase in CPI and staff expenses as a percentage pf total asset.	Pooled time series approach to estimate linear regression with value-added technique	Most of the results are to some extent in line with the Edwards-Heggestad-Mingo hypothesis indicating that banks with greater degree of market share can avoid risk. However, there is no evidence of the findings arrived at by Short, (1979).
(Molyneux & Thornton, 1992)	--	Uses a sample of banks across 18 European countries over a sample period from 1986 to 1989. Variables used: Similar to that of Bourke, (1989)	Applies similar methodology like that of Philip Bourke, 1989.	Findings affirm the relation between bank profitability and concentration in US., However, there is no support in favour of Edwards-Heggestad-Mingo hypothesis.
(Berger, 1995)	--	Uses an extensive data spread across 30 datasets spread between 1300 to 2000 observations each covering a period of 10 years of 1980s and belongs to region from unit banking, state-wide branching states and limited branching. Variables used: ROA, ROE, Concentration measured by HHI, bank's share of market deposits, X-efficiency, Scale efficiency, scale economy efficiency, scale diseconomy efficiency, dummy variable for metropolitan region, real growth rate of deposits, state dummy.	Distribution free approach under efficiency measures and Pooled OLS regression technique.	Concentration is usually negatively related to profitability; however the findings indicate that relationship of profit and concentration is a spurious one that incorporates the impact of other variables.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
(Neely & Wheelock, 1997)	--	Uses a sample of banks across 48 states in US (excluding Alaska and Hawaii) over a sample period from 1949 to 1995. Variables used: ROA, ROE, lagged values of ROA ROE and percentage changes in ROA and ROE, Time fixed effects and state fixed effects.	Pooled time series, Cross section model	Per capita income growth at state level influences the earnings of commercial banks in US, however such growth in state income can only explain a little in respect of variations in bank-earnings. State based dummies provides a significant explanatory power too.
(Miller & Noulas, 1997)	--	Uses a sample of 243 banks during the initial years of the sample period in 1984 and 201 banks during the terminal years of the sample period i.e., 1990. Variables used: ROA, asset management, liability management, productivity and efficiency and asset quality.	Cross section and Pooled time series regression	Large banks experiences more poor quality of loan portfolio whereas real estate loans have a negative impact on bank profitability of large banks only although for lower magnitude of significance levels.
Demirgui-Kunt & Huizinga, (1999)	--	Uses a sample of 80 countries over a period of 8 years (1988-1995). Variables used: Net interest margin, BTP to total assets, equity/lagged total assets, loan, interest income, overhead/total assets, GDP per capita, inflation, tax rate, deposit insurance, market concentration, number of banks, ratio of stock market capitalization to GDP, law and order	Weighted least square regression technique.	A higher bank asset to GDP ratio alongside lower concentration ratio results in lower profit margins in the presence of other control variables. Also, the burden of corporate tax is passed directly to the customers but higher requirement of reserves are not.
(Barajas et al., 1999)	--	Uses data on banking system in Columbia across a period from 1974 to 1988 (quarterly) as well as between May 1992 to August 1996 (monthly basis) to prepare for the aggregate system. Moreover, for the period between March 1991 to August 1996 only 21 banks are considered.	OLS, Fixed and Random effects regression technique.	Variations in spread is although positively related to changes in quality of loans disbursed more significantly during the post-liberalisation period. Further considerable changes in

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
		Variables used: market power, retail loans, retail wage rate, non-performing loans, interest spreads and time dummy for June 1980.		efficiency as well as reduction in allied expenditures will be more clearly visible as foreign competition increases.
(Hughes et al., 1999)	Consolidation; Diversification; Mergers; Efficiency	Uses a sample of 441 highest level Bank Holding Companies across US for four quarters of 1994. The data on market values were collected from the stock-price database of Standard and Poor's CompStat for 190 sub-sample BHCs. Variables used: Number of BHCs, Assets, Asset's growth, percentage that are one bank holding companies, number of states, number of branches, deposit dispersion, macroeconomic diversity, expected profit, profit risk, insolvency risk, profit inefficiency, net assets acquired, net institutions acquired, market value of equity, market value of assets, market-value equity inefficiency, market-value asset inefficiency.	Non-linear two stage least squares approach	The economies of bank consideration is more prominent for those banks that have experienced interstate expansion more significantly that on turn results in diversification of bank's macroeconomic risk. Furthermore, besides banks the society also gains considerably from increased financial performance of banks.
(Demirguc-Kunt & Huizinga, 2000)	Financial structure; bank profits; interest margins	Uses a sample of bank-level data across all OECD nations, over a sample period from 1990 to 1997. Variables used: profit/ta, NIM/ta, equity/lagged total assets, loan/total assets, non-interest earning assets/ta, customer and short-term funding/ta, overhead/ta, GNP/capital, growth rate, inflation, tax rate, bank/GDP,	OLS regression with country and time fixed effects.	For countries with underdeveloped financial systems, a shift towards developing financial system results in decline of bank profits as well as margins. However, there is no significant impact of market development, bank development as

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		Central bank/GDP, bank credit/GDP, Market cap/GDP, Tvt/GDP, structure, market		well as development in financial structure on bank performance.
(Abreu & Mendes, 2002)	--	Uses a sample of banks across different nations of European Union (Portugal, Spain, France and Germany) over a period from 1986 to 1999. Variables used: ROA, ROE, NIM, Labour/Assets, Equity/Total Assets, Loans/Assets, bank's market share defined by bank's loans/nation's domestic credit, unemployment rate, inflation rate, exchange rate, country based dummy variables.	OLS regression with country and time fixed effects.	Well capitalized banks are less prone bankruptcy costs, there is significant degree of variations in the results using ROA, ROE and NIM. Inflation has a negative impact on bank performance.
(Mamatzakis & Remoundos, 2003)	--	Uses a sample of major Greek Commercial banks across a period from 1989 to 2000. Variables used: ROA, ROE, ratio of personnel expenses to assets, natural log of bank assets and its squared value, bank ownership dummy variable, ratio of equity to assets, ratio of loan loss provisions to loans, ratio of loans to assets, concentration ratio (HHI), inflation (CPI), narrow money supply and changes in Athens stock exchange on yearly basis.	Panel regression technique, Fixed and Random Effects model as validated by Hausman test.	Finds weak evidence of persistence in bank profits. Measures of deregulation and introduction of Euro has contributed to increased competition in banking sector. Furthermore, variables related to management decisions significantly impact the profits of Greek banks.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Goddard et al., 2004c)	--	Uses a sample of 665 banks across six European nations (Denmark, France, Germany, Italy, Spain and the UK) across a sample period from 1992 to 1998. Variables used: ROE, bank size measured by total assets, Off Balance Sheet business as a proportion of assets together with Off Balance Sheet business and Capital Adequacy Ratio.	Pooled OLS and Dynamic Panel model using GMM techniques.	Finds very weak evidence of size-profitability relationship across the sample nations. While the association between the off-balance sheet businesses carried on by banks and profitability is positive only in case of UK but such result is either nil or negative for other countries. However, capital to assets ratio significantly impacts profitability.
Pasiouras & Kosmidou, (2007)	Banks; European Union; Profitability	Uses a sample of 15 European Union States over a sample period of 7 years (1995-2001). Variables used: ROAA, asset size, CRAR, liquidity, cost to income ratio, inflation, GDP, market concentration, total assets of deposit money with banks to GDP ratio, MACPASS[36], MACGDP.[37]	Fixed Effects Model (Panel Data regression technique)	Except concentration all other variables considered turns out to be significant determinants of bank profitability. However, concentration shows inconsistent degree of significance to domestic and foreign banks.

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[36] Market share capitalization to total asset of deposit money with bank.
[37] Market share capitalization to GDP ratio.

A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
Athanasoglou et al., (2008)	Theory used: Traditional Structure conduct, performance, or SCP hypothesis. Key words: Bank profitability, Business Cycle and Dynamic Panel	Uses a sample of Greek Banks over a time of 17 years, 1985-2001. Variables used: ROA; ROE; HHI; Equity to Assets ratio; Loan loss provisions to Loans; Dummy for Ownership; Real Assets and square of Real Assets in logs; Inflation rate at CPI; Cyclical output.	Dynamic panel regression technique using Arellano and Bond estimator of 1991.	Capital is positively profitability whereas the credit risk is found to be negatively significant with the profitability of the banks. Productivity and business cycle positively impacts profitability. HHI although negatively impacts bank profitability but is insignificant.
Flamini et al., (2009)	Banks; credit risk; market structure	Uses a sample of 41 Sub-Saharan African countries over a period of 9 years. Variables used: ROA ratio, Asset Size, Physical capital, credit risk, cost management, activity mix, market share, ownership, wealth, growth rate of GDP, inflation, fuel price and non-fuel commodity prices, regulatory situation.	Arellano-Bond (Two-step GMM approach)	Moderate persistence of profitability. Also, the finding highlight the need for higher capital requirements to ensure more financial stability of Sub-Saharan African banks.
Alper & Anbar, (2011)	Bank profitability; Commercial banks; Turkish banking sector	Uses a sample of Turkish banks over a period of 9 years (1992-2010). Variables used: ROA, ROE, Asset size, asset quality, capital adequacy, liquidity, deposits, GDP, inflation, real interest rate.	Fixed Effects Model (Panel Data regression technique)	Bank size, non-interest income, decrease in credit to asset ratio significantly elevates bank profitability while real interest rate also significantly impacts bank profits among macroeconomic factors.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Bouvatier et al., (2012)	Credit cycle; Economic cycle; Banking structure; Panel VAR	Employs a sample of 17 OECD countries to explain the credit procyclicality over a period of 25 years from 1986 to 2010. Variables used: GDP; Bank credit to private non-financial sector; Short term interest rates and House Prices.	Vector Autoregressive models and provides a detail of banking system structure using the hierarchical clustering methodology.	Shows different clusters using HP and MHP filters. One such cluster show a more pronounced relationship of the credit to shock in GDP which is apparently much higher and highlights the US credit response function to a shock in GDP.
Delechat et al., (2012)	Central America; Bank Liquidity; Credit; Dollarization; Foreign Banks	Uses a sample of 96 Commercial banks in the backdrop of Central America, Dominican Republic, and Panama for a period of 5 year, 2006 to 2010. Liquidity Buffers (Liquid Assets to total assets); Spread between lending and deposit rates; Log of Assets and its squared value; Equity to total assets; Loan loss reserves to gross loans; Private Sector Credit to GDP; Growth for Economic Cycle; Deposit dollarization; Net international reserves holdings of Central banks.	Applied the GMM methodology as developed by Blundell and Bond (Blundell & Bond, 1998).	Measures of Liquidity buffers are positively related to bank size whereas, but negatively related to loan-loss reserve ratio, NIM, capitalization (for baseline model only), credit to GDP ratio. Bank size has significant impact on liquidity but mostly through interaction term.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
Curak et al., (2012)	Determinants of profitability; Dynamic panel analysis; Macedonian banking sector	Uses a sample of Macedonian banks over a period of 6 years (2005-2010). Variables used: ROA, bank size, solvency risk, liquidity risk, credit risk, fees earnings, operating expense, management quality, concentration, EBRD index, growth rate in GDP.	Dynamic Panel Analysis.	Management of operating expenses alongside solvency and liquidity risk emerge as the most important determinant of bank profitability amongst the internal factors, while economic growth, reforms in banking systems and concentration turn out to be significant external factors.
Ongore & Kusa, (2013)	Financial Performance; Bank Specific Factors; Macroeconomic Variables	Uses a sample of 37 commercial banks in Kenya over a period of 10 years. Variables used: ROA, ROE, Net Interest Margin, asset quality, capital adequacy, management efficiency, liquidity, GDP, and inflation.	Generalised Least Square technique (Using cross-section weights)	Bank's financial performance as proxied by profitability are mainly driven by effective board and management decisions while macroeconomic factors reveal insignificant impact.
Abdullah et al., (2014)	--	Uses a sample of banks from Bangladesh over a period of 4 years. Variables used: ROA, NIM, asset size, credit risk, ratio of loan to total asset, taxation, bank capitalization, cost efficacy, proxy for non-conventional activities, labour productivity, market concentration, banking sector development, inflation.	Multivariate regression analysis technique.	Higher cost efficiency, bank size, greater concentration, capitalization are the key drivers of bank profitability. While, credit risk, is negatively associated with ROA, labour productivity and non-traditional banking operations positively impacts ROA. On the contrary credit risk positively affects NIM and inflation is significant to NIM only.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Căpraru & Ihnatov, (2014)	Determinants of banks' profitability; financial crisis; Central and Eastern Europe	Spread over a period of 8 years covering a sample of 1098 banks from EU27 countries. Variables used: ROA, ROE, Net Interest Margin, asset size, capital adequacy, management efficiency, business mix indicator, inflation, GDP.	Ordinary Least Square techniques. (Fixed and Random Effects Model)	Management efficiency and growth in capital adequacy significantly impact all proxies of bank profitability while inflation and credit risk impact ROA and ROE only.
Dietrich & Wanzenried, (2014)	Banking profitability; Country income level; Financial crisis; GMM estimation; Macroeconomic impact on banking profitability	Uses a sample off 118 countries over a period of 15 years. Variables used: ROA, ROE, Net Interest Margin, bank size, deposits, physical capital, cost to income ratio, loan loss provisions, proportion of interest income, funding cost, ownership, nationality, effective tax rate, inflation, ratio of listed share to GDP, GDP growth rate, concentration, crisis.	Arellano & Bover, (1995) (GMM estimation technique)	Levels of profits varies significantly across countries of different income-levels.
Jara- Bertin et al., (2014)	Credit risk; Diversification; Interest margin; concentration; Latin American bank industry; Performance	Selected Latin American countries over a period from 1995 to 2010. Variables used: ROA, Net interest margin, diversification, bank size, capital, depositor's demand, liquidity and credit risk, management efficiency, concentration, inflation, crisis.	Panel GMM technique	Bank size, service diversification, capital ratio, economic growth, inflation, bank concentration and degree of specialization show a positive impact whereas credit risk, liquidity risk as well as operational inefficiencies show negatively impact bank profits.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Albulescu, (2015)	Banking sector profitability; internal determinants; financial soundness indicators; emerging countries	Uses a sample from emerging countries in Central and South America over a period of 9 years (2005-2013). Variables used: ROA, ROE, asset quality, capital adequacy, ratio of liquid assets, ratio of non-interest expense and interest margin to gross income.	Fixed Effects Model. (Panel regression technique).	Non-performing loans negatively impacts bank profitability while level of liquidity and non-interest expenses has a mixed impact on bank profitability (ROA and ROE). Capitalization and interest rate margins positively impacts bank profitability.
Ali, (2015)	Assets; Asset's size; Bank-specific determinants; Banks; Operating costs; Profitability; Profits	Uses a sample of 26 banks from Pakistan over a sample period of 5 years (2009-2013). Variables used: ROA, ROE, asset size, asset quality, liquidity, asset management, deposit, operating efficiency, debt equity ratio, financial risk, GDP, inflation.	Fixed Effects Model. (Panel regression technique).	Pakistan banking industry is able to well manage the effects of inflation and GDP on their profitability while there is a need for effective management to improve the internal factors more.
Petria et al., (2015)	bank profitability; banking system; European Union	Uses a sample of EU27 countries over a period of 8 years (2004-2011). Variables used: ROA, ROE, bank size, capital adequacy, credit and liquidity risk, management efficiency, indicator of business mix, concentration, inflation, GDP.	Fixed Effects Model (Panel regression technique).	Competition has a significant and positive impact on bank profits of EU27 countries, while credit risk, liquidity risk, business diversification, market concentration and economic growth also significantly influences ROA and ROE.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Titko et al., (2015)	Bank profitability; Regression analysis; Latvia; bank profitability; Lithuania; regression analysis	Uses a set of sample banks from Latvia and Lithuania over a period of 7 years (2008-2014). Variables used: ROA, ROE, Net Interest Margin, NFCITA[38], size, liquidity, cost to income ratio, loan to deposits ratio, infrastructure[39].	Multiple regression analysis	NFCITA has a negative relationship with number of Latvian bank branches, cost to income ratio has a significant positive relationship with bank profits for Lithuanian banks as expressed by NIM.
Abel & Roux, (2016)	Banking Profitability; External Determinants; Internal Determinants; Fixed Effects; Generalized Methods of Moments	Uses a sample of 18 Zimbabwean banks across a period of 6 years (2004-2014). Variables used: ROA, ROE, asset size, liquidity risk, credit risk, capital adequacy, operating expense management, GDP, inflation, concentration index.	Fixed Effects Model. (Panel date regression technique)	Profitability can be improved through increase in asset quality, improvement in expense management as well as improved liquidity and capital levels.
Saona, (2016)	Bank profitability; Capital ratio; Diversification; Institutional environment	Uses a sample of 156 banks in the backdrop of 7 Latin American countries[40]. Variables used: Net Interest Margin, ROA, capital ratio,	System GMM estimator.	Asset diversification and market concentration have a positive impact on bank profitability, while revenue diversification and development in legal and

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[38] Net fees and commission as a percentage of total assets.
[39] A composite variable consisting of E-Banking and Infrastructure comprising of: Number of payment cards, Number of ATMs, Number of POS terminals, Number of internet banking users and Number of branches.
[40] Argentina, Brazil, Chile, Mexico, Paraguay, Peru and Venezuela.

A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
		business diversification, bank size, credit size, bank concentration, loan, deposit, inflation, GDP.		regulatory systems reveal a negative impact on bank profits.
Tan, (2016)	Bank competition; Bank profitability; China; GMM; Risk	Uses a sample of 41 Chinese Banks over a period of 8 years (2003-2011). Variables used: ROA, ROE, Net Interest Margin, Profit before tax to total assets, asset size, liquidity, bank risk (z-score), shareholder's equity to total assets, cost management, diversification, labour productivity, tax, operating profit ratio, competition, development of banking sector and stock market, inflation, GDP.	One-step GMM Estimator.	The final results do not support any robust conclusion but indicate that Chinese banks are significantly affected by taxation, overhead costs, labour productivities and inflation.
Kamarudin et al., (2016)	Global financial crisis; Private Commercial Banks; Profit efficiency; State Owned Commercial Banks	Uses a sample of 31 commercial banks operating in Bangladesh over a period of 8 years (2004-2011). Variables used: Profit efficiency, banks size, credit risk, diversification, capitalization, overhead expenses, liquidity, GDP,	Data Envelopment analysis, OLS, Fixed Effects and Random Effects model (Panel data regression technique)	Bank size, liquidity, economic growth as well as market concentration show a negative but significant impact on bank's profits efficiency of State-Owned Commercial banks but are positive to Private Sector banks. However,

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
		Inflation, market concentration.		capitalization, credit risk and inflation show significant impact on profit efficiency of state-owned banks post financial crisis only.
Caporale et al., (2017)	Banking sector; Global financial crisis; MENA region; Profitability	Uses a sample of 515 different banks from 24 Middle East and North African countries over a period of 13 years (2000-2012). Variables used: log of return on assets, bank size, log of net loans to total assets ratio, inflation, GDP, bank ownership, crisis.	Random Effects Model. (Panel data regression technique).	Domestic banks outperform foreign banks during the crisis phase. Further, GDP positively impacts domestic banks, while liquidity ratio as well as net interest revenues reveals a negative and positive impact on bank profits respectively.
Ebenezer et al., (2017)	Bank-specific; Macroeconomic; Commercial bank; Profitability; financial institutions.	Uses a sample of 16 commercial banks from Nigeria over a period of 6 years (2010-2015). Variables used: ROA, ROE, asset size, asset quality, capital adequacy, liquidity, deposits, efficiency, pattern of revenue expenses, GDP.	Fixed and Random Effects Model. (Panel Data regression technique).	Increase in capital and liquidity along with simultaneous decrease in operating costs of banks significantly impacts their profitability. Also, a good economic environment also contributes positively to an increase in bank profits.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Srinivasan & Britto, (2017)	financial performance; liquidity; profitability; solvency; commercial banks.	Uses a sample of 16 Indian commercial banks over a period of 5 years (2013 to 2017). Variables used: ROA, Quick ratio, current ratio, loans to deposits ratio, P/E ratio, EPS, Net profit margin, Turnover ratios, solvency ratios.	Fixed and Random Effects Model. (Panel Data regression technique).	Liquidity, solvency and turnover ratio have significant impact on the profits of selected private and public banks in the study.
Subbarayan & Jothikumar, (2017)	Least Square Method; Macro Economic Variables; Panel data; Profitability; Return on Assets	Uses a sample of 26 Indian commercial banks over a period of 6 years (2010-11 to 2015-2016). Variables used: ROA, bank size, equity to total assets ratio, net interest income ratio, reserves and surplus, operating expense ratio, physical capital, GDP, inflation, HHI.	Pooled Ordinary Least Square technique.	Bank profits are not only dependent on its own characters but is significantly impacted by industry specific and macroeconomic factors.
Yahya et al., (2017)	Bank-specific factors; Islamic banks; Macroeconomic factors; Political instability; ROA; ROE; Yemen.	Uses a sample of 3 full-fledged Islamic banks of Yemen over a period of 5 years (2010-2014). Variables used: ROA, ROE, bank's asset size, liquid assets to total assets ratio, equity to total assets, deposits to total assets, operating income to total assets, operating efficiency, financial risk, annual real GDP growth rate, inflation, rank of political stability.	Multiple regression analysis.	Operating efficiency and financial risk negatively impacts ROA and ROE. Bank size, asset management, deposits, liquidity, GDP, inflation and political stability have positive and significant impact on bank profits.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Al-Homaidi et al., (2018)	GMM; India; bank-specific; macroeconomic; NIM; panel data; profitability	Uses a sample 60 Indian commercial banks over a period of 10 years (2008-2017). Variables used: ROA, ROE, Net Interest Margin, log of total asset, capital ratio, capital adequacy, loans to total assets, liquidity ratio, deposits to total assets, Asset management, operating efficiency, financial risk, number of bank branches, GDP, inflation, average annual exchange rate, lending interest rate.	Pooled OLS, Fixed Effect, Random Effects of Panel regression technique and GMM Estimator.	Bank size, number of branches, leverage ratio and asset management ratio significantly impact ROA, while except number of bank branch all bank-specific factors significantly affects NIM. However, macroeconomic factors negatively impact bank profitability.
Antoun et al., (2018)	Bank performance, CEE, CAMEL, factor analysis, panel regression.	Examines a sample of 128 banks from nine[41] Central and Eastern European countries over a period of 6 years (2009-2014). Variables used: CAMELS ratio, bank size, deposits to total assets, business mix, operating efficiency, concentration, per capita growth rate in real GDP, annual percentage change in CPI.	Fixed Effect model. (Panel data regression technique).	Business mix and inflation positively impacts bank earnings and their asset quality, while size negatively impacts bank earnings, asset quality, capital adequacy and liquidity. Also, bank concentration and economic growth positively impacts capital adequacy and liquidity.

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[41] Belarus, The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland and Ukraine

A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
Brahmaiah & Ranajee, (2018)	Bank Profitability, Internal Factors, External Factors.	Employs panel of 89 banks operating in India over a period of 11 years (2005-2015). Variables used: ROA, ROE, bank size, ownership, shareholder's equity to total assets, operating efficiency, credit risk, NPA ratio, PSL ratio[42], Interest income to total income, ratio of wage bills to total income, interest cost to total liabilities, banking sector deposits to GDP ratio, stock market development to GDP, inflation growth rate, annual GDP growth rate.	Fixed Effects model. (Panel data regression technique).	GDP and inflation have negative impact on ROA, but inflation positively impacts ROE. Overall capital base, operational efficiency, banking sector deposits to GDP ratio positively impact bank profitability while inflation, NPA, credit risk, cost of funds negatively impacts bank profitability. Size and PSAL ratio do not have any significant impact on bank profits.
Robin et al., (2018)	Financial reform; Banking; Panel data; Profitability	Uses a sample of 12 major commercial banks in Bangladesh over a period of 30 years. Variables used: NIM, ROA, ROE, bank size, transition dummy, post reform dummy, concentration ratio, ownership dummy, independent director, political director, capital ratio, asset quality, growth rate in GDP, inflation.	Fixed and Random Effects model. (Panel data regression technique)	Capital base and asset quality form the main base for driving bank profitability. Also, financial reform has no significant impact on profitability.
Serwadda, (2018)	bank, profitability, liquidity,	Uses a sample of 26 Hungarian		More control over overhead costs

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[42] Ratio of Priority sector advances to total advances.

A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
	credit risk, Hungary.	commercial banks over a period of 16 years (2000-2015). Variables used: ROA, NIM, capital adequacy, liquidity risk, bank size, overhead cost, NPAs.	Fixed and Random Effects model. (Panel data regression technique)	is essential to ensure increase in profitability. Besides credit and liquidity risk should be monitored more strictly, along with focused policies on diversification.
Yao et al., (2018)	Bank profitability; determinants; generalized method of momentum (GMM); Pakistan; government change	Examines a sample of 28 Pakistan banks over a period of 10 years (2007-2016). Variables used: ROA, ROE, NIM, profit before tax to average assets, bank size, solvency ratio, credit quality, liquidity, operating efficiency, financial structure, diversification, funding cost, operating cost, labour productivity, bank-type dummy, industry concentration, assets of all banks to GDP ratio, market power, annual GDP growth rate, change in consumer price index rate, government change dummy.	Two step GMM regression technique.	Bank profitability is significantly explained by size, increased solvency, financial structure, productivity in labour, market power as well as economic growth. Bank profitability is lower during period of government transition, whereas credit quality, inflation, development in banking, operating efficiency appear to negatively significant with profitability.
Almaqtari et al., (2019)	India; bank-specific; commercial bank; demonetization; financial crisis; profitability	Uses a sample of 69 Indian commercial banks over a period of 10 years (2008-2017). Variables used: ROA, ROE, asset size, capital ratio, asset quality, liquidity ratio, deposits to total assets, asset management, financial	Pooled, Fixed and Random Effects Model (Panel data regression technique).	Most of the bank-specific factors are common in impacting ROA and ROE, while all macroeconomic determinants except demonetization significantly affects ROE.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
		risk, operating efficiency, number of branches, annual GDP growth rate, annual inflation rate, exchange rate, lending interest rate, dummy for financial crisis, dummy for demonetization.		
Le & Ngo, (2020)	ATMs; Bank cards; Bank profitability; POS terminals; System GMM; Technology	Uses a sample of banks from 23 countries over a period of 15 years (2002-2016). Variables used: ROA, NIM, payment card, ATM, POS terminals, overhead cost to total assets ratio, capital adequacy ratio, credit risk, stock market capitalization to GDP ratio, proportion of assets of three largest banks to the share of total assets of all banks, GDP, inflation, financial crisis.	System GMM Estimator. (Arellano & Bover, 1995)	Development in bank infrastructure and service delivery channels (issue of cards, number of ATMs and POS terminals) significantly increases bank profitability. Also, bank profitability and developments in capital markets are complimentary to each other .
Desalegn & Zhu, (2021)	Bank industry; China; Economic Policy Uncertainty index; Earnings opacity; 2-step system GMM estimator	Uses a sample of 81 Chinese banks over a period of 8 years. Variables used: earnings opacity, EPU index, capital to risk weighted assets, bank size, loan ratio, loan loss provisions to total assets at the beginning of each year, NPA ratio, change in ROA, Tier 1 capital to	System GMM Estimator. (Arellano & Bover, 1995)	Impact of EPU on bank's earnings depends on the financial strength of banks and effective policy should be in place to reduce the uncertainty in bank earnings.

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A-3.1: EVIDENCE ON DETERMINANTS OF BANK PROFITABILITY (continued)				
Author(s), Date	**Theory(s) used // Key words**	**Period of study and Variables used (Principal explanatory and explained)**	**Research methodology (Tools used)**	**Major findings**
		risk-weighted assets, ratio of loan charge-offs to total assets at the beginning, inflation.		
Sarkar & Rakshit, (2021)	Return on assets, return on equity, net interest margin, GDP, GMM	Uses a sample of 33 Indian commercial banks over a period of 18 years (2000-2017). Variables used: ROA, ROE, NIM, growth rate in annual real GDP, annual inflation, unemployment rate, lending interest rate, bank size, asset quality, asset management, interaction term.	2 step Difference GMM approach	Besides the internal bank-specific variable the external factors also significantly influence bank profitability, and such results remain static with simultaneous inclusion of control variables.
(Desalegn & Zhu, 2021)	EPU; earnings opacity; Two-step system GMM technique; bank industry; China	Uses a sample of 81 Chinese banks across a period from 2011 to 2018. Variables used: Earnings Opacity, Economic Policy Uncertainty, Loan, Non-performing Loans to total assets, Tier 1 capital to risk-weighted assets, ratio of Loan Loss provisions to beginning Total Assets, change in ROA, ratio of changes in loan charge-offs to beginning total assets, annual CPI, US EPU, Japan EPU, 6 countries average EPU, EPU index in general.	Fixed Effects, Random Effects and Two-Step System GMM technique.	Impact of EPU on bank's earnings opacity is dependent on financial strength of banks. There should be adequate policies to deal with proper framing of economic policies during situations of increased uncertainties.

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A-3.2: RELATED TO BUSINESS CYCLES				
Author(s), Date	**Theory(s) used // Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
Bry & Boschan, (1971)	--	Uses the monthly bituminous coal production series from 1914 to 1938 for US	Analysis of time series curves.	Provides the opportunity of determining the turning point as well as historically diffusing over a large group of time series for various companies that will serve as a base for different indicators across the 50 states.
Dua & Banerji, (2000)	--	Uses Indian data from November 1964 to February 1997. Variables used: Factory wages (various issues of RBI bulletin), total monthly employment of private and public sectors, GDP at factor cost and constant prices and index for industrial production of consumer goods	Traditional NBER methodology	Highlights the timing of economic recessions as well as expansions in the aggregate economy and at the same time indicates the slowdown or acceleration in economic growth.
Chitre, (2001)	--	Uses data on 94 monthly time series for India from 1951 to 1982.	Follows the methodology as proposed by NBER	Using of deflated indicators may not resolve the issue of Indian growth cycle with that of other countries.
Bikker & Hu, (2002)	--	Uses data across 29 OECD countries along with data for US and UK from 1979 to 1999. Variables used: ROA, ROE, real GDP growth, unemployment, inflation, loans, net interest incomes and failures.	OLS regression technique	Mandated higher capital buffer will create more procyclical effect related to bank lending. Also, credit rationing during the period of busts is propelled to a minor extent by the capital crunch hypothesis.

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A-3.2: RELATED TO BUSINESS CYCLES (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
Dua & Banerji, (2007)	Indian Leading Index; Exports; Evaluation of Leading Indicator; Lead Profile	Uses a sample of 17 country index as a weighted average value of the Economic Cycle Research Institute over a period from 1976 to 2006. Variables used: Total value of Exports Growth rate and Leading index of Exports growth rate.	Identifies the leading peak and troughs rather than statistical fitting. More precisely based on the understanding of fundamental factors that drives business cycles.	Performance of the leading index of Indian exports is credible over the last 7 years since its construction in 2001. Such index forms a better source of information in comparison with the DSE-ECRI Indian leading index.
Albertazzi & Gambacorta, (2009)	Bank profitability; macroprudential analysis; economic cycles.	Uses a sample across 10 industrialized countries[43] over a sample period from 1981 to 2003. Variables used: Net interest income, non-interest income, Operating cost, provisions, Log of real GDP, Inflation rate, money market rate, long term rate, log of total assets, lending/GDP, Stock market cap/GDP, stock market volatility, loan loss provisions.	Two step difference GMM estimator technique.	GDP influences both net interest income as well as loan loss provisions. The presence of procyclicality is although significantly evidenced but greater proportion of such cyclical scenario is present in UK and USA compared to other sample countries.
Tsatsaronis, (2012)	--	Uses a sample of annual returns on stock for 50 actively traded global bank stocks across 11 OECD countries over a period from 1990 to 2009 to analyze the relationship between bank's stock returns, leverage and business cycles. Variables used: business cycles (deviation of GDP growth from its times trend, ratio of total assets to MV of equity, book value to MV ratio, past bank earnings.	Pooled OLS model based on the CAPM theory.	Bank having higher leverage faces higher cost of equity and that increased capital ratios attract lower funding costs.

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[43] Austria, Belgium, Germany, Italy, the Netherlands, Portugal, Spain, United Kingdom and United States.

A-3.2: RELATED TO BUSINESS CYCLES (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
Drehmann et al., (2012)	Financial cycle, business cycle, credit, asset prices, financial crisis, medium term.	Uses a sample of seven countries[44] to analyze the behaviour of six variables over a period from 1986 to 2011 using quarterly data. Variables used: GDP as proxy for business cycles, credit, credit/GDP, house prices, Equity prices, index of aggregate asset prices (that includes residential property, commercial property and equity prices), residential property prices.	Frequency based filter analysis and turning point analysis.	Financial cycles last longer than the business cycles, but the latter lasts longer when it coincides with business cycles. Further policies that are successful in controlling short run recessions ignoring the length of financial cycles are exposed to long run recessions in the future.
Dua & Banerji, (2012)	--	Draws a comparison between the business as well as growth rate cycles in India over the period from March 1990 to January 2009.	--	Highlights the importance of leading index that is a composite index comprising of leading economic indicators. Such an index is useful in anticipating business as well as growth rate cyclical upswing and troughs.
Lahiri & Zhao, (2016)	Consumer confidence; cross sectional heterogeneity; asymmetry; news; recessions	Uses household data and consumer-based surveys from 1979 to 2013 identifies the main determinants of the 5 indicators contained in the University of Michigan's Index on Consumer Sentiment to magnify its role on variations in business cycles.	OLS regression model	Highlights that a drop in sentiments are due to differences in interpretation of varying macroeconomic conditions helps in predicting cyclical upswing.

[44] Australia, Germany, Japan, Norway, Sweden, United Kingdom and United States

A-3.3: RELATED TO EFFICIENCY				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Berg et al., 1992)	--	Uses a sample of 503 Finnish banks, 150 Norwegian and 126 Swedish banks for the year 1990. Variables used: Outputs = Loans, Deposits and Number of bank branches. Inputs = Capital (book value of machinery and equipment) and Labour.	Malmquist index using DEA technique.	The largest Swedish banks records the highest efficiency in comparison to one large Finnish bank that has a score of 0.90. However, none of the Norwegian banks show a score close to 0.90.
(Yue, 1992)	--	Evaluates the efficiency based on a sample of 60 Missouri commercial banks over a period from 1984 to 1990. Variables used: Output = Bank labour, Capital and Operating costs. Inputs = Interest Expense, Non-Interest Expense, Transaction deposits and non-transaction deposits.	Data Envelopment Analysis	The results present the efficiency scores under the CCR model and also the additive form of it. Although there is similarity between the two efficiency scores but there exists certain minor differences.
(Fecher & Pestieau, 1993)	--	Studies the productive efficiency of insurance and banking institutions across 11 OECD nations over a period from 1971 to 1986.	Data Envelopment Analysis	There are considerable variations noted in the average efficiency estimates across different nations, of which the noteworthy are Denmark and Japan. However, the overall average efficiency recorded a value of 0.82.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Elyasiani & Mehdian, 1995)	--	Study is conducted over a period on 1979 and 1986 (December 31st) on a sample of small and large US commercial banks. Variables used: Investments, Real estate Loans, Commercial industrial loans, other loans, Time, Demand and Savings Deposits, Capital, Labour.	Data Envelopment Analysis (DEA)	In pre-deregulation era small banks are more efficient than large ones, however there is no significant difference in their efficiency post-deregulation. While dispersion in efficiency measures of small banks significantly increased but that of large banks have changed only a little post-deregulation.
(Wheelock & Wilson, 1995)	--	Uses a sample of 269 US commercial banks that participated in the Federal Reserve's Functional Cost Analysis program for the year 1993. Variables used: Outputs = Number of demand deposit accounts, number of time deposit accounts, number of real estate loans, number of installment loans, number of commercial loans. Inputs = Number of employees, Occupancy costs and expenditure on furniture and equipment, expenditure on materials.	Data Envelopment Analysis	Technical and overall efficiency is higher under intermediation approach as compared to production approach. Additionally, the authors also find that under intermediation approach most banks are less scale efficient and operate under CRS portion of the efficient frontier.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Favero & Papi, 1995)	--	Uses a sample of 174 Italian banks for the period of 1991. Variables used: Outputs = Loans to other banks and non-financial institutions, investment in securities and bonds, and non-interest income. Inputs = Number of full-time employees, Book values of fixed assets and premises, Loanable Funds including current A/c, savings deposits, Certificate of Deposits, and net funds borrowed by other banks, financial capital available for investment.	DEA Technique. Simple OLS Regression technique.	Results on efficiency is similar under different specifications of input and output under both Assets and Intermediation Approach. Finally, the important finding is that efficiency is best explained by specialization in productive capacity, size and to some extent by location of operation.
(Mester, 1996)	Banks; Efficiency; Risks.	Uses a sample of 214 US banks contained in the Third Federal Reserve District for the year 1991-92. Variables used: Outputs = Real estate loans, Commercial and Industrial Loans and Loans to individual. Inputs = Labour, Physical capital and Borrowed money along with their corresponding prices.	Stochastic Cost Frontier Approach and Logistic Regression technique	The Third Federal Reserve District banks although operates at cost-efficiency output levels as well as across different product mixes but are not using their inputs efficiently termed as X-inefficiency. The study also presents certain bank-specific inefficiency estimates.
(Miller & Noulas, 1996)	Technical Efficiency; Large Banks.	Uses a sample of 201 large banks in US over a sample period from 1984 to 1990. Variables used: Outputs = Commercial and industrial loans, Industrial loans, Real estate loans, Investments, Total interest income and Total non-interest income.	Data Envelopment Analysis technique	Overall average technical efficiency is slightly over 5 percent contrary to other studies. Larger as well as profitable banks show greater levels of technical efficiency, however such banks tend to operate under a Decreasing

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		Inputs = Total transaction deposits, total non-transaction deposits, total interest expense and total non-interest expense.		Returns to Scale.
(Resti, 1997)	Efficiency; Data Envelopment Analysis; Banking; Frontiers.	Uses a sample of 270 Italian banks over a period from 1988 to 1992. Variables used: Outputs = Loans, Deposit, Non-interest income. Inputs = Labour with their corresponding prices, Capital with their corresponding prices and Operating costs.	Data Envelopment Analysis technique.	Bank efficiency shows greater degree of variation and there exist an inverse relationship between the productive efficiency and asset quality of Italian banks. However, there is no evidence of decrease in efficiency of these banks over the sample period.
(A. Das, 1997)	--	Uses a sample Indian Public Sector banks operating under a regulatory environment over the periods of 1970, 1978, 1984, 1990 and 1996. Variables used: Outputs = Margin (Total interest earned – Interest paid) and Commission, exchange, Brokerage etc. Inputs = Labour and Loanable Funds (Deposits + Borrowings)	Non-Parametric technique to evaluate the technical and allocative efficiency.	State Bank Group records higher rate of efficiency rather than other nationalized banks and the nature of inefficiency is technical in nature than being allocative. Although the public bank groups show improved efficiency during post-liberalization period but most of their inefficiency is due to either underutilization or wasting of resources than incorrect input mix.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(E. J. Leightner, 1997)	--	Uses data on Thai finance and securities companies over a period from 1990 to 1994.	DEA technique.	The security companies were too small to compete with the large banking entities over the sample period analyzed and such finance and security companies can attain more profits through alteration in their input-output mix.
(Berger & Humphrey, 1997)	--	A survey literature comprising a survey across 130 studies across 21 countries over a period of 1992 to 1997	Survey based study	Ample variations exist among the different efficiency methods used across nations yielding inconsistent results. It also highlights areas that requires additional work.
(Pastor et al., 1997)	Data Envelopment Analysis; Productivity; Banking systems	Uses data on 168 US banks, 45 Austrian banks, 59 banks in Spain, 22 banks of Germany, 18 banks from UK, 31 banks in Italy, 17 banks in Belgium and 67 banks from France for the period 1992. Variables used: Output = Loans, Other productive assets, and Deposits. Inputs = non-interest expense, excluding personal expense and Personal expense	Malmquist type index under DEA technique	Obtained efficiency measures are more homogenous vis-à-vis those corresponding to changes in productivity and technology. Since the is data collected based on different nations, but they are unable to capture the variations in productive specifications of every banking system and therefore internal efficiencies are less heterogenous compared to those results arrived by international comparisons of variations in productivity and technology.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Bhattacharyya et al., 1997)	Banking; Data Envelopment Analysis; Efficiency measurement	Uses a sample of 70 Indian commercial banks over a sample period from 1986 to 1991. Variables used: Outputs = Advances, Investments and Deposits. Inputs = Capital, Labour and other non-financial inputs. Four branch related Variables for regression : Number of branches in rural areas, suburban areas, urban areas and in metropolitan areas	Data Envelopment Analysis to compute radial technical efficiency.	Public banks emerge as most efficient units followed by foreign and private banks. There is also a temporary improvement in the performance of foreign banks while there is a temporal decline in the performance of public banks, however performance of private banks remain unchanged.
(Chandra et al., 1998)	DEA; CCR model; Returns to scale; Capacity planning; Vertical integration	Uses a sample of 29 Canadian textile companies for the period of 1994. Variables used: Output = Annual sales Inputs = Number of Employees, Average investment for last 10 years.	Data Envelopment Analysis	Most of the companies are poorly efficient except a few that are the best performers. To deal with the huge gap in efficiency scores the DMUs need to restructure their strategies, framework and operational capacities to boost their performance.
(Bauer et al., 1998)	Financial institution, Efficiency, Regulation.	Conducted over a period from 1977 to 1988 on a sample of 683 US banks and presents a comparative study based on 4 efficiency techniques. Variables used: Output quantities= Demand Deposits, Real estate loans, Instalment loans, Commercial Loans. Input quantities= Labour, Physical Capital, Time Deposits, Purchased funds and their corresponding prices.	Non-Parametric Approach: Data Envelopment Analysis. Parametric Approach: Stochastic Frontier Approach, Thick Frontier Approach and Distribution Free Approach.	While parametric and non-parametric results are not mutually consistent with each other while results from al parametric approach are consistent with each other. As a part of policy related decision computation of relative efficiency based on multiple approaches and specifications might be also helpful.
(Gilbert & Wilson, 1998)	Deregulation; Productivity; Banking	Uses a sample of Korean banks over the period from 1980 to 1994. Variables used: Outputs = Loans with domestic	Data Envelopment Analysis and Malmquist index of productivity change.	Government control imposed on the banking units leads to reduced productivity and Korean banks

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		currency, Loans with foreign currency, demand deposits and loans by trust account. Inputs = Labour, Physical capital and purchased funds.		responds positively towards privatization and deregulation through alterations in their input, output bundle. Final suggestion by the authors includes balancing government impact on economic growth of Korea with the negative effects of productivity among Korean banks.
(Hao et al., 1999)	--	Uses a sample of 19 Korean Private banks over a period from 1985 to 1995. Variables used: Output = Total Loans and securities, Demand deposits and Fee income. Inputs = Wage rate, Interest on borrowed funds and price of Physical capital.	Stochastic Frontier Cost Function Approach.	The study first computes the efficiency scores and then employs regression techniques to find the determinants of such efficiency. Banks having high assets growth rate, huge amount of core deposits as well as lower expense ratios emerge as most efficient units.
(Saha & Ravisankar, 2000)	Indian banks; efficiency; Productivity; Rating; Data Envelopment Analysis	Uses a sample of 25 Indian Public banks for a period from 1992 to 1995. Variables used: Outputs = Deposits, Advances, Spread, Investments, Total income, Interest Income, Non-interest income and Working Funds. Inputs = Number of branches, Number of employees, Establishment expenditure, Non-Establishment expenditures (excluding interest expenditures)	Data Envelopment Analysis.	DEA can emerge as a sustainable approach to measure the relative efficiency of banks in Indian context. Also, besides a few exceptions the study suggests that Public Sector banks are successfully able to increase their efficiency over the sample period.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Demirguc-Kunt & Huizinga, 2000)	Financial Structure, Bank profits and Interest Margins.	Uses a data from all OECD nations as well as for some developing economies from 1990 to 1997. Variables used: Profit to total assets, Net interest margin to total assets, Overhead to total assets, Equity to total asset, Loan to total asset, non-interest earning asset to total asset, Customer and short-term funding to total asset, Bank to GDP ratio, Central to GDP ratio, Bank credit to GDP ratio, total value of stock traded to bank credit to private sector, Structure and Market	OLS regression technique	For underdeveloped economies a shift towards a developed financial system result in subsequent decline of profitability and margins. However, impact of controlling variables like market development and bank structure do not have any impact on bank performance.
(Mukherjee et al., 2001)	Bank Productivity; Malmquist Index; Deregulation	Uses a sample of 201 large US commercial banks over a period of 7 years (1984-1990). Variables used: Outputs= Commercial and Industrial loans, Consumer loans, Real estate loans, Investment and Non-Interest income. Inputs= Transaction deposits, non-transaction deposits, Labour, Other non-interest expenses and Equity.	Malmquist type of productivity index using DEA technique.	Although the overall productivity shows an average growth rate of 4.5% every year it declined by 7.61% in 1984-85 and further by 0.33% in 1988 to 1989. Also, banks with larger asset base and specialized in product mix enjoy increased productivity while higher levels of equity to assets leads to lower productivity.
(Maudos & Pastor, 2001)	--	Uses a sample of banks across 14 EU nations alongside Japan and USA across a period from 1984 to 1995 with few exceptions. Variables used: Output = Deposits. Inputs: Deposit, Labour and Physical capital and their corresponding prices.	Cost and Profit Efficiency using SFA technique	In the 1990s the advent of competition led to the increase in profit efficiency for USA and Europe, however the overall finding also suggests that inefficiency is a potential source for improvement in profitability.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Barr et al., 2002)	Bank Efficiency; Performance; Benchmarking; DEA	Uses a sample of US commercial banks over a period from 1984 to 1988. Variables used: used: Output = Earning Assets, Interest Income and Non-Interest Income. Inputs = Salary Expense, Premises and Fixed Assets, Other Non-interest Expense, Interest Expense and Purchased Funds.	Data Envelopment Analysis	There is a strong and harmonious relationship of efficiency with CAMELS ratings system. Also, there is a close association of efficiency and soundness measured by CAMELS framework. Variations in economic conditions is mitigated to certain extent in presence of relative efficiencies of banks that operates under such conditions.
(Rajaraman & Vasishtha, 2002)	--	Uses a sample of 27 Indian Public Sector banks over a period from 1996-97 to 1999-2000. Variables used: Proportion of Gross NPA to Gross Advances, Proportion of Net NPA to Net Advances, Proportion of Operating profits to W-funds.	Fixed Effects and Random Effects Model	Recapitalization of the weak banks may not be the solution as there exists a persistent residual problem after controlling for operational efficiency.
(Kumbhakar & Sarkar, 2003)	--	Uses a sample of 27 public banks and 23 private banks of India over a sample period from 1985 to 1996. Variables used: Outputs = Fixed deposit, Savings deposit, Current deposit, Investments, Loans and Advances, Number of branches in metro, rural, urban and semi-urban locations. Inputs = Labour and Capital together with their corresponding prices..	Analyzed TFP growth using trans-log shadow cost function technique. Panel data technique.	Although there has been a significant decline in the regulatory framework but the anticipated growth in TFP have not materialized in the post deregulation era. Also, private banks are able to increase their output in contrast with public banks that are less responsive to deregulation measures.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(Sathye, 2003)	Banking Efficiency; DEA analysis; Indian banks	Uses a sample of 94 Indian Commercial banks for the period 1997-98. Variables used: Outputs = Net interest income and non-interest income, Net Loans and Non-Interest income. Inputs = Interest expenses and non-interest expenses, Deposit, Staff members.	DEA technique	Results show that how efficiency changes with the change in input-output mix. The study reinstates the objective of Government of India regarding reduction of NPA, number of branches as well as rationalization of number of employees are effective measures to increase the gains in efficiency.
(Shanmugam & Das, 2004)	--	Uses a sample of Indian commercial banks (SBI group, Nationalized banks, Private and Foreign banks) over a sample period from 1992 to 1999. Variables used: Outputs = Net interest margin, non-interest income, credits disbursed and investments. Inputs = Deposits, Borrowings, Labour and Fixed Assets.	SFA approach for panel data to measure technical efficiency	Except efficiency of raising interest margins the efficiency of all other outputs are time varying in nature. SBI group and foreign banks emerges as the efficient units vis-à-vis their counterparts. Although the reforms in banking leads to improvement in efficiency but there is significant difference between actual and potential performance of banks.
(Mohan & Ray, 2004)	--	Uses a balanced panel of 58 Indian commercial banks over a period from 1992 to 2000. Variables used: Output = Loans, Investments and Other Income. Inputs = Deposits and Operating costs.	Revenue efficiency using DEA.	Public sector banks perform better than private banks but at par with foreign banks. The study points at the convergence in performance of private with public banks in post reform phase.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(A. Das et al., 2005)	--	Uses a sample of 71 Indian commercial banks during the initial years of the sample period beginning from 1996-97 and 68 banks towards the end of the sample period 2002-03. Variables used: Outputs = Investments, performing loans and other non-interest fee based income. Inputs = Borrowed funds, number of employees, fixed assets and equity.	DEA technique.	There not much difference in efficiency scores between either input or output oriented techniques as well as cost efficiency. Although such efficiency measures differ in terms of profit efficiencies. ownership, bank size and listing in stock exchange significantly affects the mean profit efficiency and very little the revenue efficiency.
(Kumbhakar & Sarkar, 2005)	--	Uses a sample of 27 public banks and 23 private banks in India over a sample period from 1986 to 2000. Variables used: Outputs = Deposits, Loans and Advances, number of branches and Investments. Inputs = Labour and Capital.	Translog cost function to estimate efficiency of Indian banks.	Although there is evidence of increase in cost efficiency of Indian banks post reforms, the rate of reduction in inefficiency is slow as compared to the pre-deregulation era. Public banks are less cost efficient than private banks with no impact of deregulation on the two groups. Further in post deregulation era private banks show more volatility in variations of relative efficiency compared to public banks.
(Sensarma, 2005)	--	Uses a sample of all scheduled Indian commercial banks over a period from 1986 to 2003. Variables used: Outputs = Fixed deposit, Savings deposit, Current deposits, loans, investments and	SFA technique to examine the bank cost and profit efficiencies	Although the cost efficiency of the banking industry increased during the sample period, the profit efficiency declined more notably during deregulation era. However, domestic banks are more efficient than foreign

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		Number of branches. Inputs = Labour and Capital as well as their corresponding prices.		banks.
(Sensarma, 2006)	Banking; Efficiency; Productivity; Cost; Frontier.	Uses a sample of 25 public sector banks, 25 domestic private sector banks, 22 foreign banks and 9 new domestic private banks over a period from 1986 to 2000. Variables used: Outputs = Fixed deposit, savings deposit, current deposits, investments, loans and advances and number of branches. Inputs = Labour and Capital together with their corresponding prices.	SFA approach and use of trans-log cost function to model inefficiency.	Evidence of improved efficiency as well as productivity of the sample banks over the sample period is witnessed. In contrary to other literatures the foreign banks emerges as the worst performers across the entire sample period vis-à-vis state owned and private banks.
(A. Das & Ghosh, 2006a)	Productivity; credit risk; non-performing assets; leverage; priority sector.	Uses a sample of Indian state-owned banks across a sample from 1995-96 to 2000-01. Variables used: Outputs = net interest margin and net income. Inputs = deposits, borrowings, fixed assets (capital), provisions and contingencies.	TFA technique, DEA technique and Malmquist productivity change. Regression model to justify the determinants of NPA, Capital and Productivity change.	The factors of capital, credit risk as well as changes in productivity are interrelated to each other. In that banks that have insufficient amount of capital are under a greater degree of regulatory pressure vis-à-vis the adequately capitalized ones. However, for medium-sized banks reduced Government control yields improved productivity.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
(A. Das & Ghosh, 2006b)	Bank efficiency; Data Envelopment Analysis; Indian banks.	Uses a full sample of Indian commercial banks (public, private and foreign) over a sample period from 1992 to 2002. Variables used: Intermediation Approach: Outputs = Advances and Investments. Inputs = Demand deposits, Savings deposit, Fixed deposit, Capital related to operating expenses and Employee expenses. Value-added approach: Outputs = Advances, Investments, Demand deposits, Savings deposits and Fixed deposits. Operating Approach: Outputs = Interest income and non-interest income. Inputs = Interest expense, Employee expenses, Capital relating to operating expenses.	Data Envelopment Analysis technique and Multivariate Tobit Model.	Medium-sized commercial banks performed significantly better and have the potential to operate at higher levels of technical efficiency. Also, efficiency and degree of soundness (as measured by CRAR) are much interrelated. Further, the results reveal that banks that have less amount of non-performing loans are more efficient. These findings are reinstated by employing a Multivariate Tobit analysis.
(Ray, 2007)	Most productive scale; Scale efficiency.	Uses a sample of Indian commercial banks varying between 68 and 73 over a sample period from 1997 to 2003. Variables used: Output = Credit, Investments and Other income. Inputs = Borrowed funds, Labour,	DEA technique	Many banks operating across the sample period are too large and breaking them into smaller units will lead to higher efficiency. Moreover, banks that operate in

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		Physical capital and Equity.		a location where there exists a diminishing return to scale prevailing may be a good choice for break up.
(Sensarma, 2008)	--	Uses a sample of 83 Indian banks across different ownership groups across a period from 1986 to 2005. Variables used: Outputs = Fixed deposits, savings deposits, current deposits, investments, loans and advances and number of branches. Inputs = Labour and Capital along with their corresponding prices.	Parametric technique	Profit efficiency as well as productivity declined over the period post deregulation. In contrast to public banks the foreign and private banks recorded the highest levels of profit and productivity. However, contrary to existing estimates this study suggests that there is no noticeable improvement in efficiency and productivity of Indian banks under cost-form of measures.
(Mahesh & Bhide, 2008)	Liberalisation; Banking; Frontier Efficiency.	Uses an unbalanced panel of 94 Indian commercial banks over a period from 1985 to 2004. Variables used: Outputs = advances and Investments. Inputs = Labour, Capital and Material.	SFA technique to measure the Cost, Profit and Advance efficiencies. Trans-log cost function to estimate the different factors influencing efficiency.	Contrary to loan advance efficiency the cost and profit efficiencies shows varying trends post deregulation. Public sector banks rank as most efficient under most of the efficiency measures. Also, competition significantly affects efficiency of banks under all three measures.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
				Further, different factors used in the study indicate that those factors considerably impact efficiency of banks and frequent changes in financial industry of India will impact performance of banks.
(Zhao et al., 2008)	Deregulation; Indian banking; Productivity change; Malmquist Index.	Uses a sample of Scheduled Indian commercial banks over the period from 1992 to 2004. Variables used: Outputs = Performing loans, non-interest income and other earning assets. Inputs = Total operating cost as a single input to aggregate the expenditures related to loanable funds, fixed assets and labour.	DEA-type Malmquist total factor productivity change index.	After a little transition phase post deregulation, the Indian banking industry witnessed a consistent growth in productivity steered by technological progress. Overall, the results reveal that although ownership impacts bank efficiency but is neutral towards to productivity. Further there is also a gradual rise in risk with the deregulation operations.
(A. Das & Ghosh, 2009)	Indian banks, Deregulation, Profit efficiency, DEA model.	Uses a sample of Indian commercial banks with 72 banks at the initial years and 85 banks during the terminal year of the study over a sample period from 1991-92 to 2003-04. Variables used: Outputs = investments, loans and advances and non-interest fee income. Inputs = deposits, number of	DEA technique.	Results indicate higher levels of cost but lower level of profit efficiency post deregulation era. Estimates towards a proximate determinant of profit efficiency reveal that larger state-owned banks performed significantly better and tends to operate at a high profit efficiency. Moreover, the study reinstates the findings

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		employees, fixed assets, and equity together with their corresponding prices.		similar to their own past works of 2006.
(S. Kumar & Gulati, 2010)	Organizational effectiveness; Performance measures; Public sector organizations; Data analysis; Banks; India.	Uses a sample of 27 Indian public sector banks for the period of 2006-2007. Variables used: Stage I Outputs = Advances and Investments. Stage I Inputs = Physical capital, Labour, Loanable funds. Stage II Outputs = Net interest income and non-interest income. Stage II inputs = Advances and Investments.	DEA technique.	High efficiency does not guarantee high effectiveness. The study also notes a strong correlation between effectiveness and performance.
(Tabak & Tecles, 2010)	Stochastic frontier; Bayesian methods; Banking system; Emerging markets.	Uses a sample of 67 Indian banks over the period from 2000-06. Variables used: Outputs = Loans (net of provisions), other earning assets, deposits and off-balance sheet items. Inputs = labour, purchased funds and physical capital.	Bayesian Stochastic Frontier technique.	Public banks emerge as most efficient units followed by private and foreign banks, however foreign banks outperform domestic banks in terms of profit efficiency towards the terminal years of the sample period.
(Ray, 2014)	Network efficiency; DEA; Banking	Uses a sample of single large public sector bank within the city of Calcutta for the year 2012. Variables used: Outputs = total amount of deposits, total amount of credit and other non-interest income.	DEA technique.	Results highlight the existence of over-branching and for that if the large bank reduces the number of branches is likely to increase the cost efficiency.

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A-3.3: RELATED TO EFFICIENCY (continued)				
Author(s), Date	**Key words**	**Period of study/Variables used**	**Research methodology (Tools used)**	**Major findings**
		Inputs = Labour and Physical capital.		
(Bhatia & Mahendru, 2015)	Technical efficiency; Public Sector banks; India; Data Envelopment Analysis, Panel Data Tobit Regression.	Uses a sample of Indian Public Sector banks over the sample period from 1990-91 to 2011-12. Variables used: Outputs = Investments, Loans and Advances and Total Income. Inputs = Deposits, Borrowings, Interest Expenses and Operating Expenses.	DEA technique and TOBIT regression technique.	Most of the inefficiency in Public Sector banks are attributable to Pure Technical Efficiency during the reformatory phase whereas the same is attributable to scale inefficiency during post-reforms phase. Final results from the TOBIT analysis suggests different parameters of the CAMELS rating system have considerable impact on technical efficiency.
(Goyal et al., 2019)	DEA; Directional distance function; Meta-frontier; Banking; India; ownership Structure.	Uses a sample 66 Indian commercial banks for the period of 2015-16 only. Variables used: Outputs = net-interest income and non-interest income. Inputs = Total loanable funds, personnel and operating charges and physical capital.	DEA technique and Meta-Frontier analysis through directional distance function.	Group and meta-frontier of foreign banks converge with each other followed by private banks while the public banks emerge as the laggards in the industry.

CHAPTER IV

EMPIRICAL EVIDENCE ON QUESTION OF EFFICIENCY IN INDIAN BANKING

4.1. Introduction:

Talking about bank performance, we cannot oversee the importance of a bank's ability to enhance its services for its clients through adoption of new technology. With the advancement and development of technology in Indian banking sector over time, banks have gradually become tech-shabby towards the use of modern tech-tools to transform their service delivery in a better form. The present era is marked by increased competition due to developments in information technology and consistent globalization, that challenges the sustainability of banks across the country (Goyal et al., 2019). The experience of the Asian financial crisis of 1997-98 and the very recent Sub-Prime lending crisis of 2007-08 highlights the significance of a sound, resilient and efficient banking industry to warrant macroeconomic stability in the country. An inefficient and wobbling banking system may drive the economy of a nation into a slump (Caprio and Honohan, 2002). As a result of surge in liberalization and gradual shift towards a globally consolidated financial system, only strong and efficient banks can sustain. However, presence of a greater number of weak banks in the Indian banking industry may lead to misallocation of scarcely available resources, thereby hindering growth prospects of Indian banking sector and ultimately the Indian economy. Therefore, the Ministry of Finance, Government of India and Reserve Bank of India together considered the process of merger of various public sector banks, to retain a handful of healthy banks. Given this decision of the government it is necessary to examine the efficiency of the Indian banking sector over the sample period from 2005-06 to 2016-17, to understand the loopholes and analyze the government's decision towards bank merger.

Post introduction of the Economic Policy of 1991, that opened doors for private and foreign participants because of greater recognition to liberalization, globalization, and privatization, exposed the Indian banking sector to an ever-increasing competitive environment. Since then, the Indian banking industry have progressed at a healthy pace despite certain global turmoil. As per the IBEF, (2017) report, over the span of past 12 years (2006-2017) the overall bank deposits grew at a CAGR of 12.03% and by March 2017 it amounted to USD 1.54 trillion. This scenario may be attributed to higher disposable income as well as increased rate of savings.

Also, the consolidated balance sheet components of Indian banking sector consistently grew at a fair pace during 2015-16 as the assets and liabilities expanded at 7.7 percent, compared to 9.7 percent during 2014-15 (RBI, 2016). Furthermore, a report by KPMG and CII, (2013) claims that the exponential growth rate of Indian banking sector is significant and the sector can become the third largest banking sector among the globe by 2025.

Despite the notable progress of Indian banking industry over the years, the future journey seems to be more challenging in the light of increasing NPAs, more particularly for the public sector banks. The Asset Quality Review (ASQ) report of banks during 2015-16 revealed that interest earnings of the banks declined a steady pace whereas the provisions and contingencies showed significant uptick due to poor asset quality. Provisioning for NPAs of banks almost doubled having adverse impact on bank's profitability, as a result of which net profits shrunk by more than 60 percent (RBI, 2016). Unlike the private and foreign banks, the public banks witnessed a 148% decline in their profits (RBI, 2016). The effectives and success of the steps declared and undertaken by Government of India as well as RBI, (like capital infusion, bank mergers, enhancing provisioning norms etc.) will depend on an efficiency analysis of the sub-sectors in Indian Commercial banking industry only to provide a clearer picture of their performance vis-à-vis the industry best performer.

Therefore, to achieve the aforesaid objectives, we employ a non-parametric liner programming-based frontier measure, known as Data Envelopment Analysis (DEA) to investigate the idea of input resources as well as the resulting output quantity for banks. On the contrary, there also exists certain accounting measures of efficiency that appear to be weak. In this chapter we draw a comparative analysis between these two aspects, indicating the key weaknesses in the accounting measures (based on CAMELS rating system). As our study encompasses the Indian Commercial Banks (hereafter referred as Indian banks), hence we discuss the aspect of efficiency[45] in the backdrop of Indian Commercial Banking sector only. Further we also use the efficiency scores computed under this chapter as a control variable in our study to examine the impact of its variations on bank's financial performance in terms of its profitability. A detailed explanation of the emergence of efficiency measures as a popular choice is explained in the subsequent sections of this chapter.

[45] In this thesis we restrict our computation to input oriented technical efficiency only, in terms of Indian Banking using specific, input-output combinations. A detail explanation is mentioned in section 3.1.b of this chapter.

4.1.a. Question of Effectiveness, Productivity and Efficiency:

The term benchmarking that evaluates the performance of individual firms belonging to a specific industry in comparison to the best performer of that industry is often argued to be coupled with three distinct mechanisms, Effectiveness, Productivity and Efficiency. The shortcomings associated with the first and second term gives rise to investigate the concept of efficiency. According to neo-classical economic approach, the term efficiency is an extension of production economics. Suppose a provider of public service is said to be effective when it attains or exceeds a pre-specified output target. Under such a situation the effectiveness of that service provider only considers the output it can achieve (whether near to or less than target output), with complete disregards to the inputs that are involved. Such inputs may also play a role in generating the target output. Hence, only considering the output achieving criteria, might not provide proper conclusion as regards to a particular firm performance. Thus, it is necessary to move ahead of such misleading measure of benchmarking criteria. The challenge is therefore to resort to such a performance measure that incorporates not only the outputs but also the inputs that goes into the process of producing those outputs. For this the popular criteria that evolved over time is that of Productivity. To illustrate this, we take a hypothetical example:

Example Table-1

Firm	**A**	**B**	**C**	**D**	**E**
Output(y)	10	8	16	9	7
Inputs(L)	4	7	12	10	9
Labour Productivity	2.5	1.14	1.33	0.90	0.77

For instance, we assume that there are five firms namely, A, B, C, D and E producing a given output (y) with a single input, labour (L). Then the input productivity of the firm, thus, will be simply that output per unit of input. Hence, according to labour productivity firm A is most productive whereas firm E is least productive. This seems to be a better measure of assessing the benchmark firm. But, we can have more than one inputs and outputs, in reality. Therefore, we augment the above table and assume that all the above firms are producing the same Output (y) with two different set of inputs, Labour(L) and Capital (K), then the individual productivity can be represented as follows:

Example Table-2

Firm	A	B	C	D	E
Output(y)	10	8	16	9	7
Inputs(L)	4	7	12	10	9
Input (K)	9	3	8	6	8
Labour Productivity	2.5	1.14	1.33	0.9	0.77
Capital Productivity	1.11	2.67	2	1.5	0.88

In this case the productivity among the firms differs based on these two inputs and it is very much possible that improvement in one of the inputs may be mistakenly assigned to the other input. This might again lead to inconclusive results and is a practical problem with the partial productivity measure. For instance, if in case of bank branch the introduction of a new software enhances the number of transaction handling capacity but such increased reason of capacity might be mistakenly assigned to increase in productivity on the labour factor (or bank employees). A way out to this can be the Total Factor Productivity approach (TFP) whereby the per unit price of inputs (corresponding to the units of inputs used) is used as a proxy to obtain the firm wise total cost of inputs, and subsequently the average cost (by dividing the total cost by total units of output). Thus, firms that will have the least average cost will have the highest productivity. However, it might so happen that due to certain demographic or individual constraints faced by the firm the prices of inputs also vary among different firms. In such a case considering cost as a measure of TFP will not be a reliable measure.

A natural solution to it can be the average of partial factor productivities for a measure of TFP. Therefore, as per the values in Example Table 2, the labour and capital productivities for firm A can be written as:

$$AP_L^A = \frac{y_A}{L_A} = \frac{10}{4} \; and \; AP_K^A = \frac{y_A}{K_A} = \frac{10}{9} \ldots\ldots\ldots\ldots (1)$$

Where, AP_L^A and AP_K^A is the average productivity of firm A in terms of labour and capital respectively, and the value is computed as output (y_A) per unit of inputs ($L_A \; and \; K_A$). Thereafter, TFP is defined as the weighted geometric mean[46] of average productivity of labour of firm A and average productivity of capital of firm A:

[46] Initially when we talk about mean, we speak about the additive average of two number say x_1 and x_2. On the other hand, when we want to compute the weighted mean, we assign simple weights to the additive average of x_1

$$TFP^A = (AP_L^A)^{\beta_L} (AP_K^A)^{\beta_K} \text{ ..... (2)}$$

Where,

$$\beta_{L+} \beta_K = 1 ; \beta_L, \beta_K > 0$$

Therefore, for any firm *j*, the Total Factor Productivity is represented as:

$$TFP^j = \left(\frac{y_j}{L_j}\right)^{\beta_L} \left(\frac{y_j}{K_j}\right)^{\beta_K} = \frac{{y_j}^{\beta_L} . {y_j}^{\beta_K}}{{L_j}^{\beta_L} . {K_j}^{\beta_K}} = \frac{y_j}{X_j} \ (since \ \beta_{L+} \beta_K = 1) \ ; X_j = L_j^{\beta_L} K_j^{\beta_K} \text{ .... (3)}$$

Generally, $\beta_L \ and \ \beta_K$ are the weights that is defined as the cost shares of capital and labour or cost shares of other inputs as per use, for a particular firm. Thus, we define TFP of firm *j* as the total input of firm *j* divided by the grand input X_j that is the weighted geometric mean of labour and capital. Suppose we want to compare the TFP of two firms, A and B, the representation of the same will be given by:

$$TFPI_{B,A} = \frac{TFP_B}{TFP_A} = \frac{{y_B}/{X_B}}{{y_A}/{X_A}} = \frac{{y_B}/{y_A}}{\left(\frac{L_B}{L_A}\right)^{\beta_L} \left(\frac{K_B}{K_A}\right)^{\beta_K}} = \frac{Q_y}{Q_x}$$

The above representation is also known as Tornqvist index that we denote as equation (4). Moreover, the way we define our TFP in the form of weighted geometric mean and use a measure of aggregation in such a manner that our outcome results follow Cob-Douglas production function [f (L,K)] that exhibits constant returns to scale. Hence, rather than using a cost measure, to aggregate inputs, we represent a production function to aggregate the inputs. In this case the production function is $L_j^{\beta_L} K_j^{\beta_K}$. In simple terms it can be written as $f(L_j, K_j)$, combining labour and capital to get the output. Further, as per the definition, production function represents the *maximum* quantity of output that can be produced from a given set of inputs (also known as input bundle). Now we can represent the same in the form of an industry production function that is common to all firms, as:

$$y_j^* = f(L_j, K_j) \text{.....(5)}$$

and x_2 as $(w_1x_1 + w_2x_2) / (w_1+w_2)$. But geometric mean is the multiplicative average of x_1 and x_2. It is simply stated as $(x_1.x_2)$ ^1/2. Implicitly both x_1 and x_2 has the same weights. However, in case of a weighted geometric mean, where both x_1 and x_2 consists of some weights and such weights are defined to have a sum equal to 1.

Where, y_j^* is the maximum output that is producible using a production function approach from a grand input X_j (as mentioned in equation 3). Also, the maximum possible output y_j^* cannot exceed the actual output y_j but can be either less than or equal to y_j and that (y_j^*) is represented as:

$$y_j \leq y_j^* = f(L_j, K_j) \ldots\ldots\ldots\ldots (6)$$

Thus, using the production function and the aggregation approach we define a ratio of actual output of a firm (using the inputs) divided by the maximum possible output for firm *j*. This ratio is known as technical efficiency:

$$\tau_j = \frac{y_j}{y_j^*} \leq 1 \ldots\ldots\ldots\ldots (7)$$

Hence, technical efficiency draws a relative comparison between the maximum output and the actual output whereas productivity measures the output per unit of inputs used by a particular firm. Thus, productivity is a positive measure, whereas efficiency is said to be a normative measure.

We now consider a more general production function[47]:

$$y^* = g(L, K) \ldots\ldots\ldots\ldots\ldots (8)$$

Where, function $g(L, K)$ defines the maximum output that can be produced from some specific input bundle (L, K). Thereafter technical efficiency of firm *j* producing output y_j using input bundle (L_j, K_j) is:

$$\tau_j = \frac{y_j}{y_j^*} = \frac{y_j}{g(L_j, K_j)} \leq 1 \ldots\ldots\ldots (9)$$

Therefore, technical efficiency shows what fraction of maximum output producible from the input bundle used is actually produced by the firm *j*. Like this it sets a benchmark that is appropriate for input quantities used. This approach is known as output-oriented technical efficiency.

Conversely, there also exists another perspective, where the given level of output is fixed, and a firm *j* is tries to attain that fixed level of output through maximum possible reduction in its

[47] For example, purpose we keep two inputs, in reality a greater number of inputs can also be accommodated.

inputs say x_j^* . This can be also represented as an input-oriented technical efficiency in the form of the following ratio:

$$\tau_j = \frac{x_j^*}{x_j} \leq 1$$

In case if a firm operates under Constant Returns to scale (CRS), the resulting output increases in the same manner with proportionate increase in inputs and under such a situation the value of technical efficiency under both input and output-oriented approach will give the same conclusion, whereas if there is Variable Return to scale (VRS) in operation both input as well as output-oriented values tend to differ. Also, the transformation of the input bundle *x* into an output bundle *y* is said to be the result of a technology (Berger and Humphrey, 1992, 1994, 1997) used in the production process, that can be characterized by a production possibility set:

$$T = \{(x, y): y \text{ can be produced from } x;\ x \geq 0;\ y \geq 0\ \}$$

In the above specification, technology (T) is defined as all those input-output combination that are feasible. An input-output bundle (*x, y*) is considered feasible if the output bundle *'y'* can be produced from input-bundle *'x'*. If output bundle *'y'* can be produced from input-bundle *'x'* then both *x* and *y* falls within the technology set. In this case the assumption is that the same technology set is accessible by all firms in that industry. This specific technology set again follows certain key assumptions that forms the base of the production frontier line. These assumptions are very crucial in the context of existing efficiency literatures and are stated as follows:

1. All observed input-output bundles are feasible (or observable). That is every input-output combination (x_j, y_j) (j = 1,2,…….N) in the sample is covered under T.

2. The production possibility set is convex. That is if (x^1 , y^1) and (x^2 , y^2) are both feasible, then any weighted average combination of the two input bundles can produce the corresponding weighted average combination of the two output bundles. This will hold true for any number of feasible input-output bundles. This is said to be a convex combination of the observed inputs (such that the weights necessarily add to 1). Thus, $\bar{x} \sum_{j=1}^{n} \lambda_j x^j$ can produce $\bar{y} \sum_{j=1}^{n} \lambda_j y^j$ for any set of non-negative (either greater than or equal to zero) weights λ_j (j = 1,2,3,…N), such that $\sum_{j=1}^{n} \lambda_j$ = 1. We write x^j compactly to denote an input vector or bundle comprising different sets of inputs and similarly we write y^j for combination of output.

3. Inputs are freely disposable. This means that increasing any input without reducing any other input would not cause a decrease in the output. More formally, if $(x^0, y^0) \in T$ and $x^1 \geq x^0$, then $(x^1, y^0) \in T$.

4. Outputs are also freely disposable. That means that if x^0 can produce y^0, then it can always produce a smaller output bundle $y^1 \leq y^0$. Thus, stated simply, if $(x^0, y^0) \in T$ and $y^1 \leq y^0$, then $(x^0, y^1) \in T$.

Development in efficiency measures evolved from the early works of Farrell, (1957) who proposed two different approaches to efficiency, Parametric and Non-Parametric Approach. While the former is limited to a fixed number of parameters used to construct a frontier whereas non-parametric approach uses such variables that are flexible in number. Within non-parametric approach efficiency is best represented by Data Envelopment Analysis (DEA) while the Stochastic Frontier Analysis (SFA) under the parametric approach happens to be a close rival of DEA. The DEA approach considers the above-mentioned assumptions about the technology set, to generate the grand production frontier that gives a piecewise linear measure of relative efficiency of different firms within an industry. The main advantage of DEA over the existing approaches to determine efficiency, is that there is no need to define any functional relationship between the inputs and outputs or specifying the weights of inputs and outputs (Chandra et al., 1998). Thus, the resulting efficiency scores derived under SFA partially depends on accuracy of choice of the functional form representing the production function (Kumar and Arora, 2011). DEA overcomes this problem and further has the ability to incorporate multiple inputs and outputs to compute the relative efficiency scores (Goyal et al., 2019). It also has the ability to investigate into the reasons behind the changes in efficiency whether due to improvement in scale (scale efficiency) or management practices (pure technical efficiency) (Topuz et al., 2005).

Thus, the main aim of this chapter is to evaluate the technical efficiency of Indian commercial banking sector to highlight the health conditions of Indian banks. Post reforms of 1990s, Indian banking system is subject to increased competition with the entrance of foreign participants in banking sector and development of new private banks. Besides this, certain significant changes also happened in the domain of Indian banking. For instance, exercise of significant control by RBI over the statutory norms in the form of CRR and SLR[48], granting permission to banks to diversify into non-interest income-based activities, enhancing flexibility in banking operations

[48] https://www.rbi.org.in/Scripts/NotificationUser.aspx?Id=12131&Mode=0

and granting banks freedom in their day-to-day process of decision making to respond to the dynamic changes in banking environment. Further, banks are mandated to follow the prudential norms as implemented by RBI, in line with those of international standards (e.g.: CRAR). Moreover, to tackle the loss arising amongst banks due to growing NPAs, multifaceted arrangement is put in place to enable banks to recover their locked funds of the past. Together with all these, considerable advancement in technological changes have provided Indian banks a platform to enhance their delivery mechanism, launch new products and services and build up their internal control systems stronger. These changes have paved a new way in which banks use and combine their available resources to produce and provide different financial products and services with relevance to their abilities across public, private, and foreign banking business in India. Therefore, how much one bank is superior to another is the main question that gives rise to the intent to investigate the efficiency in Indian banking.

4.1.b. An overview of different approaches to efficiency:

The evidence of the concept of efficiency although became popular after the pioneering works of Charnes et al., (1978) in the European Journal of Operations Research, but the existence of efficiency measures are available from the early works of Farrell, (1957) who extended the works of Debreu, (1951) and Koopmans, (1951) to bring out a simple measurement of efficiency at firm level that can accommodate the use of multiple inputs[49]. According to Farrell, economic efficiency mainly comprises of two components: Technical efficiency and Allocative efficiency. While the former refers to the ability of a firm or unit to attain a maximal[50] output from an available collection of inputs, the later refers to the potential of a firm to utilize its inputs optimally with respect to their corresponding prices. A combination of Technical and Allocative efficiency gives the economic efficiency. Economic efficiency again can be classified in two types: Cost efficiency and Revenue efficiency. Cost efficiency is used to compute the efficiency of a unit with the objective of reducing costs whereas Revenue efficiency follows the objective of maximizing output. Efficiency in banking sector is most popularly represented by the Data Envelopment Analysis (DEA) technique. The computation of DEA depends on employing either constant returns to scale (CRS) or variable returns to scale (VRS), that incorporates the mode of transformation of input resources into the final output. Finally, the results from either CRS or VRS based efficiency requires the application

[49] In simple sense the term inputs refer to the resources available to any firm or institution for use, to produce value creating outputs or final products.
[50] Meaning as highest as possible.

of orientation in their representation to include the restriction in terms of a bank's control either over its inputs or outputs (T. J. Coelli et al., 2005). Such orientation is either output based, or input based. A detailed description is provided under methodology in section 3.4 of this chapter. However, a short explanation of output-oriented and input-oriented efficiency is mentioned in Appendix IV.1 of this chapter.

Efficiency measures can be estimated for Indian banks under two broad approaches (RBI, 2008): Parametric and the Non-Parametric approach. There are three prime parametric approach to estimate the best practice frontier[51] are, Stochastic frontier approach; Distribution free approach and Thick Frontier Approach (short description is mentioned in Appendix IV.3). On the other hand, the two main non-parametric approaches are Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH).

The former or DEA employs a linear programming problem to construct a best practice frontier out of the collected dataset for different units to measure the efficiency of those units vis-à-vis the benchmark unit operating on the frontier line. Each of these functional unit is known as a Decision-Making Unit or DMU. The object of DEA is to represent either a convex or a concave production frontier in context of the orientation employed (input or output) (Berger & Humphrey, 1997). The later or FDH ignores the convexity assumption. Compared to FDH and other parametric measures to efficiency, DEA evolves as a more significant yardstick, as it does not overlap any specific functional form on the input-output bundle to compute the efficiency of a DMU. Thus, DEA shows the interaction between the inputs and outputs of different alternatives. A detail of DEA methodology, use of input-output bundle and approach followed to compute the efficiency scores is discussed in section 3.4 of this chapter.

4.2. Accounting versus Economic Measures:

Academicians, financial managers as well as analysts often use financial ratio analysis as a tool to estimate the performance of different functional business units. Most of these ratios are collected from the Statement of Profit and Loss or that of Balance Sheet of those business units, available in public domain. Some of the most popular measures among these financial ratios include the profitability ratios (either RoA or RoE), liquidity ratios, dividend yield, P/E ratio

[51] It is a curve the defines the variability in the number of products that can be produced when such products depend on similar finite resources.

and others. Most of these ratios are well accepted for performance analysis in finance domain and has also gained popularity in few economic literatures more precisely because of their ease in availability. However, as per financial management these ratios are often not termed as measures of accounting while economic literatures (pertaining to productivity and efficiency) address these ratios as measures of accounting mainly because they evolve as a nature of specific accounting entries in context of financial statements. RBI, (2008) explains these financial ratios, only to be a representative measure of productivity and so far, as possible can partly represent the efficiency of a functional business unit. Also, use of such financial ratio might lead to the problem of attributing economic relevance to accounting numbers. Again, there exist a risk of accounting biasness. This is because, different functional business units operate under different economic environment having differences in their accounting norms and practices, hence computing, and comparing accounting ratios between two or more business unit operating in different economic environment may not be fit to draw correct economic conclusions. On the contrary, most of the regulatory banking authorities across the globe are following the international rating mechanism for banks, based on these financial ratios (e.g.: CAMELS). Nevertheless, measurement of efficiency of banks using accounting measures also poses difficulties in drawing long-term conclusions, hence alternative measures addressing to compute such efficiency have emerged over time. To illustrate this argument, we draw a comparative analysis between the accounting-based CAMELS rating and the efficiency scores that we compute by employing DEA technique.

4.3. Ratio-based Supervisory Framework (CAMELS):

The idea of insuring deposits kept with the banks in India, gained attention for the first time in 1948 post the banking crisis in Bengal. The proposal for its consideration came up in 1949 but was on hold till the time Reserve Bank of India ensured adequate arrangements for inspection of banks. However, the sudden crash of Palai Central Bank Ltd., and the Laxmi Bank Ltd. in 1960 invited serious thoughts on this issue by RBI and Government of India. Subsequently the Deposit Insurance Corporation (DIC) Bill was passed in the parliament in August,1961. Further, the Government of India in discussion with RBI, launched a Credit Guarantee Scheme (CGS) in July 1960 and RBI was given the power to supervise the scheme as an agent of the Government as a Credit Guarantee Organization (CGO) to warrant the credit extended by banks and other financial institution to various small-scale industries under section 17(11A) (a) of the

RBI Act, 1934. Further, on January 14, 1971, RBI promoted a public limited company in the name of Credit Guarantee Corporation of India Ltd. (CGCI) and brought the credit guarantee scheme under it. The main objective was to encourage commercial banks to provide credit requirement to weaker and neglected sections of the society involved in non-industrial activities, by ensuring guarantee over the disbursed loans and advances granted by credit institutions to such priority sectors. Finally, with the aim to integrate the operations of deposit insurance and credit guarantee the two organizations (DIC and CGCI) were merged to form the Deposit Insurance and Credit Guarantee Corporation (DICGC) in July 1978. Subsequently the act of 1961 was renamed as 'The Deposit Insurance and Credit Guarantee Corporation Act, 1961'.

Similar to India the idea of deposit insurance has been dominant in other nations also. With the objective of providing insurance on loans disbursed by commercial banks and other credit institutions the deposit insurers across the globe used to collect a flat rate premium from those financial institutions. However, the bank crisis during 1980s and early 1990s raised concerns across the United States that lead the Federal Deposit Insurance Corporation (FDIC) to introduce a system of risk based premium. This system was based on primarily two criteria, namely the capital ratios as per the reports that insured institutions were mandated to submit to regulatory authorities in a quarterly basis and a subjective criterion namely CAMELS rating based on on-site examination approach. Similar to this mechanism as per recommendations of the Padmanabhan Committee (1996) the Reserve Bank of India also decided to launch a rating system (RBI, 2012). In Indian context the CAMELS rating consists of a differential mix of several risk factors (Capital, Asset Quality, Management, Earnings, Liquidity, Systems, and Internal Control) rated on a scale ranging from 1 to 5. Also, unlike the US mechanism of on-site examination, for India it was resolved that the rating shall be at the Central Office after on-site examination and other supervisory information available at Central Office.

Over the years, CAMELS rating system was extensively used but due to certain vital loopholes in the rating system, RBI started shifting its focus to ascertain the different risk behaviors in terms of Credit Risk, Operational risk and Market Risk through enhancement of the BASEL I and II Capital Accord norms (RBI, 2012). Further, the CAMELS rating is shared as an internal document with the MD, EDs, selected GMs and Chairman of the audit committee that makes it very much difficult to draw numerical measure out of the same (DICGC, 2015). Hence, we try to present a representative measure based on financial ratios of banks to highlight the weaknesses in CAMELS rating system compared to the efficiency measures under DEA.

For our analysis we can only consider the CAMEL components as the Systems and Internal control is specifically based on supervisory audit report carried on at the Central Office based on certain information that are not available in the public domain. While in US the component 'S' is represented as Sensitivity to Market risk. We follow a methodology similar to that of Kaur, (2010) for our sample period based on data collected from STRBI, Reserve Bank of India from 2005-06 to 2016-17. Further we could only provide a contemporaneous result based on the combination of all components for 2016-17 only following the methodology proposed by Kaur, (2010).

4.3.a. Measuring Capital:

The Capital Adequacy represents the overall financial health of an individual bank together with the capacity of its management to comply with the need of additional capital. It further reflects the leverage effect a bank can enjoy to take benefit from attractive investment opportunities arising in near future (Kaur, 2010). We use two ratios to evaluate the capital adequacy of banks: CRAR (Capital to Risk weighted Assets Ratio) and Debt-Equity ratio. The former is a ratio of bank's capital base to the risk weighted assets and is readily available from RBI site. A higher ratio defines a bank's ability to safeguard itself from the operational, credit, market risks etc. and provides cushion to the unforeseen losses thereby protecting bank depositors as well as lenders.

The later ratio is arrived at (computed and not readily available) by dividing the total available funds (borrowings plus deposits) for an individual bank by a bank's net worth (Capital plus Reserves and Surplus). This ratio denotes the leverage of a bank and thus lesser the ratio stronger is the bank. We compute the average of each of these ratios over our sample period and assign a rank based on the same across different ownership group. Further we form an average rank on the basis of individual rank of these two ratios to represent Capital measures of CAMELS. Tables 4.8 to 4.10 (Appendix IV.4) gives the measures of Capital component for three bank groups.

4.3.b. Measuring Asset Quality:

Asset quality of a bank represents the extent of financial strength as well as risk in an individual bank's assets, specifically advances and investments. Assessing the asset quality gives a true picture about the present condition as well as the future prospect of a bank. Higher levels of asset classification may have negative impact on bank's earnings due to higher provision requirements to safeguard the advances disbursed that in turn reduces the interest income of

the banks. Also, the amount of administrative cost involved in the collection process also impacts the interest income of a bank. Further poor asset quality also indicates management in competencies. We compute and use two ratios to compute the Asset quality of banks: Net Non-Performing assets (NNPA) to Total Assets and Net NPA to Net Advances. For both these ratios the lower the value the better is the rank of the bank (towards 1). Thus, we compute the average of each of these ratios over our sample period (2006 to 2017) and assign a rank based on the same across different ownership groups. Further we form an average rank on the basis of individual rank of these two ratios to represent the Asset Quality component of CAMELS. Tables 4.11 to 4.13 (Appendix IV.4) shows the measures of Asset Quality component for three bank groups.

4.3.c. Measuring Management Quality:

This component measures the competence of the management. We consider two ratios to evaluate this parameter. We use the ratio of Net profit after tax to Net worth (RONW) to evaluate the overall return (computed for this study), and the Profit per employee (readily available at RBI website) to ascertain the efficiency of bank staff. While the former (RONW) measures the relative return in investment in a bank and indicates how well a bank leverages the investment, the later measures efficiency of the management in managing its bank staff. For both these ratios the higher the value the better is the rank of an individual bank (towards 1). Following similar pattern as stated above we compute the average of each of these ratios over our sample period (2006 to 2017) and assign a rank based on the same across different ownership groups. Further we form an average rank on the basis of individual rank of these two ratios to represent the Management component of CAMELS. Tables 4.14 to 4.16 (Appendix IV.4) shows the measures of Management component of the bank groups.

4.3.d. Measuring Earnings Quality:

Under this measure we try to compute the quality of the income generated from the fundamental banking activities. Therefore, we compute and use the ratio of total interest income to total income and changes in net profit (in percent) for individual banks over our sample years. For both these ratios the higher the value the better is the rank of an individual bank (towards 1). Thus, we compute the average of each of these ratios over our sample period (2006 to 2017) and assign a rank based on the same across different ownership groups. Thereafter, we form an average rank on the basis of individual rank of these two ratios to represent the Earnings Quality component of CAMELS. Tables 4.17 to 4.19 (Appendix IV.4)

gives the measures of Earnings Quality components of public, private, and foreign banks respectively.

4.3.e. Measuring Liquidity:

This component intends to look into the bank's ability meet the demand of depositors at any specific point of time. Thus, we assign better rank (towards 1) for those banks that have higher liquidity ratios. We compute and use two ratios to measure this liquidity component: Liquid Assets to Total Deposit and Liquid Asset to Total Asset. Thereafter, we find the average of each of these ratios over our sample period (2006 to 2017) and assign a rank based on the same across different ownership groups. Tables 4.20 to 4.22 (Appendix IV.4) shows the measures of Liquidity component of the bank groups. A short description of all the ratio components is shown in Table 4.2 (Appendix IV.5) of this chapter.

Therefore, we consider two financial ratios to represent each component of CAMELS rating system except the component 'S'. Stepwise, we first derive the bank group wise average rank for each parameter from the bank-wise ranks given to each ratio and finally we compute the bank-group wise composite CAMEL index based on the rank given to combined average score across all parameters. A bank with the highest score in every group is awarded the rank of 1. We present our results of CAMEL composite index in Table 4.1 to 4.3 (Appendix IV.4).

4.4. Empirical specification for technical efficiency:

Traditionally the analysis of bank efficiency included the application of financial ratio measures, in line with the CAMELS measures. But, Sherman and Gold, (1985) argues that financial ratio approach may provide inconclusive conclusions to assess bank efficiency since such a technique provides aggregate results for several aspects and also lacks to reflect the long-term efficiency due to dependency on some arbitrary benchmark ratio. DEA first came into recognition, in operations research literature through the works of Charnes et al., (1978), that shows the application of DEA to compute efficiency of non-profit entities engaged in public programs. However, even before the recognition of DEA approach in 1978, in India the PEP Committee, (1977) proposed a method of assessing the relative bank performance under four major points that is, productivity, sectorial social objectives, social objectives (spatial) and profits. Based on these recommendations the Finance Ministry during 1985-86 evaluated the

relative performance of banks under 19 such indicators proposed in the report (Saha and Ravisankar, 2000).

Different studies on efficiency measurement extensively use either parametric Stochastic Frontier Analysis (SFA) or non-parametric DEA method (Sathye, 2003). The parametric method requires a functional form whereas DEA requires a mathematical form. Additionally, DEA does not mandate any assumptions for the functional form or the error component or inefficient unit (T. J. Coelli et al., 2005). Thus, compared to parametric Stochastic Frontier approach, DEA technique (that follows a linear programming approach) provides more robust results (Sheiford and Thrall, 1990).

Within DEA the term efficiency is best represented by technical efficiency, that measures the ability of the managers to successfully utilize their available resources. In other words, technical efficiency of a bank will refer to its success or inability to transform its inputs into outputs relative to other banks. DEA model can be estimated either under constant returns to scale (CRS) or variable returns to scale (VRS). The CRS based efficiency comes from solving the Charnes, Cooper and Rhodes (CCR) model (Charnes et al., 1978) that gives the overall technical efficiency (OTE) of a DMU (here banks) as a combination of technical and scale efficiency. Where, the former (technical efficiency) denotes the ability of transforming inputs into outputs, the later (scale efficiency) states the most productive scale size, at a scale where efficiency is 100 percent. The VRS based efficiency on the other hand is obtained by solving the Banker, Charnes and Cooper (BCC) model (Banker et al., 1984). VRS based DEA models allows the overall technical efficiency (OTE) to be decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Again, the scale efficiency of a DMU can be estimated as a simple ratio of its CRS to VRS efficiency. In this study we restrict our estimation to input oriented technical efficiency only.

The estimated efficiency obtained through either input or output oriented DEA models will be same under the CRS, where the assumption is that all firms operate at the same optimal scale. However, such estimation values (input/output-oriented DEA) will be different under VRS assumption. In their pioneering works, Coelli and Perelman, (1999), states that selection of orientation (either CRS or VRS) only has a minor impact on the efficiency scores so obtained. Besides, T. J. Coelli et al., (2005, p.181) also argue that application of either input or output oriented DEA measures, estimates the same frontier and identifies the same set of DMU's as efficient units. Only the measures of inefficiency for the inefficient firms differs between the

two orientations. Also, the choice of input or output orientation depends on the quantities (either inputs or outputs) where the DMU (banks in our case) exercise most of its control and thus such quantities form the primary decision variables for a DMU (T. J. Coelli et al., 2005). Therefore, we first compute an input-oriented CRS-DEA (Charnes et al., 1978) in our study to evaluate the technical efficiency only, for our sample banks. Further, to conduct an in-depth analysis, we also compute the input-oriented VRS-DEA (Banker et al., 1984) for our sample banks.

Charnes et al., (1978) presents an estimate of efficiency for every DMU that is obtained as a maximal of the ratio of weighted outputs to its weighted inputs. These weights for the said ratio is decided by the limitation criteria that similar ratios of every DMU should be either less than or equal to 1, thereby reducing the multiple inputs and outputs into a single form of 'virtual' input and an corresponding single 'virtual' output without the necessity of pre-determined weights. The efficiency estimate is then defined as a function of the weights of that 'virtual' input-output bundle. Therefore, the efficiency estimate for a DMU_0 can be computed by solving the following mathematical form of programming problem:

$$max h_0(w,t) = \left. \sum_{s=1}^{m} w_s y_{s_0} \middle/ \sum_{i=1}^{k} t_i x_{i_0} \right.$$

$$\text{subject to, } \left[\left. \sum_{s=1}^{m} w_s y_{sj} \middle/ \sum_{i=1}^{k} t_i x_{ij} \right. \right] \leq 1, j = 1,2,3, \dots\dots\dots, j_0, \dots . . n \qquad \text{(A1)}$$

$$w_s \geq 0, s = 1,2,3 \dots\dots\dots\dots, m$$

$$t_i \geq 0, i = 1,2,3 \dots\dots\dots\dots, k$$

Where, x_{ij} is the observed input quantity of the ith type for the jth DMU (i.e., $x_{ij} > 0, i = 1,2, \dots\dots, k, j = 1,2,3, \dots\dots\dots\dots, n$. Similarly, y_{sj} is the observed output quantity of the sth type for jth DMU (i.e., $y_{sj} > 0, s = 1,2,3, \dots\dots, m, j = 1,2,3, \dots\dots\dots\dots, n$).

The components w_s and t_i are the corresponding weights that is to be determined by the programming problem stated above. However, this problem gives an infinite quantum of solutions, since if (w^*, t^*) is optimal, therefore for any $\alpha > 0, (\alpha w^*, \alpha t^*)$ is too optimal.

Hence, following the proposed transformation by Charnes-Cooper, a researcher can select an indicative solution (w, t) for which:

$$\sum_{i=1}^{k} t_i x_{i0} = 1,$$

To derive a linear programming problem like the linear fractional programming problem. This, formulation thus satisfies our second assumption for DEA model. (A2)

Thus, if the denominator of the above efficiency estimate is set to unity (or, 1), the modified linear problem for DMU_0 can be stated as:

$$\text{Max } z_0 = \sum_{s=1}^{m} w_s y_{s_0} \; subject\ to \; \sum_{s=1}^{m} w_s y_{sj} - \sum_{i=1}^{k} t_i x_{ij} \leq 0,$$

$$j = 1,2,3 \ldots\ldots, n \; and \sum_{i=1}^{k} t_i x_{ij} = 1 \qquad \text{(A3)}$$

$$w_s \geq 0, s = 1,2,3 \ldots\ldots\ldots\ldots, m$$

$$t_i \geq 0, i = 1,2,3 \ldots\ldots\ldots\ldots, k$$

Similarly, for the above LPP , the dual[52] can be stated (for DMU_0) as:

$$\text{Min } z_0 = \varphi_0 \; subject\ to \; \sum_{j=1}^{n} \lambda_j y_{sj} \geq y_{s0}, s = 1,2, \ldots\ldots, m \;\; \varphi_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0,$$

$$i = 1,2, \ldots\ldots, k. \qquad \text{(A4)}$$

$$\lambda_j \geq 0; j = 1,2, \ldots\ldots\ldots\ldots n; \varphi \text{ is unrestricted.}$$

Two of the above mentioned LPP will give the optimal solution φ_0^*, that indicates the efficiency score (popularly referred as technical efficiency or efficiency under CCR model) for a DMU_0. Likewise, the efficiency for all other DMUs is obtained using a recursive approach for each DMU_j = 1,2,….,n. The φ attains a value of either less than or equal to 1, always. Those DMUs for whom the $\varphi_0^* < 1$ are relatively inefficient in comparison to those who have $\varphi_0^* = 1$ and

[52] This is also known as 'input-oriented CCR-model' that is incorporated in our study initially along with the BCC model. The CCR model thus allows the maximization of "virtual multipliers" (i.e., weights, *w* and *t*) that tends to produce the highest rate of "virtual output" per unit of "virtual input".

are regarded as relatively efficient, indicating that such DMUs ($\varphi_0^* = 1$) have their virtual combinations of input-output points on the frontier line.

However, moving ahead and allowing for the variable returns to scale (VRS) assumptions, it is required to incorporate the convexity condition for the existing weights λ_j that is to include a constraint in the above model:

$$\sum_{j=1}^{n} \lambda_j = 1.$$

Therefore, the following DEA model that exhibits VRS is also called BCC model (Banker et al., 1984). Thus, the input-oriented DEA model following the BCC criteria is presented as:

$$\text{Min } z_0 = \varphi_0 \; subject\ to \sum_{j=1}^{n} \lambda_j y_{sj} \geq y_{s0}\,, s = 1,2, \ldots\ldots, m \;\; \varphi_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0, i = 1,2, \ldots\ldots, k \sum_{j=1}^{n} \lambda_j = 1 \qquad \text{(A5)}$$

$$\lambda_j \geq 0; j = 1,2, \ldots\ldots\ldots . . n$$

In the above specification, the transformation of the input-bundle into value creating output also depends on a specified technology set faced by the banks. Such a technology set is endogenously determined by the model itself and is included into the model (as stated in Section 4.1.a of this chapter, above). We follow the same specification to determine our results of this chapter. Further, to study the movement in bank-wise efficiency in depth we compute both Overall Technical Efficiency (OTE) under CCR model and Pure Technical Efficiency (PTE) under BCC model. The efficiency scores obtained under the BCC model are called PTE scores as BCC specification eliminates the 'scale part' by employing the VRS. The computed measures of such input oriented technical efficiency scores lie between 0 and 1. Once, the PTE estimates are available with us the scale efficiency (SE) can also be evaluated, simply using the following formula:

$$\text{Scale Efficiency (SE)} = \frac{TE_{CRS}}{TE_{VRS}} = \frac{OTE}{PTE}$$

4.4.a.: Theoretical underpinnings and Input-Output bundle:

The selection of a specific input-output bundle to compute the efficiency of a DMU (banks in our case) under the DEA is challenging due to the several assumptions coupled with its

selection. In addition to the existing literatures on the selection of input-output variables we also provide additional argument in support of our selection. We describe inputs as those elements whose availability reduces with the increase in use over the time, while we define output as those components that will increase with the use of inputs.

The variations in the selection of input-output bundle depends on the nature of the approach followed to recognize a DMU's activity. On one hand banks are viewed either as financial intermediaries or providers of financial services and as a result different approach under DEA, arises. For instance, the production approach (Benston, 1965) points that banks produce loans and other financial services. On the other hand, several studies resort to the intermediation approach and prefer to view banks as a financial intermediary that aims to channelize funds from a set of agents or depositors to another group or borrowers. The main assumption here is that such funds are received by banks in the form of deposits that are subsequently transformed into value creating loans by use of other inputs. Different components like operating expenses, capital expenditures, number of labours, interest expenses, interest income, non-interest income, deposits, loans, investments etc. of individual banks are considered in various studies as specific sets of input-output bundles under DEA (Berg et al., 1993; Debasish, 2006; M. Kumar et al., 2016; S. Kumar, 2008; Saha & Ravisankar, 2000; Sathye, 2003; Sherman & Gold, 1985; Yeh, 1996).

However, there exists sufficient contradiction regarding treatment of deposits either as an input or output component. But, based on the definition and operations in banking activity in this study, we consider deposits as an input component. Firstly, because banks are engaged in the ongoing process of credit creation through the acceptance of deposits from customers and such disbursed loans generates returns to the banks. Secondly, such deposits are also channelized to profitable investment sectors by way of investments or otherwise, that provides income to the banks. Since deposits successfully triggers both these facilities and therefore qualifies as a vital input component. Further, existing difference of opinions among authors, regarding deposits, gives rise to three sub-approaches under the intermediation approach. Asset approach (Sealey Jr and Lindley, 1977) that considers deposits along with other liabilities as well as certain real resources as input variables, while loans are treated as output. Similarly, the user cost approach given by Hancock, (1985) considers financial returns on an asset and the opportunity cost of funds. If the former is greater than the later then the former is treated as output, while in the reverse case if opportunity cost of funds exceeds the financial returns, then the former is treated as inputs. Likewise, the value-added approach (Berger et al., 1987; Berger and Humphrey,

1997) considers those variables as outputs that contribute to increase the bank value. This approach is mainly based on the balance sheet classification of banking operations. To study the efficiency at bank-level, most of the past literatures support the intermediation approach (Berger and Humphrey, 1997), while to study efficiency at branch level only, production approach (Benston, 1965) is preferred.

On the other hand, the modern approach (Freixas and Rochet, 1997) considers the asset quality of banks and their probability of default. This approach can be best evaluated using a CAMELS framework. Lastly, the operating or income approach (Leightner and Knox Lovell, 1998) views banks as units that generates revenue out of their incurred costs.

Finally, most studies on bank efficiency focus on the intermediation approach due to its benefit of easy availability of data from bank's Income statement and Balance Sheet. Hence, in this study we follow the Asset approach given by Sealey Jr and Lindley, (1977) and consider a five input and two output model, whereby deposits, number of employees, expenditure on fixed assets, operating expenses and borrowings form our input-bundle, while we consider performing loans (Total Advances minus Non-Performing Assets, for individual bank) and investments as our output-bundle. In the growing era of non-performing assets, we mainly argue that banks with higher efficiency are better able to create values through management of their disbursed loans or earning assets. This approach of including earnings assets in case of banks is a considered as a noble approach since only the proportion of earnings assets generates revenues to banks rather then their disbursed loans (A. Das et al., 2005). In addition, banks are also able to channelize their funds towards profitable investment opportunities that are likely to provide them good returns too. Since NPA arises as an ex-post facto component for banks and highlights their inability to judge credit risk, we consider the above specification in our study. Also, as the share of performing loans is higher among the output-bundle hence we argue that efficiency results depend much on a bank's ability to better manage its performing loans. Furthermore, following the recent works of Goyal et al., (2019) we divide our bank-wise input-output variables by the corresponding number of individual bank's branches to remove the extreme heterogeneities in our dataset. A short description of the data on input-output bundle is shown in Table 4.1 (Appendix IV.5) of this chapter.

4.4.b. Data and Sample Construct:

We restrict our study to compute the input-oriented technical efficiency with a sample of 71 Indian Commercial banks over a period of 12 years (2005-06 to 2016-17) based on the annual

data of specified input-output bundle collected from Statistical Table Related to Banks in India (STRBI) of Reserve Bank of India. This publication comes from RBI and furnishes us with the audited annual data on balance sheet as well as on profit and loss accounts components including selected ratios of individual banks. As the financial year for bank runs from the 1st day of April of a particular year till 31st March of the immediately subsequent year, accordingly our data for the year 2006 corresponds to the period 2005-06 (April to March) and so forth for other years. This data is publicly available from RBI website[53]. Also, we restrict our sample size till 2016-17, mainly because since from April 2017 onwards the process of bank-merges started through merger of State Bank of India with its associates and other mergers among prime Indian public sector banks, hence considering a sample period beyond 2016-17 shall not be prudent as it is too early to comment on the efficiency of such merged banks. However, due to increase in bank size and market share of such merged banks the inclusion of those banks in our study is likely to give inconsistent results. Further, eliminating those merged banks that were once the important players in public sector shall not be logical, to draw correct conclusion. Again, for this thesis extending our sample period backwards beyond 2005-06 is also a challenge since most of the variables are either unavailable or inapplicable.

Further, since the efficiency estimates under DEA technique is largely dependent on the sample size, the number and selected alternative of input-output variables chosen, the discussion on the sufficiency of sample size is applicable too (Goyal et al., 2019). The sample size that we use in this study is in line with the several thumb rule available across DEA literature. For instance, Cooper et al., (2007) proposes two such rough rule of thumb that can be stated as:

$$n \geq \{m \times s\}, or;$$

$$n \geq \{3(m + s)\}$$

Where, n is the count of number of DMUs, m represents the number of inputs. The first rule states that the number of DMUs used shall be either greater than or equal to the multiplied value of inputs and outputs. On the other hand, the second rule states that number of DMUs shall be no less than three times the total of input and output variables. In our case we have m = 5 and n = 2 (input * output = 5 x 2 = 10) in this study and our number of DMUs n = 71, that sufficiently exceeds the above requirement. Furthermore, our total number of DMUs (71) also

[53] www.rbi.org

meets the requirement as suggested under the second rule, indicating adequate discriminatory strength of our sample size (Goyal et al., 2019; S. Kumar & Gulati, 2010).

Finally, Das & Ghosh, (2006) argues that, since the main objective of RBI has been to promote competition under the liberalization policy (Reserve Bank of India, 2002) by providing a common field in terms of avaricious norms on capital adequacy, income recognition and assets classification is also expected to significantly impact bank efficiency and that is important to address. Hence, we consider a sample of 71 Indian commercial banks. We use the software R[54] for our DEA analysis in this chapter.

4.5. Findings:

In this section we first present the shortcomings and drawbacks associated with the CAMELS rating system for Indian banks, as a measure of efficiency and highlight the superiority of relative efficiency measures over the same. Mcnaughton and Barltrop, (1992) argues that in a globally competitive environment to determine the strength of a particular bank certain parameters (Capital Adequacy, Human Resources, Asset Quality, Innovation in Finance, Technology and Brand Equity) are necessary. But all such parameters are not directly measurable. However, following the highlights of the Pendharkar Working Group, (1983) and the proposals of Padmanabhan Committee (1996) to suffice the need for a single index to evaluate the relative efficiency of banks under several parameters, RBI recommended adoption of CAMELS[55] rating system. However, post implementation of the same there exists ample criticisms about the rating. For instance, Saha and Ravisankar, (2000) in their pioneering works opines that such a measure is only capable of presenting the financial condition of a bank at any particular point of time, rather provides a contemporaneous measure instead of relative efficiency. Also, this approach lacks in providing a true picture about the productive efficiency of the banks (although certain ratios partially provide scattered information). Moreover, the benchmark ratios may also vary between different bank sector groups, thereby making the CAMELS rating system inconclusive. Additionally, the parameter *'S'* that represents Systems (and Internal Control) in Indian context is also not possible to quantify based on financial ratio, as the said indicator is typically based on audit of supervisory process among banks, the report

[54] Packages used: lpSolveAPI, ucminf, quadprog and Benchmarking.
[55] Capital Adequacy, Asset Quality, Management, Earnings, Liquidity and Systems (and Internal Controls)

of which is thereafter shared by RBI to the selected internal management personnel only, across the banks.

The report on Review of Supervisory Processes of Commercial Banks (RBI, 2012), also lists a series of limitations about this rating mechanism, that initiated a shift to accommodate various kind of risks under the BASEL I and II Capital Accord norms that are not adequately addressed under the CAMELS rating. We present our findings of the CAMEL Composite Index in Table 4.1 to 4.3 (Appendix IV.4) whereas the analysis of individual components is shown in Table 4.8 to 4.22 (Appendix IV.4). Thereafter, we rank the top three banks from each of the Public, Private and Foreign sectors. A closer look at the results infers an interesting thing, that is almost all banks maintain the mandated capital ratios (CRAR) as specified by RBI, that significantly contribute towards the rating scores, whereas measures of other parameters are determined based on other financial ratios that form a representative measure and not an actual measure. Hence, along with other loopholes, this approach is unable consider the impact of resources a bank uses to generate output. Thus, we employ a more superior approach to evaluate efficiency using the DEA technique.

Table 4.4 and 4.5 of Appendix IV.4 lists the bank-wise efficiency scores across our sample period, arrived at by application of CCR and BCC models respectively. The summary of the efficiency range and the mean of year wise distribution of overall (OTE) and pure (PTE) technical efficiency scores for all 71 banks are presented chronologically in Table 3.6 (Appendix IV.4). Starting from the initial years of our sample period, the mean value of OTE scores for Indian banking industry is least in 2005-06 and 2010-11 respectively. However, towards the terminal year (2016-17) after 2013-14 we note a consistent reduction in mean of OTE scores for Indian banking industry. The corresponding mean values of OTE are 0.897, 0.862 and 0.830 respectively for years 2014-15, 2015-16 and 2016-17. In 2016-17 the mean of OTE for Indian banking industry is 0.830, that indicates that overall technical inefficiency (OTIE) of Indian banking industry is approximately 17 percent (16.99 percent). Since we compute an input oriented technical efficiency, it indicates that Indian banks are capable to reduce their inputs further to the extent of 16.99 percent with an equivalent increase in their outputs. The underlying reason behind such inefficiency trend from 2014-15 onwards may be due to operation at a scale size that is not optimal or because of poor management quality of banks.

The overall technical efficiency (OTE) scores obtained by application of the CCR model can be again decomposed into two non-additive and mutually exclusive elements, pure technical efficiency (PTE) and scale efficiency (SE). As mentioned earlier we restrict our study to the analysis of overall technical efficiency and pure technical efficiency only. The values of pure technical efficiency (PTE) can be computed using the BCC model using the same data. We also follow a similar specification to compute the PTE in this study. Thus, the efficiency scores obtained under the BCC model gives us the measure of PTE that is free of scale effects. We present our results of PTE scores in Table 4.5 (Appendix IV.4). In case there is any difference in the efficiency scores of an individual bank, it indicates scale inefficiency (SIE). According to the existing DEA literatures, DMUs having OTE scores equal to 1 are addressed as 'globally technically efficient' while those having PTE scores of 1 but OTE scores less than 1, are referred as 'locally technically efficient'. Also, the efficiency obtained under the BCC model by application of VRS assumption forms a frontier line that envelopes the data points more tightly (i.e., it creates a convex hull of the intersecting planes) than the CRS based model (CRS creates a conical hull) and therefore gives technical efficiency scores (i.e., PTE) that are either greater than or equal to the scores obtained under CRS model (i.e., OTE) (T. Coelli, 1996; Goyal et al., 2019).

Table 4.6 (Appendix IV.4) further reveals the percentage of Indian banks out of the sample banks that have acquired either the status of globally or locally technically efficient over the years. During the beginning of the sample period (2005-06) out of 71 sample banks, 39 banks (i.e., 54.93 percent) are locally technically efficient with a PTE score equal to 1. While at the terminal year (2016-17) out of 71 sample banks, only 31 banks (i.e., 43.66 percent) are locally technically efficient. The mean value of PTE has also reduced from 0.924 in 2005-06 to 0.915 in 2016-17 indicating that extent of pure technical inefficiency (PTIE) of Indian banking industry has increased from 7.6 percent (in 2005-06) to 8.5 percent (in 2016-17). Hence, the results show that 8.5 percentage points out of 16.99 percent of overall technical inefficiency (OTIE) as stated above can be primarily allocated to managerial inefficiency. We also find that despite scattered recovery in overall efficiency till 2012-13, from 2013-14 onwards out of 71 sample banks the number of banks having relative efficiency under CRS with OTE scores equal to 1 has consistently reduced, and by the end of sample period (2016-17) only 20 banks are globally as well as locally technically efficient (i.e., have OTE scores equal to 1). Further, for the remaining 11 banks (i.e., 31 banks with PTE score of 1 minus 20 banks with OTE score of 1) it might be stated that although they are locally technical efficient but are globally inefficient.

It further reveals that OTIE in these 11 banks, might have cropped up due to inability of banks to operate at a most productive scale size (MPSS). We also find that in 12 banks (i.e., 16.90 percent) the extent of PTIE is greater than 20 percent that has also significantly increased from 2012-13 onwards.

We extend our analysis and provide an ownership structure wise number of efficient banks in Indian banking industry over our sample period in Table 4.7.a and 4.7.b (Appendix IV.4). This analysis shows a clearer picture of the status of the number of public, private, and foreign banks in terms of their efficiency over the years. For the year 2016-17, under the CRS based OTE, out of 20 globally efficient banks only 3 banks belong to the public bank group while only 2 belong to private group and under VRS technology (i.e., PTE) 6 public banks and 4 private banks are found to be locally efficient. Moreover, under both CRS and VRS the foreign bank group consists of the highest number of efficient units, both locally and globally. Another important finding from Table 4.7.a and 4.7.b is that the proportion of public banks among the efficient units are consistently reducing over the past five years of the sample period. Therefore, we deduce that while public banks are stragglers, foreign banks are the leaders in Indian banking industry.

Further, we also present a brief representation of scale efficiency (SE) scores in this chapter. Table 4.1 of Appendix IV.6 shows our SE scores that is simply the ratio value between OTE and PTE (or, TE_{CRS} / TE_{VRS}). A SE score of 1 indicates that a particular bank is operating at the MPSS, whereas a SE $\neq$ 1 implies that the bank is inefficient as it is not operating at the required scale size. From our descriptive statistics of efficiency scores on Indian banking industry in Table 4.2 (Appendix IV.6) we find that towards the end of the terminal years of our study (i.e., 2016-17) we find that the mean of SE score is 0.905 that indicates that average level of scale inefficiency (SIE) in Indian banking is 9.47 percent. Moreover, during the same period the SE score has a minimum range of 0.363 to a maximum of 1. Also, the higher mean and lower standard deviation values of PTE scores vis-à-vis SE scores hint that a significant proportion of OTIE is due to SIE at the end of the sample period.

3.6. Summing up:

Indian banking industry is under continuous pressure due to increasing burden of NPAs (non-performing assets). This situation became worse over the past five years of our sample period, affecting the efficiency of Indian commercial banks. Induced by such higher levels of

inefficiencies, the RBI and Ministry of Finance (Government of India) recommended the merger of several public banks with the aim to retain a few but healthy banks. Different yardsticks of measuring the efficiency of Indian commercial banks are argued to exist. Of them the accounting measure of efficiency through computation of a single index under the CAMELS rating system was adapted as per the recommendations of Padmanabhan committee of 1996 (RBI, 2012). In line with the international standards of U.S, RBI also launched the system of on-site inspection of different parameters under the CAMELS rating system with an exception to the component 'S'. The said element in Indian context is termed as Systems and Control unlike the international context of Sensitivity to Market Risk. Unlike the U.S system of on-site review, the CAMELS approach in India aimed at rating an individual bank at the Central Office of RBI, based on information collected from on-site inspection along with other supervisory matters available at the Central Office. The report submitted by the K.C Chakraborty committee (RBI, 2012) although highlights the history, subsequent introduction and certain key features of the CAMELS rating system for Indian banks, but simultaneously also criticizes the said rating technique.

According to committee the CAMELS rating was devised to provide a comprehensive overview about the efficiency of an individual bank that is not limited to the on-site examination only. However, in the regime of significant shifts in the functions of banks over the years from providing traditional products and services towards involving into more diversified activities, the need for frequent revision in such rating system at regular intervals is adequately highlighted in the K.C Chakraborty committee report. Further, the committee itself highlights the key loopholes in the rating system in the same report. It states that the rating system is weak as it provides only contemporaneous result of the health of an individual bank at a point of time; it ignores the weights of certain key risks in the form of market risk, operational risk, credit risk etc. Also, the rating system is unable to provide long-term conclusions regarding the efficiency of an individual bank.

Further, the report on CAMELS rating is shared internally among the MD, ED and Chairman of audit committee of individual banks, making it difficult to draw an actual measure of same. Hence in this chapter we could only draw a representative measure of the CAMEL (collectively for 2016-17 only) based on certain financial ratios without the component 'S' (since it is based on supervisory report of individual banks that is unknown at public domain) using our sample of 71 Indian banks. Therefore, the measure of relative efficiency through technical efficiency

using DEA technique qualifies as a significant yardstick to study the long-term efficiency of banks (RBI, 2008).

RBI, (2008) report on productivity and efficiency also states that use of financial ratios to draw economic conclusions can lead to the danger of assigning economic conclusions to accounting numbers. Further such values also tend to suffer from accounting biasness. Hence, we highlight the different distinctions of effectiveness, productivity, and efficiency compute the technical efficiency scores for the sample banks in our study. We use a sample of 71 Indian banks from 2005-06 to 2016-17 for our analysis. Then we compute both overall (OTE) as well as pure (PTE) under the CCR and BCC models respectively. While the former involves application of CRS, the later uses VRS. Our results infer that towards the terminal years (end of 2016-17) the Indian banking sector is only 83.01 percent efficient. This indicates that there still ample scope for Indian banks to enhance their efficiency to become globally competitive. Also, there is further scope of reduction in its inputs with an equivalent expansion of outputs in the sector to the extent of 16.99 percent. This also reveals the existence of different production functions across various ownership structures.

Similar to the findings of Sahoo et al., (2007) and others existing DEA literatures in Indian context, we also find significant lack of efficiency among the public banks. Such inefficiency persisted over the years and therefore induced the Government to resort to merger of several public banks in India. Our findings from this chapter also highlights that overall, the Indian banking sector is not fully efficient and there is ample scope to reduce their inputs to improve their resulting outputs. Secondly performance of foreign banks is much superior over other ownership structures in India, more likely due to their better outreach to international markets and less bureaucratic obligations. Lastly, there is significant drop in the efficiency of public as well as private banks might be because of the recommendations of RBI to follow the enhanced provisioning mandate as a shield to rising NPAs, that adversely impacted their profitability. Therefore, we empirically prove that our results warrant the decision of the Ministry of Finance (Government of India) and RBI to merge the public banks to retain a few but healthier banks.

Finally, we plot the OTE and PTE in Figures 2 and 3 (Appendix IV.4) respectively and observe certain degree of heterogeneities among the banks. Further, we also find close degree of association between bank profitability (measured by ROA) and OTE in Figure 4 (Appendix IV.4) and intend to check its impact on the financial performance of Indian commercial banks in terms of its profitability in the following chapter.

APPENDIX IV.1. Note to Orientation in Efficiency

A-4.1.1. Input Oriented Efficiency:

Under this approach the output of the firm is taken as the constant and the technical efficiency of the firm depends upon the ability of a firm in maximal equi-proportionate minimization of its available resources to produce the given level of output (or without any reduction in its output). This measure is known as input-oriented technical efficiency and is measured as:

$$\text{Min } \varphi^*$$

$$\text{s.t} \sum_{J=1}^{N} \lambda_j y_j \geq y;$$

$$\sum_{J=1}^{N} \lambda_j x_j \leq \varphi x$$

$$\sum_{J=1}^{N} \lambda_j = 1.$$

$\lambda_j \geq 0; (j = 1,2, \ldots \ldots \ldots \ldots N)$; φ is unrestricted.

Where,

φ = The efficiency of individual banks, to be evaluated by maximal equi-proportionate reduction in the available inputs at the hands of the bank.

x^0 and y^0 are the set of inputs and outputs for the firm j (here banks) respectively.

The λ_j's are the set of raw weights that is endogenous to the model and is assigned to specific vectors of input and output. The value of λ_j is greater than zero without any specified limit attached to it. The term j denotes the number of cross-sectional DMU's or banks whose efficiency we intend to evaluate.

A-4.1.2. Output Oriented Efficiency:

For a given set of input resources available, the maximum output that can be potentially produced from the same given set of input, gives the output-oriented efficiency measures. If we assume that θ* denotes the maximum value of output (θ) such that for a firm j (x_j , θy_j) stays within the technology set. Therefore, $y^* = \theta^* y_j$ and the output-oriented technical efficiency for firm j is stated as $TE_j = TE\ (x_j , y_j) = 1/\ \theta^*$. Thus, the output oriented technical efficiency is obtained as:

$$\theta^* = \text{Max } \theta$$

$$\text{s.t} \sum_{J=1}^{N} \lambda_j y_j \geq \theta y^0;$$

$$\sum_{J=1}^{N} \lambda_j x_j \leq x^0$$

$$\sum_{J=1}^{N} \lambda_j = 1.$$

$$\lambda_j \geq 0; (j = 1,2, \ldots \ldots \ldots N); \theta \text{ is unrestricted.}$$

θ^* = The efficiency of individual banks, to be evaluated by maximal equi-proportionate increase in the value of outputs for each bank relative to its peer group.

x^0 and y^0 are the set of inputs and outputs for the firm j (here banks) respectively.

The λ_j's are the set of raw weights that is endogenous to the model and is assigned to specific vectors of input and output. The value of λ_j is greater than zero without any specified limit attached to it. The term j denotes the number of cross-sectional DMU's or banks whose efficiency we intend to evaluate.

A-4.1.3. Exhibit for scale of operation (CRS or VRS):

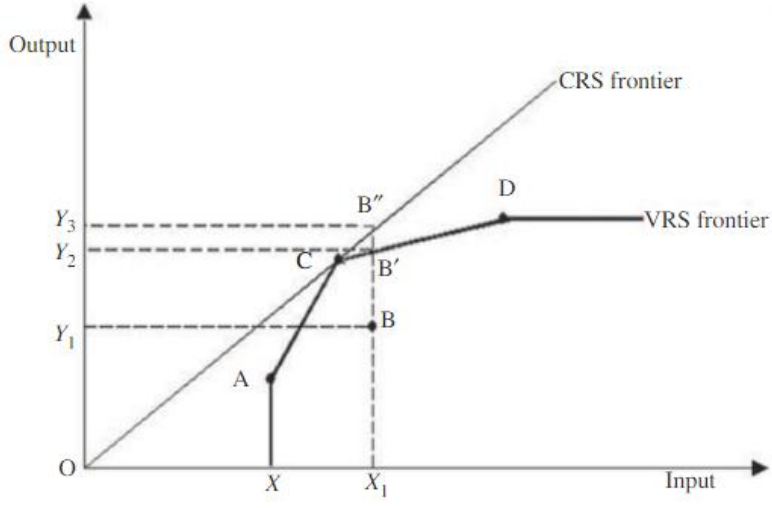


Figure 4.1: Distinction between the scale of operation

Note: The above figure shows a hypothetical production frontier and scale of operations

**Source:* Dutta et al., (2014)

The above diagram shows the efficiency frontier and extent of capacity utilization under either CRS or VRS assumptions by use of four data points, A, B,C and D with regards to the output orientation approach. It is clearly visible that capacity output under the CRS is more than capacity output under VRS. Since in the former case only the point C is defined as an efficient one with point A, B and D falling below the frontier, while in the later case only B lies below the frontier line.

APPENDIX IV.2: Other Economic measures of Efficiency

A-4.2.1. Cost Efficiency:

While measuring technical efficiency under input-oriented approach, every input is treated equally, and the aim is the equivalent minimization of all inputs. But in doing so if certain inputs cannot be substituted or are binding in nature after a certain point then further reduction is not feasible. However, if input prices are readily available, reduction of a more costly input appears a greater priority than the less costly ones. Therefore, cost efficiency measures the cost-based performance of a banking unit vis-à-vis the best practice banking unit (or least costly) producing similar output. Thus, the objective in this case is the reduction in cost of target output bundle.

$$C^* = \text{Min } v'x$$

$$\text{s.t} \sum_{J=1}^{N} \lambda_j y^j \geq y;$$

$$\sum_{J=1}^{N} \lambda_j y^j \leq x$$

$$\sum_{J=1}^{N} \lambda_j = 1.$$

$$\lambda_j \geq 0; (j = 1,2, \dots \dots \dots \dots N)$$

The notations of the above LPP are similar to that of input and output-oriented technical efficiency.

A-4.2.2. Revenue Efficiency:

Measuring the output-oriented efficiency, the main aim is to secure the maximum increase in revenue that is feasible for all outputs. But, unlike case of inputs certain outputs are more valuable in comparison to others, given the availability of prices.

APPENDIX IV.3: Brief explanation of parametric measures of Efficiency

As this chapter considers the measurement of efficiency of Indian commercial banking sector, hence it is necessary to mention the fine difference between the approaches to measure such efficiency. Different measures of efficiency can be evaluated under two broad approaches- Parametric and Non-Parametric measures. While parametric method is limited to a fixed number of parameters used to construct a model, non-parametric approach uses such variables that are flexible in number. We provide a brief description of different Parametric and Non-Parametric approaches that exists:

Stochastic Frontier Approach:

Under this approach the cost, profit and production function of highly efficient producer is evaluated first and a deviation in such efficiency of an institution from the frontier is said to have two components, an inefficiency term, and a random error. While the portion of the error component indicating the deviation from the frontier is assumed to be taken from a two-side distribution while the inefficiency term is assumed to be derived from a one-sided distribution, since with increase in inefficiency costs also rise. Such estimation can be executed using cross-sectional data.

Distribution Free Approach:

This approach addresses efficiency under the assumption that differences in such efficiencies are stable over time and no specific theory is applied related to distribution (Goddard et al., 2004a). Here the value of inefficiency for a particular firm is the deviation between its average residual and the average residual of the firm operating on frontier line. Estimation under this approach requires a panel data set.

Thick Frontier Approach:

Here the deviations of predicted costs between the highest and the lowest cost quartile represent productive inefficiencies. Like Distribution Free Approach, this approach also does not

consider any distributional presumption to evaluate inefficiency. However, one of the main drawbacks of this approach is that it does not provide efficiency estimate for a particular firm unit rather it gives an estimation of total efficiency level.

APPENDIX IV.4: Results of the Chapter

A-4.4.1: Table 4.1: CAMEL Composite Index and Rank of Public Banks

Bank Name	Capital	Asset Quality	Management	Earnings Quality	Liquidity	Composite Index	Rank
STATE BANK OF BIKANER & JAIPUR	16.5	13	11.5	13	2.5	11.3	8
STATE BANK OF HYDERABAD	10	9	6	13	4	8.4	4
STATE BANK OF INDIA	3	8.5	8.5	15	11	9.2	5
STATE BANK OF MYSORE	14	19	19.5	21	11.5	17	20
STATE BANK OF PATIALA	13.5	20.5	24	8.5	21.5	17.6	21
STATE BANK OF TRAVANCORE	17.5	7	15.5	17.5	13.5	14.2	15
ALLAHABAD BANK	13	18.5	12.5	14	17.5	15.1	16
ANDHRA BANK	**9.5**	**5.5**	**4**	**8**	**10**	**7.4**	**2**
BANK OF BARODA	**3.5**	**1**	**8.5**	**18.5**	**1**	**6.5**	**1**
BANK OF INDIA	21	14	17	20	7	15.8	19
BANK OF MAHARASHTRA	22	19.5	20.5	14	19.5	19.1	25
CANARA BANK	6	11	9	16	26	13.6	13
CENTRAL BANK OF INDIA	23.5	23	25.5	12	4	17.6	21
CORPORATION BANK	10.5	6.5	5.5	21.5	17	12.2	11
DENA BANK	22	20	18	14	17	18.2	24
IDBI BANK LIMITED	5	19	19	22.5	12.5	15.6	18
INDIAN BANK	**1.5**	**2**	**2**	**10.5**	**25**	**8.2**	**3**
INDIAN OVERSEAS BANK	12.5	25.5	22	4.5	12	15.3	17
ORIENTAL BANK OF COMMERCE	8	16.5	14	15.5	15.5	13.9	14
PUNJAB AND SIND BANK	9.5	11.5	14	4	21	12	10
PUNJAB NATIONAL BANK	6	15	8.5	19	8	11.3	8
SYNDICATE BANK	22.5	3.5	10.5	8.5	7.5	10.5	6
UCO BANK	22	24	22.5	7	22	19.5	26
UNION BANK OF INDIA	18.5	9	4.5	8	24	12.8	12
UNITED BANK OF INDIA	21.5	25.5	13.5	22	7.5	18	23
VIJAYA BANK	18.5	3.5	15	3.5	13	10.7	7

**Source: Own calculations*

A-4.4.2: Table 4.2: CAMEL Composite Index and Rank of Private Banks

Bank Name	Capital	Asset Quality	Management	Earnings Quality	Liquidity	Composite Index	Rank
AXIS BANK	9	5	3	13.5	8	7.7	4
CATHOLIC SYRIAN BANK LTD	18	19	17.5	4	9	13.5	16
CITY UNION BANK LIMITED	12	11	4	10.5	12	9.9	12
DCB BANK LIMITED	10	14	17.5	14.5	13	13.8	17
FEDERAL BANK	5.5	6.5	10	8	15	9	7
HDFC BANK	**5**	**3**	**3.5**	**11**	**6**	**5.7**	**2**
ICICI BANK	2.5	16	8.5	16	7.5	10.1	13
INDUSIND BANK	11.5	8.5	9	10.5	5	8.9	6
JAMMU & KASHMIR BANK LTD	14.5	13	12.5	9.5	6	11.1	14
KARNATAKA BANK LTD	15.5	15	12.5	13.5	18	14.9	19
KARUR VYSYA BANK	11	4	6.5	10.5	16.5	9.7	11
KOTAK MAHINDRA BANK LTD	1.5	12	9	10	15.5	9.6	9
LAKSHMI VILAS BANK	16.5	17.5	15.5	4.5	13	13.4	15
NAINITAL BANK	**8**	**1.5**	**9**	**6.5**	**1**	**5.2**	**1**
RBL	**2**	**6.5**	**15.5**	**5**	**2**	**6.2**	**3**
SOUTH INDIAN BANK	15.5	10	10.5	3	8	9.4	8
TAMILNAD MERCANTILE BANK LTD	6	8.5	5.5	10	18	9.6	9
DHANLAXMI BANK	19	17.5	19	12	3.5	14.2	18
YES BANK LTD.	7	1.5	1.5	17.5	13	8.1	5

**Source: Own calculations*

A-4.4.3: Table 4.3: CAMEL Composite Index and Rank of Foreign Banks

Bank Name	Capital	Asset Quality	Management	Earnings Quality	Liquidity	Composite Index	Rank
AB BANK LIMITED	6	24.5	15.5	22	14.5	16.5	21
ABU DHABI COMMERCIAL BANK	15	15.5	15	4	4	10.7	7
BANK OF AMERICA N.A.	15.5	6	4	20	24.5	14	13
BANK OF BAHRAIN & KUWAIT B.S.C.	10.5	21	21.5	6.5	15	14.9	14
BANK OF CEYLON	4	23	14.5	12	4.5	11.6	9
BANK OF NOVA SCOTIA	21.5	13	3	17	23.5	15.6	17
BARCLAYS BANK PLC	13	17.5	14.5	21.5	13	15.9	19
BNP PARIBAS	20.5	7.5	10	10.5	20	13.7	12
CITIBANK N.A.	23	16	7	15.5	22.5	16.8	22
CREDIT AGRICOLE	17.5	15.5	8	21.5	15.5	15.6	17
CTBC BANK	9	23	26	4.5	13.5	15.2	16
DBS BANK INDIA LTD.	21.5	20.5	18.5	14.5	10	17	23
DEUTSCHE BANK AG	20.5	9.5	9	16	9.5	12.9	10
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	21	12	10	17	15	15	15
JP MORGAN CHASE BANK N.A.	15	10	2.5	13	16	11.3	8
KRUNG THAI BANK PUBLIC COMPANY LIMITED	**7**	**1**	**14.5**	**3**	**1.5**	**5.4**	**1**
MASHREQ BANK PSC	**2.5**	**1**	**7**	**19.5**	**4.5**	**6.9**	**2**
MIZUHO BANK LTD	6	11	15	8.5	8	9.7	5
MUFG BANK, LTD.	10	7.5	13	6.5	15	10.4	6
PT BANK MAYBANK INDONESIA TBK	1	1	22	15.5	1.5	8.2	4
SBM BANK (INDIA) LTD	8.5	24.5	25	13	16	17.4	24
SHINHAN BANK	**7.5**	**1**	**14**	**8.5**	**5.5**	**7.3**	**3**
SOCIETE GENERALE	16	1	19	9	21.5	13.3	11
SONALI BANK	16.5	21	15.5	18	9	16	20
STANDARD CHARTERED BANK	22.5	15	9.5	16	26	17.8	25
NatWest Markets Plc	20	22.5	17.5	18	21.5	19.9	26

**Source: Own calculations*

A-4.4.4: Table 4.4: Bank-wise Overall Technical Efficiency Scores (OTE) under CCR Model:

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
STATE BANK OF BIKANER & JAIPUR	0.816	0.933	1	0.947	0.946	0.915	1	0.972	1	0.871	0.822	0.839
STATE BANK OF HYDERABAD	0.960	1	1	0.979	1	0.967	0.976	0.993	0.994	0.865	0.876	0.741
STATE BANK OF INDIA	0.829	0.925	0.927	0.921	0.824	0.781	0.826	0.853	0.881	0.816	0.750	0.716
STATE BANK OF MYSORE	0.790	0.962	1	0.910	0.941	0.736	0.866	0.910	0.892	0.797	0.747	0.660
STATE BANK OF PATIALA	1	1	1	1	1	0.926	0.891	0.953	0.918	0.870	0.897	0.740
STATE BANK OF TRAVANCORE	0.969	1	1	1	0.959	0.926	0.928	0.965	0.934	0.838	1	0.823
ALLAHABAD BANK	1	1	0.963	0.969	0.963	0.858	0.930	0.935	0.901	0.877	0.828	0.720
ANDHRA BANK	0.920	1	1	0.945	0.897	0.984	1	1	0.967	0.938	0.966	0.869
BANK OF BARODA	0.778	0.936	0.940	0.925	0.967	0.957	1	1	0.995	0.994	0.837	0.774
BANK OF INDIA	0.811	0.906	0.965	0.936	0.863	0.828	0.931	0.959	1	0.926	0.727	0.746
BANK OF MAHARASHTRA	0.943	1	1	0.917	0.885	0.712	0.855	0.859	0.901	0.857	0.851	0.692
CANARA BANK	1	0.986	0.965	0.937	1	0.941	0.989	0.942	0.959	0.904	0.903	0.805
CENTRAL BANK OF INDIA	0.935	0.939	0.964	1	0.941	0.686	0.883	0.887	0.857	0.822	0.781	0.710
CORPORATION BANK	0.896	0.942	0.977	1	1	1	1	1	1	1	1	1
DENA BANK	1	0.935	0.940	0.900	0.945	0.955	1	0.922	0.985	0.945	0.824	0.827
IDBI BANK LIMITED	1	1	0.920	1	1	1	1	1	1	0.987	0.918	0.673
INDIAN BANK	0.834	1	0.919	0.952	0.999	0.906	0.964	0.996	1	1	1	0.886
INDIAN OVERSEAS BANK	0.933	0.956	0.914	0.875	0.834	0.814	0.859	0.886	0.923	0.876	0.710	0.657
ORIENTAL BANK OF COMMERCE	1	1	1	1	1	1	1	1	1	1	0.934	0.832
PUNJAB AND SIND BANK	1	0.891	0.842	0.882	0.934	0.862	0.929	1	1	0.993	1	0.935
PUNJAB NATIONAL BANK	0.757	0.962	0.941	0.919	0.888	0.749	0.883	0.882	0.869	0.832	0.798	0.888
SYNDICATE BANK	0.902	0.953	0.951	0.943	0.884	0.873	0.926	0.963	1	1	0.782	0.708
UCO BANK	0.887	0.952	0.938	0.937	1	1	1	1	1	1	1	1
UNION BANK OF INDIA	0.901	0.986	0.973	0.925	0.960	0.753	0.921	0.928	0.910	0.874	0.834	0.811
UNITED BANK OF INDIA	1	1	0.969	0.944	1	0.847	0.938	0.940	1	1	0.848	1
VIJAYA BANK	0.923	1	0.999	0.906	0.982	0.944	0.968	0.965	1	0.953	0.907	0.761

**Source: Own calculations*

Continued on the following page

A-4.4.4: Table 4.4: Bank-wise Overall Technical Efficiency Scores (OTE) under CCR Model (continued):

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AXIS BANK	1	1	0.956	0.855	0.853	0.679	0.864	0.883	0.826	0.768	0.745	0.658
CATHOLIC SYRIAN BANK LTD	0.916	1	0.951	0.783	0.880	0.667	0.823	0.916	0.851	0.925	1	1
CITY UNION BANK LIMITED	0.952	1	1	1	1	1	1	0.966	0.976	0.954	0.894	0.763
DCB BANK LIMITED	0.638	0.918	0.775	0.684	0.784	0.548	0.744	0.771	0.803	0.717	0.655	0.593
FEDERAL BANK	0.842	0.956	1	0.994	1	0.908	0.918	0.933	0.863	0.815	0.778	0.728
HDFC BANK	0.895	0.996	0.983	0.833	0.825	0.622	0.831	0.912	0.788	0.734	0.687	0.639
ICICI BANK	0.850	0.912	0.879	0.808	0.687	0.701	0.728	0.751	0.815	0.809	0.736	0.664
INDUSIND BANK	1	1	0.975	0.834	0.742	0.617	0.712	0.809	0.745	0.654	0.647	0.561
JAMMU & KASHMIR BANK LTD	1	1	0.967	0.970	1	1	1	1	1	0.879	0.818	0.767
KARNATAKA BANK LTD	1	1	1	1	1	1	1	1	0.967	0.923	0.968	0.896
KARUR VYSYA BANK	0.886	1	1	1	0.992	0.946	0.958	0.902	0.877	0.804	0.786	0.734
KOTAK MAHINDRA BANK LTD	0.596	0.820	0.830	0.753	0.739	0.508	0.703	0.809	0.728	0.680	0.660	0.556
LAKSHMI VILAS BANK	0.940	0.981	0.942	0.927	0.902	0.743	0.906	0.910	0.896	0.905	0.842	0.771
NAINITAL BANK	0.747	0.786	0.972	0.833	1	1	1	1	1	1	0.803	0.981
RBL	0.847	1	0.939	0.868	1	0.998	0.815	0.862	0.758	0.754	0.778	0.643
SOUTH INDIAN BANK	1	1	1	0.933	1	1	1	0.951	0.957	0.844	0.808	0.920
TAMILNAD MERCANTILE BANK LTD	1	1	1	1	1	1	1	1	1	1	1	1
DHANLAXMI BANK	0.839	0.939	0.842	1	0.827	0.622	0.696	0.799	0.704	0.692	0.657	0.898
YES BANK LTD.	0.863	0.947	0.912	0.844	0.896	1	0.899	0.872	0.872	0.840	0.759	0.705

**Source: Own calculations*

Continued on the following page

A-4.4.4: Table 4.4: Bank-wise Overall Technical Efficiency Scores (OTE) under CCR Model (continued):

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AB BANK LIMITED	1	1	1	1	0.589	0.421	1	1	1	0.701	0.575	0.853
ABU DHABI COMMERCIAL BANK	0.366	0.504	1	1	1	0.391	0.465	0.418	1	1	1	1
BANK OF AMERICA N.A.	1	1	1	0.950	1	1	0.924	0.911	0.945	1	1	1
BANK OF BAHRAIN & KUWAIT B.S.C.	0.706	0.898	0.864	0.862	0.868	0.604	0.807	0.953	1	0.967	1	0.818
BANK OF CEYLON	1	1	0.762	0.892	1	0.898	1	1	1	1	1	1
BANK OF NOVA SCOTIA	1	1	1	1	1	1	1	1	1	1	1	1
BARCLAYS BANK PLC	1	1	1	1	0.873	0.878	1	1	1	1	1	1
BNP PARIBAS	0.735	0.936	0.978	0.871	1	0.778	1	1	1	1	1	1
CITIBANK N.A.	0.826	0.771	0.901	0.740	0.775	0.477	0.721	0.703	0.760	0.898	0.909	1
CREDIT AGRICOLE	1	0.931	1	1	1	1	1	1	1	1	1	1
CTBC BANK	1	1	0.919	1	1	0.769	1	1	0.813	1	0.836	0.851
DBS BANK INDIA LTD.	0.595	0.977	1	1	1	0.860	0.831	0.764	0.848	0.878	0.798	0.811
DEUTSCHE BANK AG	0.570	0.623	0.768	0.837	0.758	0.638	1	0.926	0.899	0.949	0.868	0.808
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	0.777	0.785	0.747	0.885	1	1	1	0.920	0.760	0.785	0.824	0.885
JP MORGAN CHASE BANK N.A.	1	1	1	1	1	1	1	1	1	1	1	1
KRUNG THAI BANK PUBLIC COMPANY LIMITED	1	1	1	0.842	1	0.772	1	1	1	1	1	1
MASHREQ BANK PSC	1	1	1	1	1	1	1	1	1	1	1	1
MIZUHO BANK LTD	1	1	1	1	0.957	1	1	1	1	1	1	0.883
MUFG BANK, LTD.	0.948	1	1	1	1	1	0.970	0.846	0.858	1	0.916	0.893
PT BANK MAYBANK INDONESIA TBK	0.641	0.532	1	1	1	0.000	0.000	0.000	1	1	1	1
SBM BANK (INDIA) LTD	1	0.688	1	0.967	0.988	1	1	1	1	1	1	1
SHINHAN BANK	0.613	0.650	0.973	1	1	0.772	1	1	1	1	1	1
SOCIETE GENERALE	0.968	0.752	0.993	0.931	1	0.994	0.996	0.911	1	1	0.853	0.833
SONALI BANK	0.600	0.472	0.716	0.390	0.749	0.302	1	0.957	0.912	0.247	0.288	0.363
STANDARD CHARTERED BANK	0.613	0.928	0.813	0.728	0.731	0.501	0.841	0.819	0.855	0.798	0.760	0.652
NatWest Markets Plc	0.748	0.861	0.849	0.829	0.756	0.691	0.690	0.790	1	0.937	1	1

**Source: Own calculations*

A-4.4.5: Table 4.5: Bank-wise Pure Technical Efficiency Scores (PTE) under BCC Model:

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
STATE BANK OF BIKANER & JAIPUR	0.879	0.967	1	0.989	0.962	0.918	1	0.978	1	1	0.981	0.853
STATE BANK OF HYDERABAD	0.968	1	1	0.990	1	0.972	0.979	0.994	1	0.975	1	0.798
STATE BANK OF INDIA	0.846	0.928	0.934	0.921	0.830	0.787	0.834	0.856	0.898	0.861	0.821	0.808
STATE BANK OF MYSORE	0.844	0.974	1	0.925	0.942	0.820	0.881	0.919	0.945	0.909	0.865	0.694
STATE BANK OF PATIALA	1	1	1	1	1	0.934	0.929	0.966	0.942	0.976	0.931	0.808
STATE BANK OF TRAVANCORE	0.984	1	1	1	0.963	0.936	0.932	0.967	0.958	0.910	1	0.832
ALLAHABAD BANK	1	1	1	0.988	0.984	0.945	0.968	0.973	0.957	1	0.949	0.950
ANDHRA BANK	1	1	1	0.981	0.940	1	1	1	1	1	1	1
BANK OF BARODA	0.808	0.940	0.946	0.930	0.974	0.973	1	1	1	1	0.863	0.889
BANK OF INDIA	0.849	0.907	0.991	0.939	0.873	0.863	0.938	0.963	1	0.939	0.780	0.879
BANK OF MAHARASHTRA	1	1	1	0.943	0.903	0.829	0.950	0.952	0.977	0.963	0.939	0.871
CANARA BANK	1	1	1	0.947	1	0.946	0.989	0.942	0.959	0.918	0.907	0.930
CENTRAL BANK OF INDIA	1	0.987	0.970	1	1	0.818	0.955	0.959	0.955	0.962	0.867	0.787
CORPORATION BANK	0.926	0.942	0.979	1	1	1	1	1	1	1	1	1
DENA BANK	1	0.951	0.948	0.946	0.946	1	1	1	0.992	0.956	0.887	0.894
IDBI BANK LIMITED	1	1	0.944	1	1	1	1	1	1	1	0.990	0.842
INDIAN BANK	0.872	1	0.925	0.954	1	0.937	0.989	0.996	1	1	1	0.967
INDIAN OVERSEAS BANK	0.947	0.957	0.930	0.880	0.834	0.873	0.900	0.907	0.944	0.927	0.844	0.823
ORIENTAL BANK OF COMMERCE	1	1	1	1	1	1	1	1	1	1	0.970	1
PUNJAB AND SIND BANK	1	0.926	0.899	0.916	0.980	0.970	0.986	1	1	1	1	1
PUNJAB NATIONAL BANK	0.819	0.968	0.946	0.925	0.889	0.835	0.911	0.908	0.899	0.890	0.856	0.977
SYNDICATE BANK	0.933	0.953	0.951	0.960	0.905	0.950	0.946	0.981	1	1	0.901	0.933
UCO BANK	0.910	0.964	0.945	0.961	1	1	1	1	1	1	1	1
UNION BANK OF INDIA	0.959	0.994	0.992	0.926	0.962	0.853	0.945	0.930	0.936	0.930	0.901	0.971
UNITED BANK OF INDIA	1	1	0.987	0.962	1	0.961	1	0.995	1	1	0.942	1
VIJAYA BANK	0.944	1	1	0.929	0.987	0.989	1	0.982	1	0.985	0.964	0.950

**Source: Own calculations*

Continued on the following page

A-4.4.5: Table 4.5: Bank-wise Pure Technical Efficiency Scores (PTE) under BCC Model (continued):

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AXIS BANK	1	1	1	0.912	0.868	0.690	0.866	0.889	0.829	0.801	0.787	0.741
CATHOLIC SYRIAN BANK LTD	1	1	1	0.937	0.912	0.848	1	1	1	1	1	1
CITY UNION BANK LIMITED	1	1	1	1	1	1	1	1	1	1	1	1
DCB BANK LIMITED	0.649	0.927	0.794	0.701	0.789	0.620	0.798	0.797	0.863	0.821	0.798	0.800
FEDERAL BANK	0.895	0.957	1	1	1	0.935	0.982	0.989	0.990	0.944	0.914	0.912
HDFC BANK	1	1	1	0.910	0.835	0.625	0.836	0.914	0.802	0.775	0.752	0.735
ICICI BANK	0.904	1	0.901	0.811	0.689	0.756	0.783	0.770	0.849	0.879	0.813	0.782
INDUSIND BANK	1	1	1	0.867	0.742	0.645	0.720	0.811	0.774	0.737	0.742	0.698
JAMMU & KASHMIR BANK LTD	1	1	0.967	0.983	1	1	1	1	1	0.883	0.838	0.800
KARNATAKA BANK LTD	1	1	1	1	1	1	1	1	0.968	0.926	0.984	0.902
KARUR VYSYA BANK	0.934	1	1	1	0.997	0.955	0.971	0.934	0.911	0.894	0.872	0.871
KOTAK MAHINDRA BANK LTD	0.606	0.833	0.831	0.762	0.742	0.563	0.729	0.813	0.772	0.748	0.726	0.681
LAKSHMI VILAS BANK	1	1	1	1	0.916	0.912	0.968	0.945	0.978	0.987	1	0.968
NAINITAL BANK	1	1	1	1	1	1	1	1	1	1	1	1
RBL	1	1	1	1	1	1	0.904	0.896	0.847	0.855	0.833	0.723
SOUTH INDIAN BANK	1	1	1	1	1	1	1	0.977	0.999	0.935	0.922	0.987
TAMILNAD MERCANTILE BANK LTD	1	1	1	1	1	1	1	1	1	1	1	1
DHANLAXMI BANK	1	1	0.993	1	0.834	0.743	0.826	0.905	0.875	0.897	0.920	0.911
YES BANK LTD.	0.879	1	1	0.879	0.898	1	0.905	0.885	0.880	0.868	0.824	0.791

**Source: Own calculations*

Continued on the following page

A-4.4.5: Table 4.5: Bank-wise Pure Technical Efficiency Scores (PTE) under BCC Model (continued):

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AB BANK LIMITED	1	1	1	1	0.589	0.421	1	1	1	0.795	0.655	1
ABU DHABI COMMERCIAL BANK	0.462	0.583	1	1	1	0.408	0.473	0.453	1	1	1	1
BANK OF AMERICA N.A.	1	1	1	0.950	1	1	0.924	0.919	0.966	1	1	1
BANK OF BAHRAIN & KUWAIT B.S.C.	0.943	1	1	1	0.951	0.609	0.860	1	1	0.970	1	0.821
BANK OF CEYLON	1	1	0.771	0.899	1	0.937	1	1	1	1	1	1
BANK OF NOVA SCOTIA	1	1	1	1	1	1	1	1	1	1	1	1
BARCLAYS BANK PLC	1	1	1	1	1	0.878	1	1	1	1	1	1
BNP PARIBAS	0.750	0.949	0.983	0.885	1	0.785	1	1	1	1	1	1
CITIBANK N.A.	1	1	0.953	0.742	0.827	0.478	0.728	0.784	0.787	1	1	1
CREDIT AGRICOLE	1	1	1	1	1	1	1	1	1	1	1	1
CTBC BANK	1	1	0.939	1	1	0.771	1	1	0.858	1	0.868	0.859
DBS BANK INDIA LTD.	0.602	1	1	1	1	0.860	0.838	0.770	0.874	0.879	0.799	1
DEUTSCHE BANK AG	0.614	0.662	0.788	0.840	0.792	0.641	1	1	1	1	0.992	1
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	1	1	0.797	1	1	1	1	1	0.823	0.840	0.868	0.924
JP MORGAN CHASE BANK N.A.	1	1	1	1	1	1	1	1	1	1	1	1
KRUNG THAI BANK PUBLIC COMPANY LIMITED	1	1	1	1	1	0.925	1	1	1	1	1	1
MASHREQ BANK PSC	1	1	1	1	1	1	1	1	1	1	1	1
MIZUHO BANK LTD	1	1	1	1	1	1	1	1	1	1	1	1
MUFG BANK, LTD.	0.967	1	1	1	1	1	1	0.848	0.882	1	0.917	1
PT BANK MAYBANK INDONESIA TBK	0.708	1	1	1	1	1	1	1	1	1	1	1
SBM BANK (INDIA) LTD	1	0.771	1	1	1	1	1	1	1	1	1	1
SHINHAN BANK	0.688	0.674	0.992	1	1	0.776	1	1	1	1	1	1
SOCIETE GENERALE	0.972	0.753	0.993	0.988	1	0.994	0.996	0.929	1	1	0.859	0.851
SONALI BANK	1	1	1	0.401	0.749	0.401	1	1	1	1	1	1
STANDARD CHARTERED BANK	0.634	1	0.851	0.781	0.804	0.504	0.915	1	0.941	0.993	0.900	0.748
NatWest Markets Plc	0.892	1	0.865	0.878	0.878	0.706	0.696	0.801	1	1	1	1

**Source: Own calculations*

A-4.4.6.: Table 4.6: Frequency distributions and Mean efficiency scores of Indian banking industry:

2005-06					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0.3<= E <0.4	1	1.4	0.4<= E <0.5	1	1.4
0.4<= E <0.5	0	0	0.5<= E <0.6	0	0
0.5<= E <0.6	3	4.2	0.6<= E <0.7	6	8.5
0.6<= E <0.7	5	7	0.7<= E <0.8	2	2.8
0.7<= E <0.8	8	11.3	0.8<= E <0.9	10	14.1
0.8<= E <0.9	14	19.7	0.9<= E <1	13	18.3
0.9<= E <1	14	19.7	E ==1	39	54.9
E ==1	26	36.6			
Mean		**0.878**	**Mean**		**0.924**

2006-07					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0.4<= E <0.5	1	1.4	0.5<= E <0.6	1	1.4
0.5<= E <0.6	2	2.8	0.6<= E <0.7	2	2.8
0.6<= E <0.7	3	4.2	0.7<= E <0.8	2	2.8
0.7<= E <0.8	4	5.6	0.8<= E <0.9	1	1.4
0.8<= E <0.9	4	5.6	0.9<= E <1	17	23.9
0.9<= E <1	25	35.2	E ==1	48	67.6
E ==1	32	45.1			
Mean		**0.926**	**Mean**		**0.964**

2007-08				
OTE			PTE	
Eff Range	Banks	Percentage	Banks	Percentage
0.7<= E <0.8	5	7	4	5.6
0.8<= E <0.9	7	9.9	4	5.6
0.9<= E <1	31	43.7	22	31
E ==1	28	39.4	41	57.7
Mean		**0.948**	**Mean**	**0.968**

2008-09					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0.3<= E <0.4	1	1.4	0.4<= E <0.5	1	1.4
0.4<= E <0.5	0	0	0.5<= E <0.6	0	0
0.5<= E <0.6	0	0	0.6<= E <0.7	0	0
0.6<= E <0.7	1	1.4	0.7<= E <0.8	4	5.6
0.7<= E <0.8	4	5.6	0.8<= E <0.9	8	11.3
0.8<= E <0.9	16	22.5	0.9<= E <1	26	36.6
0.9<= E <1	25	35.2	E ==1	32	45.1
E ==1	24	33.8			
Mean		**0.919**	**Mean**		**0.944**

**Source: Own calculations*

Continued on the following page

A-4.4.6: Table 4.6: Frequency distribution and Mean efficiency scores of Indian banking industry (continued):

2009-10				
OTE			PTE	
Eff Range	Banks	Percentage	Banks	Percentage
0.5<= E <0.6	1	1.4	1	1.4
0.6<= E <0.7	1	1.4	1	1.4
0.7<= E <0.8	8	11.3	5	7
0.8<= E <0.9	14	19.7	11	15.5
0.9<= E <1	15	21.1	16	22.5
E ==1	32	45.1	37	52.1
Mean		**0.927**	**Mean**	**0.939**

2010-11					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0<= E <0.1	1	1.4	0.4<= E <0.5	4	5.6
0.1<= E <0.2	0	0	0.5<= E <0.6	2	2.8
0.2<= E <0.3	0	0	0.6<= E <0.7	6	8.5
0.3<= E <0.4	2	2.8	0.7<= E <0.8	7	9.9
0.4<= E <0.5	2	2.8	0.8<= E <0.9	10	14.1
0.5<= E <0.6	3	4.2	0.9<= E <1	18	25.4
0.6<= E <0.7	9	12.7	E ==1	24	33.8
0.7<= E <0.8	11	15.5			
0.8<= E <0.9	9	12.7			
0.9<= E <1	14	19.7			
E ==1	20	28.2			
Mean		**0.8201**	**Mean**		**0.866**

2011-12					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0<= E <0.1	1	1.4	0.4<= E <0.5	1	1.4
0.1<= E <0.2	0	0	0.5<= E <0.6	0	0
0.2<= E <0.3	0	0	0.6<= E <0.7	1	1.4
0.3<= E <0.4	0	0	0.7<= E <0.8	5	7
0.4<= E <0.5	1	1.4	0.8<= E <0.9	8	11.3
0.5<= E <0.6	0	0	0.9<= E <1	21	29.6
0.6<= E <0.7	2	2.8	E ==1	35	49.3
0.7<= E <0.8	5	7			
0.8<= E <0.9	15	21.1			
0.9<= E <1	17	23.9			
E ==1	30	42.3			
Mean		**0.906**	**Mean**		**0.940**

2012-13					
OTE			PTE		
Eff Range	Banks	Percentage	Eff Range	Banks	Percentage
0<= E <0.1	1	1.4	0.4<= E <0.5	1	1.4
0.1<= E <0.2	0	0	0.5<= E <0.6	0	0
0.2<= E <0.3	0	0	0.6<= E <0.7	0	0
0.3<= E <0.4	0	0	0.7<= E <0.8	4	5.6
0.4<= E <0.5	1	1.4	0.8<= E <0.9	8	11.3
0.5<= E <0.6	0	0	0.9<= E <1	25	35.2
0.6<= E <0.7	0	0	E ==1	33	46.5
0.7<= E <0.8	6	8.5			
0.8<= E <0.9	12	16.9			
0.9<= E <1	27	38			
E ==1	24	33.8			
Mean		**0.911**	**Mean**		**0.946**

**Source: Own calculations*

Continued on the following page

A-4.4.6: Table 4.6: Frequency distribution and Mean efficiency scores of Indian banking industry (continued):

2013-14				
OTE			**PTE**	
Eff Range	**Banks**	**Percentage**	**Banks**	**Percentage**
0.7<= E <0.8	7	9.9	3	4.2
0.8<= E <0.9	17	23.9	13	18.3
0.9<= E <1	16	22.5	17	23.9
E ==1	31	43.7	38	53.5
Mean		**0.929**	**Mean**	**0.955**

2014-15					
OTE			**PTE**		
Eff Range	**Banks**	**Percentage**	**Eff Range**	**Banks**	**Percentage**
0.2<= E <0.3	1	1.4	0.7<= E <0.8	4	5.6
0.3<= E <0.4	0	0	0.8<= E <0.9	12	16.9
0.4<= E <0.5	0	0	0.9<= E <1	18	25.4
0.5<= E <0.6	0	0	E ==1	37	52.1
0.6<= E <0.7	3	4.2			
0.7<= E <0.8	8	11.3			
0.8<= E <0.9	19	26.8			
0.9<= E <1	15	21.1			
E ==1	25	35.2			
Mean		**0.897**	**Mean**		**0.951**

2015-16					
OTE			**PTE**		
Eff Range	**Banks**	**Percentage**	**Eff Range**	**Banks**	**Percentage**
0.2<= E <0.3	1	1.4	0.6<= E <0.7	1	1.4
0.3<= E <0.4	0	0	0.7<= E <0.8	7	9.9
0.4<= E <0.5	0	0	0.8<= E <0.9	15	21.1
0.5<= E <0.6	1	1.4	0.9<= E <1	18	25.4
0.6<= E <0.7	5	7	E ==1	30	42.3
0.7<= E <0.8	15	21.1			
0.8<= E <0.9	18	25.4			
0.9<= E <1	8	11.3			
E ==1	23	32.4			
Mean		**0.862**	**Mean**		**0.926**

2016-17					
OTE			**PTE**		
Eff Range	**Banks**	**Percentage**	**Eff Range**	**Banks**	**Percentage**
0.3<= E <0.4	1	1.4	0.6<= E <0.7	3	4.2
0.4<= E <0.5	0	0	0.7<= E <0.8	9	12.7
0.5<= E <0.6	3	4.2	0.8<= E <0.9	15	21.1
0.6<= E <0.7	9	12.7	0.9<= E <1	13	18.3
0.7<= E <0.8	15	21.1	E ==1	31	43.7
0.8<= E <0.9	20	28.2			
0.9<= E <1	3	4.2			
E ==1	20	28.2			
Mean		**0.830**	**Mean**		**0.915**

**Source: Own calculation*

A-4.4.7. a: Table 4.7.a: Ownership wise number of Efficient banks (based on PTE):

YEARS	Public Banks			Private Banks			Foreign Banks		
	Number of Banks	Percentage	Rank	Number of Banks	Percentage	Rank	Number of Banks	Percentage	Rank
2005-06	11	28.21	3	13	33.33	2	15	38.46	1
2006-07	12	25.00	2	16	33.33	3	20	41.67	1
2007-08	11	26.83	3	14	34.15	2	16	39.02	1
2008-09	6	18.75	3	10	31.25	2	16	50.00	1
2009-10	10	27.03	2	8	21.62	3	19	51.35	1
2010-11	6	25.00	3	8	33.33	2	10	41.67	1
2011-12	10	28.57	2	7	21.21	3	18	54.55	1
2012-13	8	24.24	2	6	18.18	3	19	57.58	1
2013-14	14	36.84	2	5	13.16	3	19	50.00	1
2014-15	12	32.43	2	4	10.81	3	21	56.76	1
2015-16	7	23.33	2	5	16.67	3	18	60.00	1
2016-17	6	19.35	2	4	12.90	3	21	67.74	1

**Source: Own calculations*

A-4.4.7. b: Table 4.7.b: Ownership wise number of Efficient banks (based on OTE):

YEARS	Public Banks			Private Banks			Foreign Banks		
	Number of Banks	Percentage	Rank	Number of Banks	Percentage	Rank	Number of Banks	Percentage	Rank
2005-06	8	30.77	2	6	23.08	3	12	46.15	1
2006-07	11	34.38	1	10	31.25	2	11	34.38	1
2007-08	8	28.57	2	6	21.43	3	14	50.00	1
2008-09	6	25.00	2	5	20.83	3	13	54.17	1
2009-10	8	25.00	2	8	25.00	2	16	50.00	1
2010-11	4	20.00	3	7	35.00	2	9	45.00	1
2011-12	8	26.67	2	6	20.00	3	16	53.33	1
2012-13	7	29.17	2	4	16.67	3	13	54.17	1
2013-14	11	35.48	2	3	9.68	3	17	54.84	1
2014-15	6	24.00	2	2	8.00	3	17	68.00	1
2015-16	5	21.74	2	2	8.70	3	16	69.57	1
2016-17	3	15.00	2	2	10.00	3	15	75.00	1

**Source: Own calculations*

A-4.4.8: Table 4.8: Measuring Capital component for Public Banks:

Bank Name	CRAR	Rank	Debt-Equity ratio	Rank	Average Rank
STATE BANK OF BIKANER & JAIPUR	12.12166667	16	17.40013256	17	16.5
STATE BANK OF HYDERABAD	12.48	8	16.70394093	12	10
STATE BANK OF INDIA	12.9025	3	14.00762006	3	3
STATE BANK OF MYSORE	12.11833333	17	16.36415862	11	14
STATE BANK OF PATIALA	12.23333333	13	16.83870495	14	13.5
STATE BANK OF TRAVANCORE	12.2825	11	20.44922858	24	17.5
ALLAHABAD BANK	12.02583333	19	15.48569201	7	13
ANDHRA BANK	12.39833333	9	16.07325162	10	9.5
BANK OF BARODA	13.3	1	15.3455123	6	3.5
BANK OF INDIA	11.70666667	24	17.89630864	18	21
BANK OF MAHARASHTRA	11.87416667	21	18.97518072	23	22
CANARA BANK	12.68083333	4	15.54192587	8	6
CENTRAL BANK OF INDIA	11.15083333	26	18.26450355	21	23.5
CORPORATION BANK	12.65083333	5	16.88545429	16	10.5
DENA BANK	11.54	25	17.98164646	19	22
IDBI BANK LIMITED	12.54333333	6	14.04423766	4	5
INDIAN BANK	13.2675	2	12.00905037	1	1.5
INDIAN OVERSEAS BANK	12.24916667	12	16.71464991	13	12.5
ORIENTAL BANK OF COMMERCE	12.16416667	14	13.87500231	2	8
PUNJAB AND SIND BANK	12.34	10	15.89161418	9	9.5
PUNJAB NATIONAL BANK	12.5275	7	14.59848821	5	6
SYNDICATE BANK	11.97333333	20	21.06676669	25	22.5
UCO BANK	12.03833333	18	21.47976165	26	22
UNION BANK OF INDIA	11.84333333	22	16.86953032	15	18.5
UNITED BANK OF INDIA	11.78833333	23	17.99820016	20	21.5
VIJAYA BANK	12.13166667	15	18.6415812	22	18.5

**Source: Own calculations*

A-4.4.9: Table 4.9: Measuring Capital component for Private Banks:

Bank Name	CRAR	Rank	Debt-Equity ratio	Rank	Average Rank
AXIS BANK	14.215	9	11.19653556	9	9
CATHOLIC SYRIAN BANK LTD	11.20416667	18	17.63989948	18	18
CITY UNION BANK LIMITED	13.815	11	11.55055912	13	12
DCB BANK LIMITED	13.44416667	13	10.54660634	7	10
FEDERAL BANK	16.10833333	5	10.08789858	6	5.5
HDFC BANK	15.30833333	6	9.251682963	4	5
ICICI BANK	16.62416667	3	7.050979033	2	2.5
INDUSIND BANK	13.725	12	11.52935062	11	11.5
JAMMU & KASHMIR BANK LTD	13.1425	15	12.68662376	14	14.5
KARNATAKA BANK LTD	12.59666667	16	12.74518444	15	15.5
KARUR VYSYA BANK	13.86333333	10	11.53515261	12	11
KOTAK MAHINDRA BANK LTD	17.02833333	2	6.922593564	1	1.5
LAKSHMI VILAS BANK	11.91333333	17	14.79863888	16	16.5
NAINITAL BANK	14.3425	8	10.65143699	8	8
RBL	26.815	1	7.230874936	3	2
SOUTH INDIAN BANK	13.21583333	14	15.2128906	17	15.5
TAMILNAD MERCANTILE BANK LTD	15.26	7	9.685141437	5	6
DHANLAXMI BANK	10.45666667	19	18.10326086	19	19
YES BANK LTD.	16.41666667	4	11.27725088	10	7

**Source: Own calculations*

A-4.4.10: Table 4.10: Measuring Capital component for Foreign Banks:

Bank Name	CRAR	Rank	Debt-Equity ratio	Rank	Average Rank
AB BANK LIMITED	42.89666667	9	1.002924416	3	6
ABU DHABI COMMERCIAL BANK	42.9625	8	5.557319823	22	15
BANK OF AMERICA N.A.	16.2475	20	2.719574933	11	15.5
BANK OF BAHRAIN & KUWAIT B.S.C.	47.4325	6	3.931065502	15	10.5
BANK OF CEYLON	54.39083333	4	1.038984022	4	4
BANK OF NOVA SCOTIA	16.99416667	19	6.310453807	24	21.5
BARCLAYS BANK PLC	17.93583333	18	2.408910886	8	13
BNP PARIBAS	12.8875	25	4.47594639	16	20.5
CITIBANK N.A.	15.015	23	5.985452747	23	23
CREDIT AGRICOLE	15.17416667	22	3.026546555	13	17.5
CTBC BANK	37.51916667	12	1.725643184	6	9
DBS BANK INDIA LTD.	18.30666667	17	7.657649328	26	21.5
DEUTSCHE BANK AG	14.40916667	24	4.505866486	17	20.5
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	15.31	21	5.469079928	21	21
JP MORGAN CHASE BANK N.A.	19.63166667	16	3.092920109	14	15
KRUNG THAI BANK PUBLIC COMPANY LIMITED	72.91666667	2	3.00988232	12	7
MASHREQ BANK PSC	63.83583333	3	0.792787846	2	2.5
MIZUHO BANK LTD	43.7275	7	1.416155497	5	6
MUFG BANK, LTD.	37.63833333	11	2.509881308	9	10
PT BANK MAYBANK INDONESIA TBK	285.5575	1	0.172623215	1	1
SBM BANK (INDIA) LTD	40.76416667	10	2.185745111	7	8.5
SHINHAN BANK	49.10416667	5	2.623016759	10	7.5
SOCIETE GENERALE	27.35333333	14	4.620155729	18	16
SONALI BANK	29.42916667	13	5.066569883	20	16.5
STANDARD CHARTERED BANK	11.905	26	4.963355265	19	22.5
NatWest Markets Plc	23.8895	15	7.52365278	25	20

**Source: Own calculations*

A-4.4.11: Table 4.11: Measuring Asset Quality component for Public Banks:

Bank Name	NNPA to Net Advances	Rank	NNPA to Total Asset	Rank	Average Rank
STATE BANK OF BIKANER & JAIPUR	2.360833333	13	0.014674285	13	13
STATE BANK OF HYDERABAD	2.251666667	10	0.012945993	8	9
STATE BANK OF INDIA	2.2075	8	0.013486847	9	8.5
STATE BANK OF MYSORE	2.971666667	22	0.015687113	16	19
STATE BANK OF PATIALA	2.895833333	19	0.017641431	22	20.5
STATE BANK OF TRAVANCORE	2.230833333	9	0.012030946	5	7
ALLAHABAD BANK	2.739166667	17	0.017238649	20	18.5
ANDHRA BANK	1.905833333	5	0.0122492	6	5.5
BANK OF BARODA	1.495833333	1	0.008637261	1	1
BANK OF INDIA	2.433333333	14	0.014909687	14	14
BANK OF MAHARASHTRA	2.795833333	18	0.017342003	21	19.5
CANARA BANK	2.264166667	12	0.013540222	10	11
CENTRAL BANK OF INDIA	3.269166667	23	0.017969291	23	23
CORPORATION BANK	2.0675	6	0.012281863	7	6.5
DENA BANK	2.9225	21	0.017202468	19	20
IDBI BANK LIMITED	2.914166667	20	0.016647113	18	19
INDIAN BANK	1.605	2	0.009933346	2	2
INDIAN OVERSEAS BANK	3.7875	25	0.022614549	26	25.5
ORIENTAL BANK OF COMMERCE	2.564166667	16	0.015897575	17	16.5
PUNJAB AND SIND BANK	2.256666667	11	0.013622857	12	11.5
PUNJAB NATIONAL BANK	2.536666667	15	0.015525826	15	15
SYNDICATE BANK	1.689166667	3	0.01108013	4	3.5
UCO BANK	3.354166667	24	0.019201469	24	24
UNION BANK OF INDIA	2.1	7	0.013551424	11	9
UNITED BANK OF INDIA	3.861666667	26	0.020144805	25	25.5
VIJAYA BANK	1.783333333	4	0.010716988	3	3.5

**Source: Own calculations*

A-4.4.12: Table 4.12: Measuring Asset Quality component for Private Banks:

Bank Name	NNPA to Net Advances	Rank	NNPA to Total Assets	Rank	Average Rank
AXIS BANK	0.645833333	5	0.003733946	5	5
CATHOLIC SYRIAN BANK LTD	2.523333333	19	0.01401842	19	19
CITY UNION BANK LIMITED	1.086666667	11	0.006946097	11	11
DCB BANK LIMITED	1.6275	14	0.009096076	14	14
FEDERAL BANK	0.741666667	6	0.004512132	7	6.5
HDFC BANK	0.331666667	3	0.001845755	3	3
ICICI BANK	1.758333333	16	0.010087337	16	16
INDUSIND BANK	0.893333333	9	0.004986028	8	8.5
JAMMU & KASHMIR BANK LTD	1.453333333	13	0.008661209	13	13
KARNATAKA BANK LTD	1.649166667	15	0.009461012	15	15
KARUR VYSYA BANK	0.561666667	4	0.003651841	4	4
KOTAK MAHINDRA BANK LTD	1.200833333	12	0.006992506	12	12
LAKSHMI VILAS BANK	1.9725	17	0.012396235	18	17.5
NAINITAL BANK	0.191666667	2	0.000807412	1	1.5
RBL	0.804166667	7	0.004046306	6	6.5
SOUTH INDIAN BANK	1.01	10	0.006271105	10	10
TAMILNAD MERCANTILE BANK LTD	0.834166667	8	0.005031664	9	8.5
DHANLAXMI BANK	1.995	18	0.010984	17	17.5
YES BANK LTD.	0.153333333	1	0.000892144	2	1.5

**Source: Own calculations*

A-4.4.13: Table 4.13: Measuring Asset Quality component for Foreign Banks:

Bank Name	NNPA to Net Advances	Rank	NNPA to Total Asset	Rank	Average Rank
AB BANK LIMITED	4.543333333	25	0.012781101	24	24.5
ABU DHABI COMMERCIAL BANK	1.709166667	18	0.003284427	13	15.5
BANK OF AMERICA N.A.	0.009166667	6	0.000029166	6	6
BANK OF BAHRAIN & KUWAIT B.S.C.	1.975	19	0.011626407	23	21
BANK OF CEYLON	3.559166667	24	0.009340998	22	23
BANK OF NOVA SCOTIA	0.718333333	12	0.003512596	14	13
BARCLAYS BANK PLC	1.363333333	17	0.005324991	18	17.5
BNP PARIBAS	0.0775	8	0.00029994	7	7.5
CITIBANK N.A.	1.178333333	15	0.004831331	17	16
CREDIT AGRICOLE	1.205	16	0.004173625	15	15.5
CTBC BANK	2.315	21	0.015883063	25	23
DBS BANK INDIA LTD.	2.14	20	0.007897468	21	20.5
DEUTSCHE BANK AG	0.313333333	9	0.001392496	10	9.5
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	0.729166667	13	0.002353032	11	12
JP MORGAN CHASE BANK N.A.	0.703333333	11	0.000898132	9	10
KRUNG THAI BANK PUBLIC COMPANY LIMITED	0	1	0	1	1
MASHREQ BANK PSC	0	1	0	1	1
MIZUHO BANK LTD	0.356666667	10	0.002477173	12	11
MUFG BANK, LTD.	0.066666667	7	0.000402775	8	7.5
PT BANK MAYBANK INDONESIA TBK	0	1	0	1	1
SBM BANK (INDIA) LTD	3.443333333	23	0.016034715	26	24.5
SHINHAN BANK	0	1	0	1	1
SOCIETE GENERALE	0	1	0	1	1
SONALI BANK	2.460833333	22	0.005545024	20	21
STANDARD CHARTERED BANK	0.954166667	14	0.004614931	16	15
NatWest Markets Plc	8.891666667	26	0.00533212	19	22.5

**Source: Own calculations*

A-4.4.14: Table 4.14: Measuring Management Quality component for Public Banks:

Bank Name	Net profit to Net worth	Rank	Profit per Employee	Rank	Average Rank
STATE BANK OF BIKANER & JAIPUR	13.97594862	6	3.170833333	17	11.5
STATE BANK OF HYDERABAD	15.113156	1	4.24	11	6
STATE BANK OF INDIA	13.25670382	8	4.48	9	8.5
STATE BANK OF MYSORE	10.3603811	18	1.543333333	21	19.5
STATE BANK OF PATIALA	7.017544853	23	0.65	25	24
STATE BANK OF TRAVANCORE	12.86801988	11	2.325	20	15.5
ALLAHABAD BANK	12.65342362	12	3.749166667	13	12.5
ANDHRA BANK	14.86769727	2	4.975833333	6	4
BANK OF BARODA	12.60329711	13	5.483333333	4	8.5
BANK OF INDIA	10.88449455	16	2.901666667	18	17
BANK OF MAHARASHTRA	8.4189631	19	1.465833333	22	20.5
CANARA BANK	12.93590971	10	4.516666667	8	9
CENTRAL BANK OF INDIA	4.65642485	25	0.414166667	26	25.5
CORPORATION BANK	13.13896702	9	5.841666667	2	5.5
DENA BANK	10.63036287	17	2.871666667	19	18
IDBI BANK LIMITED	4.563800908	26	3.890833333	12	19
INDIAN BANK	14.83536817	3	6.128333333	1	2
INDIAN OVERSEAS BANK	8.397284688	20	0.8375	24	22
ORIENTAL BANK OF COMMERCE	8.352963734	21	4.7175	7	14
PUNJAB AND SIND BANK	12.18509093	14	3.726666667	14	14
PUNJAB NATIONAL BANK	13.83801308	7	4.3825	10	8.5
SYNDICATE BANK	14.20369137	5	3.3475	16	10.5
UCO BANK	8.003491843	22	1.274166667	23	22.5
UNION BANK OF INDIA	14.2617778	4	5.170833333	5	4.5
UNITED BANK OF INDIA	5.294000923	24	5.760833333	3	13.5
VIJAYA BANK	11.02167918	15	3.718333333	15	15

**Source: Own calculations*

A-4.4.15: Table 4.15: Measuring Management Quality component for Private Banks:

Bank Name	Net profit to Net worth	Rank	Profit per Employee	Rank	Average Rank
AXIS BANK	17.66866492	4	12.19583333	2	3
CATHOLIC SYRIAN BANK LTD	2.413027672	17	0.021666667	18	17.5
CITY UNION BANK LIMITED	20.2292725	1	7.168333333	7	4
DCB BANK LIMITED	0.662013121	18	1.283333333	17	17.5
FEDERAL BANK	13.53236734	10	6.609166667	10	10
HDFC BANK	18.41871555	3	8.918333333	4	3.5
ICICI BANK	11.59827399	14	11.66666667	3	8.5
INDUSIND BANK	13.6914053	9	6.873333333	9	9
JAMMU & KASHMIR BANK LTD	12.55332831	13	4.833333333	12	12.5
KARNATAKA BANK LTD	13.08242082	11	4.5875	14	12.5
KARUR VYSYA BANK	17.16852728	5	6.986666667	8	6.5
KOTAK MAHINDRA BANK LTD	12.86508312	12	7.273333333	6	9
LAKSHMI VILAS BANK	9.1487851	15	2.633333333	16	15.5
NAINITAL BANK	15.51716299	7	6.166666667	11	9
RBL	6.489687812	16	4.054166667	15	15.5
SOUTH INDIAN BANK	14.4072767	8	4.720833333	13	10.5
TAMILNAD MERCANTILE BANK LTD	16.67883018	6	8.173333333	5	5.5
DHANLAXMI BANK	-3.934148505	19	-1.98	19	19
YES BANK LTD.	20.1411342	2	15.98833333	1	1.5

**Source: Own calculations*

A-4.4.16: Table 4.16: Measuring Management Quality component for Foreign Banks:

Bank Name	Net profit to Net worth	Rank	Profit per Employee	Rank	Average Rank
AB BANK LIMITED	8.819053561	10	19.9875	21	15.5
ABU DHABI COMMERCIAL BANK	7.957587371	14	27.405	16	15
BANK OF AMERICA N.A.	12.13287599	6	125.472500000	2	4
BANK OF BAHRAIN & KUWAIT B.S.C.	5.619221892	20	9.25	23	21.5
BANK OF CEYLON	7.593034227	15	27.92083333	14	14.5
BANK OF NOVA SCOTIA	13.89311766	3	91.25909091	3	3
BARCLAYS BANK PLC	3.039174524	23	69.72833333	6	14.5
BNP PARIBAS	8.74686905	11	50.77416667	9	10
CITIBANK N.A.	15.92663306	2	41.17	12	7
CREDIT AGRICOLE	8.542827481	12	86.25	4	8
CTBC BANK	-0.635295926	26	-6.275	26	26
DBS BANK INDIA LTD.	6.828401148	18	24.07666667	19	18.5
DEUTSCHE BANK AG	11.40989117	8	44.3125	10	9
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	12.21266506	5	27.81166667	15	10
JP MORGAN CHASE BANK N.A.	12.75090893	4	215.12	1	2.5
KRUNG THAI BANK PUBLIC COMPANY LIMITED	7.19584836	16	35.355	13	14.5
MASHREQ BANK PSC	9.462941096	9	73.39	5	7
MIZUHO BANK LTD	4.553445958	22	51.11666667	8	15
MUFG BANK, LTD.	6.254773855	19	55.19916667	7	13
PT BANK MAYBANK INDONESIA TBK	0.821685636	24	15.2275	20	22
SBM BANK (INDIA) LTD	0.267234582	25	-3.75	25	25
SHINHAN BANK	7.049758088	17	42.06583333	11	14
SOCIETE GENERALE	5.314729604	21	27.1575	17	19
SONALI BANK	12.01161094	7	2.464166667	24	15.5
STANDARD CHARTERED BANK	16.32392145	1	25.37	18	9.5
NatWest Markets Plc	8.079810051	13	10.27833333	22	17.5

**Source: Own calculations*

A-4.4.17: Table 4.17: Measuring Earning Quality component for Public Banks:

Bank Name	Interest Income to Total Income	Rank	Changes in Net profit	Rank	Average Rank
STATE BANK OF BIKANER & JAIPUR	0.883881079	17	-5.694739805	9	13
STATE BANK OF HYDERABAD	0.891098951	14	-14.60905963	12	13
STATE BANK OF INDIA	0.851866925	26	10.06398062	4	15
STATE BANK OF MYSORE	0.879964568	20	-47.7826707	22	21
STATE BANK OF PATIALA	0.897518571	9	-4.727634175	8	8.5
STATE BANK OF TRAVANCORE	0.894976932	12	-55.06795033	23	17.5
ALLAHABAD BANK	0.892383877	13	-17.56049773	15	14
ANDHRA BANK	0.896708998	10	0.425892827	6	8
BANK OF BARODA	0.878034774	23	-15.11411032	14	18.5
BANK OF INDIA	0.87835021	22	-21.89749122	18	20
BANK OF MAHARASHTRA	0.916137888	2	-89.60877934	26	14
CANARA BANK	0.887526038	16	-19.22871343	16	16
CENTRAL BANK OF INDIA	0.915716959	3	-34.82901824	21	12
CORPORATION BANK	0.877623405	24	-25.91292649	19	21.5
DENA BANK	0.890914118	15	-14.93157793	13	14
IDBI BANK LIMITED	0.874958495	25	-26.42888455	20	22.5
INDIAN BANK	0.883830549	18	15.52088822	3	10.5
INDIAN OVERSEAS BANK	0.899204882	8	35.14044524	1	4.5
ORIENTAL BANK OF COMMERCE	0.90404683	7	-66.17476443	24	15.5
PUNJAB AND SIND BANK	0.921482266	1	-1.242104256	7	4
PUNJAB NATIONAL BANK	0.879253836	21	-21.74489444	17	19
SYNDICATE BANK	0.908734328	6	-13.89979751	11	8.5
UCO BANK	0.914126916	4	-10.64947543	10	7
UNION BANK OF INDIA	0.89541992	11	2.944970672	5	8
UNITED BANK OF INDIA	0.881289831	19	-68.57733607	25	22
VIJAYA BANK	0.910481027	5	20.37875762	2	3.5

**Source: Own calculations*

A-4.4.18: Table 4.18: Measuring Earning Quality component for Private Banks:

Bank Name	Interest Income to Total Income	Rank	Changes in Net profit	Rank	Average Rank
AXIS BANK	0.795012299	18	27.35868247	9	13.5
CATHOLIC SYRIAN BANK LTD	0.900990984	4	58.85738712	4	4
CITY UNION BANK LIMITED	0.879956779	11	22.42649949	10	10.5
DCB BANK LIMITED	0.849666961	13	9.739544394	16	14.5
FEDERAL BANK	0.885724353	8	28.58612811	8	8
HDFC BANK	0.827494176	15	29.49307042	7	11
ICICI BANK	0.787619518	19	15.1753566	13	16
INDUSIND BANK	0.82726526	16	41.30356325	5	10.5
JAMMU & KASHMIR BANK LTD	0.922710278	2	-24.54664417	17	9.5
KARNATAKA BANK LTD	0.879919101	12	12.44040412	15	13.5
KARUR VYSYA BANK	0.880803964	10	16.81946901	11	10.5
KOTAK MAHINDRA BANK LTD	0.845223624	14	39.80139276	6	10
LAKSHMI VILAS BANK	0.885724682	7	86.68589113	2	4.5
NAINITAL BANK	0.935613444	1	15.49045592	12	6.5
RBL	0.883605643	9	122.1962853	1	5
SOUTH INDIAN BANK	0.91455066	3	63.24896918	3	3
TAMILNAD MERCANTILE BANK LTD	0.888784253	6	14.09630703	14	10
DHANLAXMI BANK	0.899765509	5	-868.2467655	19	12
YES BANK LTD.	0.81449382	17	-87.86947358	18	17.5

**Source: Own calculations*

A-4.4.19: Table 4.19: Measuring Earning Quality component for Foreign Banks:

Bank Name	Interest Income to Total Income	Rank	Changes in Net profit	Rank	Average Rank
AB BANK LIMITED	0.305406074	25	13.22191877	19	22
ABU DHABI COMMERCIAL BANK	0.905463513	2	105.6605552	6	4
BANK OF AMERICA N.A.	0.646637167	23	22.862209307	17	20
BANK OF BAHRAIN & KUWAIT B.S.C.	0.844379224	8	112.6902006	5	6.5
BANK OF CEYLON	0.749100655	17	67.4933019	7	12
BANK OF NOVA SCOTIA	0.765708216	14	-20.75069686	20	17
BARCLAYS BANK PLC	0.728654231	19	-233.8670355	24	21.5
BNP PARIBAS	0.775247257	12	46.46455169	9	10.5
CITIBANK N.A.	0.759421328	15	23.24304384	16	15.5
CREDIT AGRICOLE	0.682699381	21	-44.98762542	22	21.5
CTBC BANK	0.860021896	6	1161.49762	3	4.5
DBS BANK INDIA LTD.	0.89502934	3	-971.0571413	26	14.5
DEUTSCHE BANK AG	0.705945592	20	29.72824422	12	16
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	0.757638424	16	22.82153844	18	17
JP MORGAN CHASE BANK N.A.	0.679260527	22	382.5997363	4	13
KRUNG THAI BANK PUBLIC COMPANY LIMITED	0.876541468	5	1678.002477	1	3
MASHREQ BANK PSC	0.371329984	24	23.38001724	15	19.5
MIZUHO BANK LTD	0.819753419	9	53.328856	8	8.5
MUFG BANK, LTD.	0.786947089	11	1304.826423	2	6.5
PT BANK MAYBANK INDONESIA TBK	0.792957974	10	-36.52477503	21	15.5
SBM BANK (INDIA) LTD	0.908890856	1	-269.0397063	25	13
SHINHAN BANK	0.887677906	4	28.05116158	13	8.5
SOCIETE GENERALE	0.850367655	7	36.66400996	11	9
SONALI BANK	0.275062638	26	40.72460936	10	18
STANDARD CHARTERED BANK	0.735647583	18	26.89944886	14	16
NatWest Markets Plc	0.770730541	13	-90.3900675	23	18

**Source: Own calculations*

A-4.4.20: Table 4.20: Measuring Liquidity component for Public Banks:

Bank Name	Liquid Assets to Deposits	Rank	Liquid Assets to Total Assets	Rank	Average Rank
STATE BANK OF BIKANER & JAIPUR	0.099095573	3	0.083033617	2	2.5
STATE BANK OF HYDERABAD	0.096945033	4	0.081157689	4	4
STATE BANK OF INDIA	0.093562549	6	0.071428461	16	11
STATE BANK OF MYSORE	0.087722296	13	0.074415333	10	11.5
STATE BANK OF PATIALA	0.076959252	21	0.063210995	22	21.5
STATE BANK OF TRAVANCORE	0.085741563	14	0.07330471	13	13.5
ALLAHABAD BANK	0.082082479	18	0.070961243	17	17.5
ANDHRA BANK	0.089120232	11	0.076346068	9	10
BANK OF BARODA	0.103003324	1	0.088292257	1	1
BANK OF INDIA	0.092624244	7	0.078158283	7	7
BANK OF MAHARASHTRA	0.077178869	20	0.066641581	19	19.5
CANARA BANK	0.067790882	26	0.05864557	26	26
CENTRAL BANK OF INDIA	0.094728114	5	0.082892257	3	4
CORPORATION BANK	0.083962757	16	0.070693559	18	17
DENA BANK	0.081384224	19	0.071944106	15	17
IDBI BANK LIMITED	0.102666243	2	0.06084454	23	12.5
INDIAN BANK	0.069280524	25	0.059722057	25	25
INDIAN OVERSEAS BANK	0.08811533	12	0.073410268	12	12
ORIENTAL BANK OF COMMERCE	0.083942371	17	0.072908921	14	15.5
PUNJAB AND SIND BANK	0.076156911	22	0.066043306	20	21
PUNJAB NATIONAL BANK	0.092443556	8	0.077309623	8	8
SYNDICATE BANK	0.09176889	9	0.079488828	6	7.5
UCO BANK	0.074462854	23	0.065041601	21	22
UNION BANK OF INDIA	0.071367946	24	0.060338816	24	24
UNITED BANK OF INDIA	0.090688123	10	0.079907458	5	7.5
VIJAYA BANK	0.084221522	15	0.073853658	11	13

**Source: Own calculations*

A-4.4.21: Table 4.21: Measuring Liquidity component for Private Banks:

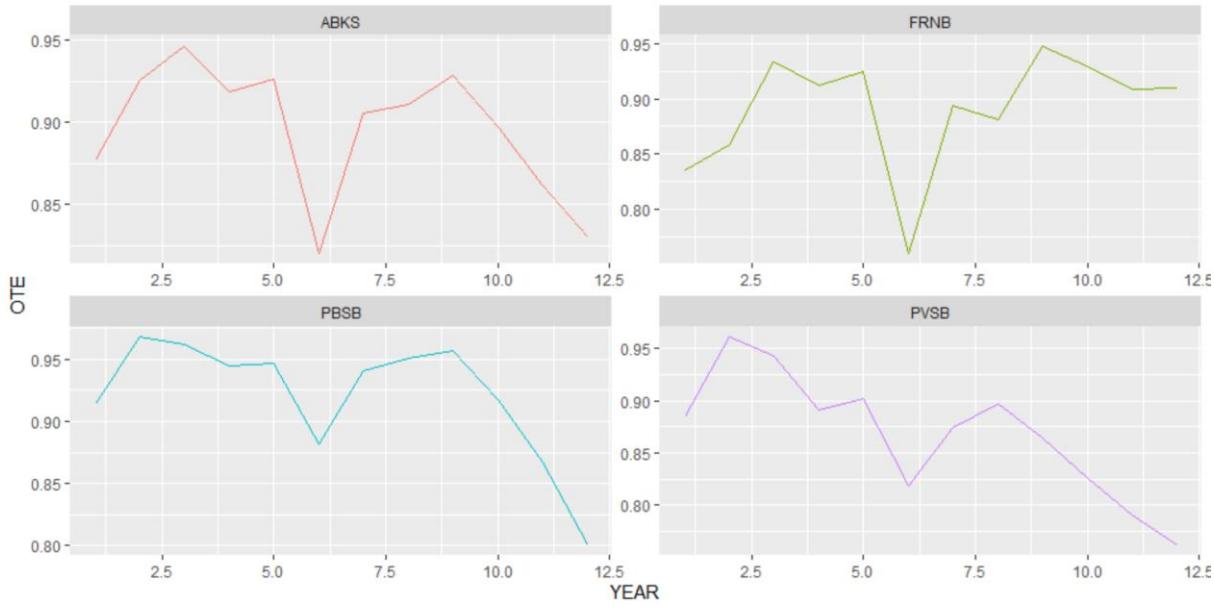
Bank Name	Liquid Assets to Deposits	Rank	Liquid Assets to Total Assets	Rank	Average Rank
AXIS BANK	0.097682051	7	0.074011458	9	8
CATHOLIC SYRIAN BANK LTD	0.088977798	10	0.080084964	8	9
CITY UNION BANK LIMITED	0.082360108	14	0.072172922	10	12
DCB BANK LIMITED	0.082823882	13	0.065192444	13	13
FEDERAL BANK	0.07710102	16	0.064184839	14	15
HDFC BANK	0.108316542	6	0.081496485	6	6
ICICI BANK	0.113648769	3	0.066298472	12	7.5
INDUSIND BANK	0.111932159	5	0.083506724	5	5
JAMMU & KASHMIR BANK LTD	0.096711714	8	0.085042475	4	6
KARNATAKA BANK LTD	0.068281975	19	0.059919804	17	18
KARUR VYSYA BANK	0.070482775	17	0.060407696	16	16.5
KOTAK MAHINDRA BANK LTD	0.082891274	12	0.052598635	19	15.5
LAKSHMI VILAS BANK	0.08136875	15	0.071011452	11	13
NAINITAL BANK	0.310580182	1	0.270933781	1	1
RBL	0.192010103	2	0.140311106	2	2
SOUTH INDIAN BANK	0.090980908	9	0.080935593	7	8
TAMILNAD MERCANTILE BANK LTD	0.069708049	18	0.059714212	18	18
DHANLAXMI BANK	0.112493005	4	0.098184355	3	3.5
YES BANK LTD.	0.088135978	11	0.062736957	15	13

**Source: Own calculations*

A-4.4.22: Table 4.22: Measuring Liquidity component for Foreign Banks:

Bank Name	Liquid Assets to Deposits	Rank	Liquid Assets to Total Assets	Rank	Average Rank
AB BANK LIMITED	0.255673145	15	0.108529889	14	14.5
ABU DHABI COMMERCIAL BANK	0.58402243	5	0.361395595	3	4
BANK OF AMERICA N.A.	0.138076764	24	0.059002120	25	24.5
BANK OF BAHRAIN & KUWAIT B.S.C.	0.184324346	19	0.13222368	11	15
BANK OF CEYLON	0.631298576	4	0.280430847	5	4.5
BANK OF NOVA SCOTIA	0.142765792	23	0.059448614	24	23.5
BARCLAYS BANK PLC	0.380105077	8	0.096810455	18	13
BNP PARIBAS	0.163675549	21	0.075847801	19	20
CITIBANK N.A.	0.128535459	25	0.072717437	20	22.5
CREDIT AGRICOLE	0.339678642	9	0.064153938	22	15.5
CTBC BANK	0.264764744	14	0.111019945	13	13.5
DBS BANK INDIA LTD.	0.287496814	12	0.146609495	8	10
DEUTSCHE BANK AG	0.312693507	10	0.145466875	9	9.5
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	0.196125686	18	0.117118127	12	15
JP MORGAN CHASE BANK N.A.	0.231255249	16	0.104370127	16	16
KRUNG THAI BANK PUBLIC COMPANY LIMITED	0.875865463	2	0.602993399	1	1.5
MASHREQ BANK PSC	0.80078109	3	0.250166617	6	4.5
MIZUHO BANK LTD	0.574727107	6	0.140205213	10	8
MUFG BANK, LTD.	0.271715356	13	0.103105274	17	15
PT BANK MAYBANK INDONESIA TBK	118.6503283	1	0.380257739	2	1.5
SBM BANK (INDIA) LTD	0.203912606	17	0.104872857	15	16
SHINHAN BANK	0.551239576	7	0.290807026	4	5.5
SOCIETE GENERALE	0.152352553	22	0.065346753	21	21.5
SONALI BANK	0.294199714	11	0.215404118	7	9
STANDARD CHARTERED BANK	0.093251042	26	0.051089855	26	26
NatWest Markets Plc	0.182479515	20	0.063972034	23	21.5

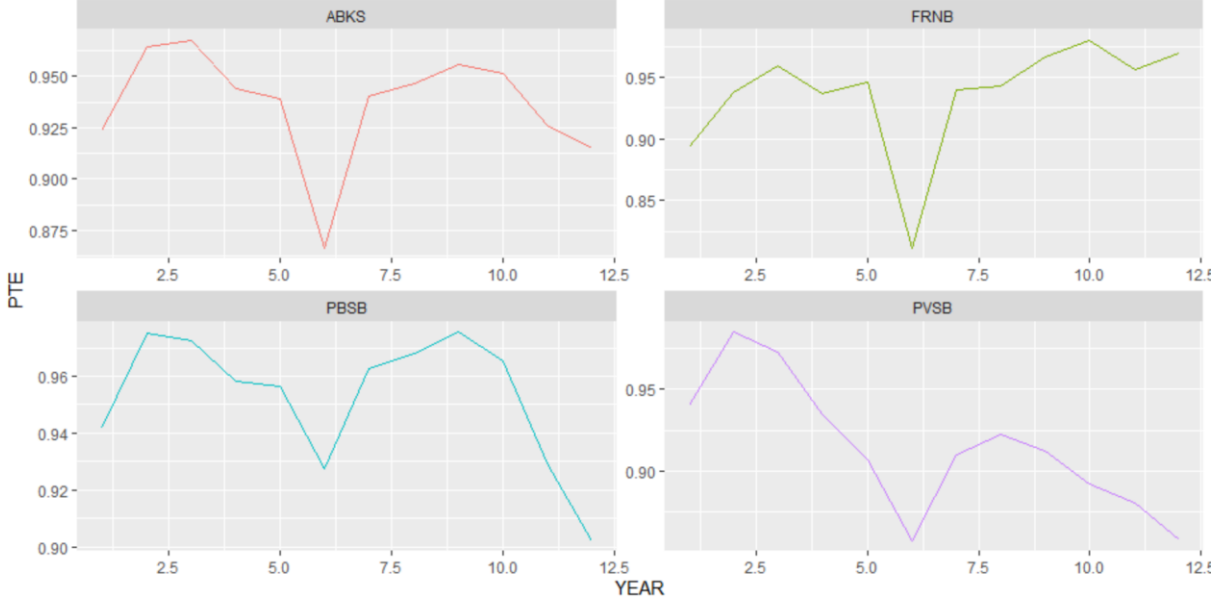
**Source: Own calculations*



A-4.4.23- Figure 4.2: Bank group wise distribution of OTE scores in India

Note: OTE captures the average pure technical efficiency scores of Public Sector banks (PBSB), private Sector banks (PVSB), Foreign banks (FRNB) and All Banks (ABKS) over the sample period for India.

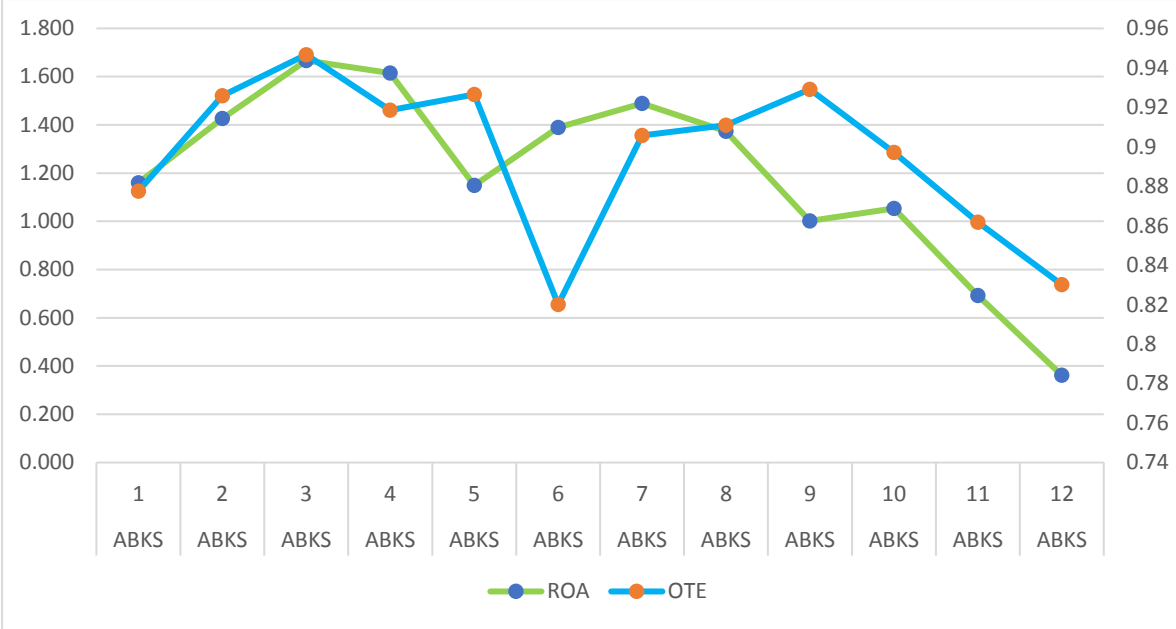
Source: Own calculations.



A-4.4.24- Figure 4.3: Bank group wise distribution of PTE scores in India

Note: PTE captures the average pure technical efficiency scores of Public Sector banks (PBSB), private Sector banks (PVSB), Foreign banks (FRNB) and All Banks (ABKS) over the sample period for India.

Source: Own calculations.



A-4.4.25- Figure 4.4: Movement in OTE and ROA of Indian Commercial Banks

Note: The right-hand side axis captures the movement in OTE while changes in ROA for Indian Banking sector is indicated by the left axis that is almost in tune with changes in overall technical efficiency, over a period of 12 years from 2005-06 to 2016-17.

**Source: Own presentation.*

APPENDIX IV.5

Short description of data used

A-4.5.1: Table 4.23. Inputs and Outputs for DEA analysis

Input bundle		Output bundle	
X1	Real resources: Expenditure on Fixed Assets or establishment cost	Y1	Performing Loans: Advances minus Net NPA
X2	Labour: Number of employees of individual banks	Y2	Investments: Total value of investments of individual banks
X3	Funds Available with Banks: Deposits		
X4	Borrowings		
X5	Operating expenses: Total of operating expenses including light, rates, rent, taxes, staff salaries etc.		

Note: Data on the above input-output bundles are collected from the statistical table related to banks in India (STRBI) available at official website of Reserve Bank of India.

**Source: Own presentation*

A-4.5.2: Table 4.24. Financial ratios used in CAMEL composite index

Component name	Ratios considered	Description of Ratios	Availability
Capital Adequacy	CRAR	Ratio of tier 1 and Tier 2 capital to Risk Weighted Assets	Readily available
	Debt-Equity Ratio	Ratio of Total Borrowings and Deposits to Net-Worth of Banks	Computed
Asset Quality	NNPA to Total Assets	Ratio of Net Non-Performing Assets to Total Assets	Computed
	Net NPA to Net Advances	Ratio of Net Non-Performing Assets to Net Advances	
Management Quality	RONW	Ratio of Net Profit of banks to Net Worth	Computed
	Profit per Employee	Net income divided by total employees	Readily Available
Earnings Quality	Ratio of Interest Income to Total Income	To measure income from core activities	Computed
	Changes in Net Profit	Changes in earnings over the years	
Liquidity	Ratio of Liquid Assets to Total Deposits	Ability of banks to repay their depositors on demand	Computed
	Ratio of Liquid Assets to Total Assets	Ability of banks to carry their normal course of operations	

Note: Data on above components are collected from the statistical table related to banks in India (STRBI) available at official website of Reserve Bank of India.

**Source: Own presentation*

APPENDIX IV.6 (About Scale Efficiency)

A-4.6.1: Table 4.25. Scale Efficiency in Indian banking industry

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
STATE BANK OF BIKANER & JAIPUR	0.9279	0.9648	1	0.9576	0.9833	0.9967	1	0.994	1	0.8711	0.838	0.9826
STATE BANK OF HYDERABAD	0.9916	1	1	0.9891	1	0.995	0.9973	0.9988	0.9943	0.8873	0.8762	0.9286
STATE BANK OF INDIA	0.9791	0.9971	0.9926	0.9995	0.9921	0.9912	0.991	0.9968	0.9806	0.9475	0.913	0.8859
STATE BANK OF MYSORE	0.9368	0.9882	1	0.9838	0.9994	0.8972	0.9827	0.9895	0.9441	0.8762	0.8635	0.9508
STATE BANK OF PATIALA	1	1	1	1	1	0.9918	0.9589	0.9869	0.9744	0.8917	0.9628	0.9158
STATE BANK OF TRAVANCORE	0.9848	1	1	1	0.9954	0.9895	0.9961	0.9981	0.9742	0.9218	1	0.9889
ALLAHABAD BANK	1	1	0.9626	0.9804	0.9788	0.9082	0.961	0.9617	0.9414	0.8775	0.8728	0.7582
ANDHRA BANK	0.9197	1	1	0.9641	0.9542	0.9836	1	1	0.9671	0.9377	0.9656	0.8685
BANK OF BARODA	0.9633	0.9958	0.9936	0.995	0.9926	0.9836	1	1	0.9953	0.9938	0.9704	0.871
BANK OF INDIA	0.9552	0.9992	0.9742	0.9962	0.9894	0.9591	0.9928	0.9957	1	0.9867	0.9327	0.8488
BANK OF MAHARASHTRA	0.9425	1	1	0.9731	0.98	0.8588	0.9004	0.902	0.9217	0.8903	0.9065	0.7947
CANARA BANK	1	0.9862	0.9649	0.9891	1	0.9946	1	0.9996	0.9995	0.985	0.9964	0.8657
CENTRAL BANK OF INDIA	0.9347	0.9506	0.9942	1	0.9411	0.8392	0.9252	0.9254	0.8974	0.8542	0.9014	0.9014
CORPORATION BANK	0.9673	0.9997	0.998	1	1	1	1	1	1	1	1	1
DENA BANK	1	0.9829	0.992	0.9518	0.9997	0.9549	1	0.9218	0.9922	0.989	0.9292	0.9254
IDBI BANK LIMITED	1	1	0.9748	1	1	1	1	1	1	0.9872	0.9281	0.7994
INDIAN BANK	0.9562	1	0.9938	0.998	0.9991	0.9668	0.9747	1	1	1	1	0.9161
INDIAN OVERSEAS BANK	0.9844	0.999	0.9829	0.9943	0.9998	0.932	0.9547	0.9768	0.9776	0.9444	0.8418	0.7982
ORIENTAL BANK OF COMMERCE	1	1	1	1	1	1	1	1	1	1	0.9629	0.8319
PUNJAB AND SIND BANK	1	0.9623	0.9367	0.9632	0.9529	0.8886	0.942	1	1	0.9932	1	0.935
PUNJAB NATIONAL BANK	0.9244	0.9936	0.9947	0.9934	0.9986	0.8977	0.9689	0.9717	0.966	0.9348	0.9315	0.9091
SYNDICATE BANK	0.967	0.9999	1	0.9827	0.9772	0.9186	0.979	0.9816	1	1	0.8676	0.7584
UCO BANK	0.975	0.9881	0.993	0.975	1	1	1	1	1	1	1	1
UNION BANK OF INDIA	0.9397	0.9919	0.9808	0.9998	0.9986	0.8825	0.9746	0.9976	0.9728	0.9394	0.9261	0.8346
UNITED BANK OF INDIA	1	1	0.9824	0.982	1	0.8813	0.9384	0.9449	1	1	0.9	1
VIJAYA BANK	0.9781	1	0.999	0.9761	0.9948	0.9545	0.9682	0.9826	1	0.9676	0.9409	0.8015

**Source: Own calculations*

Continued on the following page

A-4.6.1: Table 4.25. Scale Efficiency in Indian banking industry (continued)

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AXIS BANK	1	1	0.9562	0.9383	0.9819	0.9834	0.9971	0.9932	0.9967	0.9582	0.9466	0.888
CATHOLIC SYRIAN BANK LTD	0.9163	1	0.9514	0.8357	0.9649	0.7863	0.8234	0.9162	0.851	0.925	1	1
CITY UNION BANK LIMITED	0.9524	1	1	1	1	1	1	0.9662	0.9764	0.9541	0.8944	0.7629
DCB BANK LIMITED	0.9832	0.9904	0.9769	0.9749	0.994	0.8838	0.9333	0.9673	0.9304	0.873	0.821	0.741
FEDERAL BANK	0.9408	0.9988	1	0.9941	1	0.9711	0.9349	0.9433	0.8717	0.8632	0.8519	0.7984
HDFC BANK	0.8946	0.9959	0.9833	0.9154	0.988	0.9955	0.9944	0.9971	0.982	0.9472	0.9134	0.8704
ICICI BANK	0.9411	0.912	0.9753	0.9969	0.9966	0.9272	0.9297	0.9757	0.9605	0.9203	0.9055	0.8491
INDUSIND BANK	1	1	0.9749	0.9624	1	0.957	0.9885	0.9975	0.9633	0.8878	0.8715	0.8028
JAMMU & KASHMIR BANK LTD	1	1	0.9998	0.987	1	1	1	1	1	0.9954	0.9772	0.9581
KARNATAKA BANK LTD	1	1	1	1	1	1	1	1	0.9982	0.9976	0.9838	0.9932
KARUR VYSYA BANK	0.9482	1	1	1	0.9944	0.9914	0.9868	0.9659	0.9628	0.899	0.9017	0.8435
KOTAK MAHINDRA BANK LTD	0.9841	0.984	0.9984	0.989	0.996	0.902	0.9649	0.9949	0.9423	0.9085	0.9087	0.8169
LAKSHMI VILAS BANK	0.9403	0.981	0.9423	0.9269	0.9839	0.8147	0.9359	0.9621	0.9165	0.9168	0.8421	0.7962
NAINITAL BANK	0.7468	0.7864	0.9718	0.8326	1	1	1	1	1	1	0.803	0.9809
RBL	0.8474	1	0.9386	0.8684	1	0.9976	0.9018	0.962	0.895	0.8814	0.9342	0.8891
SOUTH INDIAN BANK	1	1	1	0.9335	1	1	1	0.9738	0.9577	0.9029	0.876	0.9312
TAMILNAD MERCANTILE BANK LTD	1	1	1	1	1	1	1	1	1	1	1	1
DHANLAXMI BANK	0.839	0.9394	0.8476	1	0.9917	0.8365	0.8424	0.8822	0.8038	0.7711	0.714	0.9865
YES BANK LTD.	0.9823	0.9469	0.9116	0.9595	0.9982	1	0.9938	0.9856	0.9912	0.9681	0.9212	0.8913

**Source: Own calculations*

Continued on the following page

A-4.6.1: Table 4.25. Scale Efficiency in Indian banking industry (continued)

Bank Name	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
AB BANK LIMITED	1	1	1	1	1	1	1	1	1	0.8813	0.8789	0.8531
ABU DHABI COMMERCIAL BANK	0.7924	0.865	1	1	1	0.9588	0.9823	0.9238	1	1	1	1
BANK OF AMERICA N.A.	1	1	1	1	1	1	1	0.9914	0.978	1	1	1
BANK OF BAHRAIN & KUWAIT B.S.C.	0.7485	0.8978	0.8643	0.8625	0.9131	0.9914	0.9386	0.9526	1	0.9972	1	0.9971
BANK OF CEYLON	1	1	0.9879	0.9926	1	0.9584	1	1	1	1	1	1
BANK OF NOVA SCOTIA	1	1	1	1	1	1	1	1	1	1	1	1
BARCLAYS BANK PLC	1	1	1	1	0.8731	1	1	1	1	1	1	1
BNP PARIBAS	0.9795	0.9862	0.9952	0.9844	1	0.9921	1	1	1	1	1	1
CITIBANK N.A.	0.8263	0.7707	0.9456	0.9976	0.9373	0.9973	0.9903	0.8969	0.9656	0.8979	0.9086	1
CREDIT AGRICOLE	1	0.9311	1	1	1	1	1	1	1	1	1	1
CTBC BANK	1	1	0.978	1	1	0.9977	1	1	0.9479	1	0.9633	0.9913
DBS BANK INDIA LTD.	0.9887	0.9771	1	1	1	0.9997	0.9919	0.9926	0.9702	0.9988	0.9988	0.8111
DEUTSCHE BANK AG	0.9274	0.9405	0.9759	0.9961	0.9577	0.996	1	0.9265	0.8993	0.9489	0.8749	0.8083
HONGKONG AND SHANGHAI BANKING CORPN.LTD.	0.7772	0.7853	0.937	0.8846	1	1	1	0.9196	0.9232	0.9343	0.9489	0.9578
JP MORGAN CHASE BANK N.A.	1	1	1	1	1	1	1	1	1	1	1	1
KRUNG THAI BANK PUBLIC COMPANY LIMITED	1	1	1	0.8425	1	0.8349	1	1	1	1	1	1
MASHREQ BANK PSC	1	1	1	1	1	1	1	1	1	1	1	1
MIZUHO BANK LTD	1	1	1	1	0.957	1	1	1	1	1	1	0.8829
MUFG BANK, LTD.	0.9805	1	1	1	1	1	0.9704	0.9969	0.9723	1	0.9995	0.8931
PT BANK MAYBANK INDONESIA TBK	0.9055	0.5319	1	1	1	0	0	0	1	1	1	1
SBM BANK (INDIA) LTD	1	0.8925	1	0.9673	0.9881	1	1	1	1	1	1	1
SHINHAN BANK	0.8912	0.9636	0.9812	1	1	0.9957	1	1	1	1	1	1
SOCIETE GENERALE	0.9956	0.999	0.9996	0.9424	1	1	1	0.9806	1	1	0.993	0.979
SONALI BANK	0.6003	0.4724	0.7163	0.972	0.9995	0.7541	1	0.9574	0.9122	0.2473	0.2882	0.3629
STANDARD CHARTERED BANK	0.9659	0.9282	0.9552	0.9315	0.9097	0.9939	0.9196	0.8187	0.9082	0.8038	0.8443	0.8717
NatWest Markets Plc	0.8377	0.8613	0.9817	0.9445	0.8611	0.978	0.9909	0.9865	1	0.9374	1	1

**Source: Own Calculations*

A-4.6.2: Table 4.26. Descriptive statistics of efficiency in Indian banking industry

YEARS	OTE					PTE					SE				
	Min	**Mean**	**Max**	**Median**	**Std. Dev**	**Min**	**Mean**	**Max**	**Median**	**Std. Dev**	**Min**	**Mean**	**Max**	**Median**	**Std. Dev**
2005-06	0.366	0.878	1	0.923	0.143	0.462	0.924	1	1.000	0.125	0.600	0.949	1	0.979	0.076
2006-07	0.472	0.926	1	0.981	0.124	0.583	0.964	1	1.000	0.084	0.472	0.960	1	0.999	0.094
2007-08	0.716	0.947	1	0.973	0.072	0.771	0.968	1	1.000	0.058	0.716	0.978	1	0.995	0.043
2008-09	0.390	0.919	1	0.937	0.101	0.401	0.944	1	0.988	0.095	0.833	0.973	1	0.993	0.042
2009-10	0.589	0.927	1	0.982	0.098	0.589	0.939	1	1.000	0.092	0.861	0.986	1	1.000	0.029
2010-11	0.000	0.820	1	0.878	0.204	0.401	0.866	1	0.937	0.168	0.000	0.946	1	0.992	0.129
2011-12	0.000	0.906	1	0.964	0.153	0.473	0.940	1	0.996	0.098	0.000	0.964	1	0.996	0.122
2012-13	0.000	0.911	1	0.951	0.146	0.453	0.946	1	0.994	0.089	0.000	0.963	1	0.994	0.121
2013-14	0.704	0.929	1	0.967	0.085	0.772	0.955	1	1.000	0.066	0.804	0.971	1	0.994	0.041
2014-15	0.247	0.897	1	0.926	0.126	0.737	0.951	1	1.000	0.070	0.247	0.942	1	0.968	0.100
2015-16	0.288	0.862	1	0.853	0.135	0.655	0.926	1	0.964	0.087	0.288	0.929	1	0.947	0.100
2016-17	0.363	0.830	1	0.832	0.145	0.681	0.915	1	0.967	0.099	0.363	0.905	1	0.916	0.105

**Source: Own calculations*

CHAPTER V

EMPIRICAL EVIDENCE ON FINANCIAL PERFORMANCE OF INDIAN COMMERCIAL BANKS

5.1. Introduction:

The extensive structure of Indian banking sector under the supervision and control of RBI over the years has considerably helped India to efficiently overcome the negative impact of global financial crisis at different intervals in the past. The sub-prime lending crisis of 2007-08 although has a special mention in the report on Trend and Progress of Banking in India, Reserve Bank of India, (2008), but was unable to cast significant impression on the banking system of this country. Despite the resilient mechanism in place under the supervision of RBI, together with the minimum capital requirements and lending restrictions, Indian banking sector is exposed to strong challenges over the past 10 years and such a situation has become more unfavorable for the past 6 to 7 years due to rising threat of NPAs. For instance, Table 5.1 (Appendix V.1) shows the movement of the gross NPA (in percentage) vis-à-vis the net profitability of the Indian Commercial Banks over a period of 5 years (2012-13 to 2016-17). A close analysis of Figure 5.1 provides a hint of association between profitability and growing NPA among the Indian Banks. We find that although profitability has fallen in 2013-14 and 2015-16 but the reduction is massive in 2015-16. Also, the corresponding rise in gross non-performing assets for the same period is the highest for 2015-16. It also indicates the havoc rise in NPA and significant decrease in net profit. The constant corrosion in asset quality because of rising NPA mandated the implementation of increased provisioning norms and deleveraging mechanisms by RBI that boosted restrictions on lending capacity of the Indian banks (Sarkar & Rakshit, 2021). As a result, there is a subsequent negative impact on capital and profitability of banks, especially for the Public Banks.

Figure 4.1 also show a decrease in the growth of gross NPA in 2016-17 corresponding to a simultaneous increase in net profit for Indian banks ushering signs of optimism. This clearly highlights the fact that operational activities as well as the performance of Indian banks are exposed to negative shocks over the past years and a closer introspection is necessary to understand both internal and external factors that impact the performance of commercial banks in India. Most of the past studies across the globe addresses the profitability aspect of banks as a proxy for its financial performance (Robin et al., 2018). Various factors can be responsible

for fluctuations in bank profitability and ultimately can impact their financial performance. Such factors can be segregated into internal or bank-specific factors and external or macroeconomic factors. Since banking sector of every country operates in a highly competitive environment and are exposed to frequent changes, hence studying the bank-specific or internal factors alone will represent only the partial impact on bank's financial performance. On one hand bank-specific or internal factors have direct influence on bank performance whereas external or macroeconomic factors are expected to exert an indirect but important impact on bank performance. Therefore, to undertake any policy related decision for development of Indian banking industry, analysis of the impact of both these factors (together as well as individually) are necessary.

An analytical review of selected existing literatures show that GDP (Al-Homaidi et al., 2018; Almaqtari et al., 2019; Caporale et al., 2017; Tan, 2016b; Yahya et al., 2017; Yao et al., 2018), inflation (Ali, 2015; Flamini et al., 2009; Ongore & Kusa, 2013a; Robin et al., 2018) as well as lending rate (Alper & Anbar, 2011; Lutf & Omarkhil, 2018; Rashid & Jabeen, 2016) are used as external or macroeconomic factors to explain variations in bank's financial performance. However, none of these studies, consider such macroeconomic factors as the main explanatory variables to explain variations in bank performance. This study thus attempts to empirically bridge up this gap by considering certain key macroeconomic factors and a key bank-specific factor as the principal explanatory variables to analyze their effects on bank's financial performance using a Dynamic Panel Estimation procedure. We initially identify certain focused explanatory variables such as, income diversification ratio, inflation expectations and the business cycle component. Thereafter, we also include a key macroeconomic and selected bank-specific factors as control variables to observe the changes if any, in the impact of our principal explanatory variables on financial performance of Indian commercial banks. Finally, we perform robustness checks for our final model results through inclusion of two control variables, Net Interest Margin (NIM) and Asset Quality (ASQ) to highlight the impact of quality of loans as well the impact of interest spread on bank profitability.

5.2 Variables and Sample size:

In this section we discuss the data and variables used in our study. We proxy the financial performance of Indian banks through their profitability and consider two specific measures of

profitability of Indian commercial banks, ROA (Return on Asset) as the prime indicator of bank profitability and ROE (Return in Equity) as an alternative measure. Where ROA is the value of Net annual profits earned by Indian commercial banks as scaled by their total assets for the said period while ROE is the ratio between Net profit and shareholder's fund (capital plus reserves and surplus for banks).

Moving ahead from the commonly used macroeconomic variables like GDP in the existing studies, this study tries to examine the effect of movement in business cycles or output gap on the financial performance of Indian banks. Thus, to measure the effect of prime explanatory variables on bank's financial performance we consider two macroeconomic variables CPI and CO (Consumer Price Index and Cyclical Output) and a bank-specific variable DVR (Income Diversification ratio) as our focused independent variables. Thereafter we chronologically include different control variables in our study and represent various specifications of our analysis for each of the two dependent variables considered (ROA and ROE). A detailed description of all such variables is explained in section 5.2.1, 5.2.2 and also in Table 5.3 (Appendix V.1).

A highlighting feature of this study is exploring the relationship between profitability and business cycles[56]. Bank's main source of earning evolves from its normal course of business operations i.e., lending funds to potential borrowers. But during the period of cyclical downswings or recession such lending can decrease since such situations are usually coupled with increased risks. Thus, provisions corresponding to loans disbursed during recession phase are substantially higher due to poor loan quality. Hence banks tend to sit on large amount of idle funds due to lack of profitable channels, thereby losing on potential interest margin or profits. On the contrary during period of economic booms (cyclical upswings) demand for credit as well as stock market transactions increases, resulting in growth of revenues at a faster rate compared to costs, resulting in rise of interest margin and ultimately increased profits for banks (P. P. Athanasoglou et al., 2008). Till date, in India no study explicitly focusses on analyzing the effects of business cycles on bank performance. To the best of our knowledge this study is the first of its kind in India that tries to represent the effect of business cycles on the financial performance of Indian banks.

[56] Business cycle is a phenomenon of natural contraction (cyclical downswing) and expansion (cyclical upswing) persistent in the broad measures of economic activity (output or production of goods and services, income, and employment). The alternating phases of business cycles are called Expansion and Recession (also called contraction).

Almost majority of the past studies that focus on performance of Indian baking consider a cross-section or panel sample for a limited span of time. For instance, Brahmaiah & Ranajee, (2018) consider a sample of 11-years (2004-05 to 2014-15); Al-Homaidi et al., (2018) as well as Almaqtari et al., (2019) consider a period of 10-years (2007-08 to 2016-17); Subbarayan & Jothikumar, (2017) analyze a period of 7 years only (2009-10 to 2015-16) and Srinivasan & Britto, (2017) present their study for a span of 6 years (2012-13 to 2016-17). Thus, for our study we consider a balance panel of 71 Scheduled Indian commercial banks[57] comprising of 26 Public Sector banks, 19 Private Sector banks and 26 Foreign Banks over a period of 12 years (from 2005-06 to 2016-17) or 852 bank-years. Data related to the bank-specific variables (dependent, independent and control) for the sample banks are publicly available in the statistical table related to banks in India from the RBI website[58]. Only those banks that are fully operational during the sample period are selected for our study. From April 2017 Indian banking sector is exposed to several structural changes specially in the domain of public sector banks. The merger of State Bank of India with its associate banks as well as the plan of merger among different public sector banks have been underway. Variations in bank size and market share as an outcome of such merger may have significant impact on performance of these merged banks. Thus, exclusion of such merged banks that happened to be dominant players of Indian banking industry is illogical. On the other hand, forward extension of the sample period to cover these merged banks in our analysis might yield inconsistent results as it may be too early to conclude on the impact of such bank mergers on their financial performance. Again, the backward extension of our study before 2005-06 is also not practicable since data related to most of the variables are either not available or inapplicable. Moreover, the review of published literature also show that majority of the studies based on Indian banking is conducted from 2005 onwards. Hence, we consider a sample period between 2005-06 and 2016-17 for our analysis. For more details refer to Table 5.2 of Appendix V.1.

5.2.1. Dependent Variables:

To address the financial performance of Indian commercial banks we consider the profitability aspect of the sample banks in our study. We represent the profitability variable using two measures, i.e., the ratio of profit to assets or Return on Assets (ROA) and ratio of profits to equity or Return on Equity (ROE). The former represents a bank's capacity to effectively utilize

[57] We use a sample of Scheduled Indian Commercial Banks as these banks constitutes major part of the lending and deposit acceptance related activity for the nation. (Bawa et al., 2019).
[58] https://dbie.rbi.org.in

its bank assets to generate profits. While the latter refers to the return available to the shareholders on their investments with the banks, and at times equals to ROA times equity to assets ratio. Thus, ROA is often referred as an equity multiplier for banks and plays part in measurement of financial leverage[59]. Therefore, banks with a lower leverage (or higher equity) tends to report a higher ROA but a lower ROE and vice-versa. As analysis of ROE alone ignores the risks coupled with financial leverage, ROA stands out to be a key ratio for measuring bank's financial performance in terms of its profitability. Moreover, in case of banks RBI also at times mandates the use of borrowed funds through regulatory norms hence, under such a situation ROE might give inconsistent results as regards to financial performance. Since most of the past studies across the globe mainly focus on profitability as a proxy for financial performance of banks (Abdullah et al., 2014; Abel & Roux, 2016; Albulescu, 2015; Ali, 2015; Alper & Anbar, 2011; P. P. Athanasoglou et al., 2008; Caporale et al., 2017; Căpraru & Ihnatov, 2014; Curak et al., 2012; Dietrich & Wanzenried, 2014; Flamini et al., 2009; Jara- Bertin et al., 2014; Pasiouras & Kosmidou, 2007; Petria et al., 2015; Robin et al., 2018; Saona, 2016; Srinivasan & Britto, 2017; Tan, 2016b; Titko et al., 2015; Yahya et al., 2017), we also use ROA as the primary indicator and ROE as an alternative measure to represent bank's financial performance in our study and highlight the differences between considering ROA or ROE as the prime indicator.

5.2.2. Independent and Control Variables:

5.2.2.a. Bank Specific Variables:

Banking sector in India over the years have diversified their normal course of business operations to mitigate their risk associated with lending activities. Banks now a days deal in different third-party products like insurance, mutual funds, brokerage services etc. that generate good returns for them. The report on Trend and Progress of Banks in India (Reserve Bank of India, 2019, 2020b) highlights that other income component of Indian commercial banks have considerably increased on a year on year basis. Moreover, with the increasing trend in NPA banks tend to diversify their operational activities to generate returns. Hence we consider income diversification ratio (ratio of other income to total income) as a principal explanatory variable to examine its impact on bank performance.

[59] Leverage is the strategy of using borrowed money in the form of fixed interest based financial instruments or borrowed capital to increase potential of an investment.

To examine the effect of bank's owned capital on its performance we use the ratio of equity to total assets. We argue that banks with higher capital ratio are safer compared to institutions with low capital ratio. Dietrich & Wanzenried, (2011) opines that in accordance with the traditional risk-return hypothesis, highly capitalized banks remain profitable and are safer during difficult economic times. Again, a lower risk increases the creditworthiness of banks and reduces their funding cost. Furthermore, banks with higher equity to assets ratio are less dependent on external funding, thereby can have a positive impact on their profitability. With this point in mind, we also use the EA[60] (equity to asset ratio) to examine its impact on bank's performance.

A major question in assessing the determinants of bank performance is the effect of size that can maximize their profitability (P. P. Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011). Effect of size on bank profitability can be positive up to a certain extent beyond which it could be negative owing to either economies of scale or due to other bureaucratic reasons. In his pioneering works Smirlock, (1985) show that increasing bank size has a positive impact on bank performance. Similarly, Stiroh & Rumble, (2006) and Pasiouras & Kosmidou, (2007) argue that banks that have become extremely large will have negative impact on profitability. This might be due to higher agency and other costs incurred to manage such large banks. Thus, assessing the impact of bank size on its performance is important. Initially we measure bank size by taking log of total assets. Moreover, as check for robustness we use the log of total deposits as an alternative measure in our analysis.

Again, one might expect that a faster growing bank can effectively increase their business and generate greater profits. However, the contribution of profits because of an increase in deposit depend on different factors. Firstly, the ability of the banks to convert their deposit liabilities into income earning assets depends on the credit quality of those assets and indicates a bank's operating efficiency. Also banks can attain growth by investing in assets of lower credit quality that has a negative impact on bank profits (Dietrich & Wanzenried, 2011). However, higher growth rates can also lure competitors thereby reducing profits for other market participants in banking sector. We use data on annual growth rate of total deposits for individual banks as a control variable to capture the effect of this phenomenon. This variable will also indicate (though not fully) the effect of presence of NPA on bank's performance.

[60] Given the criteria of multicollinearity, it would not be appropriate to use EA in the regression model when the model is run with ROE as a dependent variable.

In their report, KPMG and CII, (2013) argues that Indian banking sector is growing exponentially and such growth rate is significant to foster the Indian banking industry to become third largest in the globe by 2025. Moreover, with the introduction of liberalization policy of 1991, the banking domain of India is subject to increased competition due subsequent emergence of new entrants in the form of private and foreign players that has increased the dimensions of Indian banking by manifolds. In the presence of such an extensive banking environment we are inclined to introspect the impact of industry concentration on bank's financial performance in terms of their profitability, alternatively known as structure-conduct-performance hypothesis (SCP). Therefore, we examine the validity of SCP hypothesis theory in Indian context. The evidence of the impact of market concentration on performance of a banking firm is available in the pioneering works of Tan, (2016b); Athanasoglou et al., (2008) and Dietrich & Wanzenried, (2011) in the backdrop of China, Greece and Switzerland respectively. Similarly in Indian context we intend to investigate the evidence of similar relationship by using the changes in industry concentration over the years. We use the year-on-year change in Herfindahl Hirschman index (CHHI) in this study to find the evidence, if any of the SCP hypothesis.

Furthermore, we extend our analysis to test the robustness of our primary model outcomes under different specifications, by inclusion of two bank specific control variables: Net Interest Margin (NIM) and Asset Quality (ASQ). The former indicates the proportion of net interest spread (difference between interest earned and interest expended) in total assets of individual banks while the later will indicate the impact of quality of loans disbursed by banks as a proportion of its total assets, on its profitability in the growing era of non-performing assets. The detail about these variables are mentioned in section 4.6 of this chapter.

5.2.2.b. Macroeconomic Variables:

We use two key macroeconomic factors as determinants of financial performance of Indian commercial banks i.e., Inflation expectations and Cyclical Output (as measures of Business Cycle) in our study:

Evidence of inflation expectation on the financial performance of banks is ambiguous and such outcome fluctuates across nations (P. P. Athanasoglou et al., 2008; Sarkar & Rakshit, 2021). For instance, pioneering works of Athanasoglou et al., (2008), Flamini et al., (2009) and Dietrich & Wanzenried, (2014) show a positive and significant effect of inflation on bank profitability, more because of the strong ability of banks to forecast future inflation. On the

contrary, Abel & Roux, (2016), Caporale et al., (2017), Yao et al., (2018) and Sarkar & Rakshit, (2021) finds a negative and significant impact of inflation on the performance measures of banks. To elaborate, if inflation has a positive relationship, it highlights that bank managements are effectively and adequately (not fully) able to predict future inflation situation and accordingly adjusts their interest rates to achieve higher profits (P. P. Athanasoglou et al., 2008). Again, given the case of India with the RBI guidelines in force, to prevent the inflation situation during increased money supply in the economy, the statutory requirements are increased by the Central bank, leaving the commercial banks with less funds to lend. Thus, commercial banks are compelled to increase their interest rates that creates a negative impression on borrowers who become reluctant to borrow, as a result banks might lose on interest earnings on potential performing loans. On the contrary an increase in interest rates on bank deposits at a faster rate than that on the loans disbursed may lead to a negative relationship between inflation and profits while the reverse may hold true in case of disinflation. Hence, it will be interesting to examine the impact of inflation on bank profitability in our study. We use annual data on CPI (Consumer Price Index) from CMIE Economic outlook to proxy the inflation expectations.

A thorough review of the existing literatures show the use of GDP as a prime macroeconomic factor (Al-Homaidi et al., 2018; Almaqtari et al., 2019; Caporale et al., 2014; Sarkar & Rakshit, 2021; Yao et al., 2018) to evaluate its estimated impact on bank's financial performance. But the cyclical upswing or downswing that is an inherent feature of every economy, for India also, we expect such movements to affect bank profitability. Such a movement is known as Business cycles. It is a natural phenomenon in every economy and is characterized by subsequent periods of boom and recession (or contraction) covering broad measures of economic activity (output or production of goods and services, income, employment, and others). Hence, like every economy such cyclical movement forms an important component of Indian too, as phases of economic recession are coupled with increased risk compelling banks to maintain higher provisions on lending due to decrease in loan quality. However, the opposite happens in situation of economic booms. Till date no explicit literature in Indian context focus on evaluating the estimated impact of business cycles on financial performance of banks. Again, the measures used to proxy the effect of business cycles is also varies across different literatures. Different measures are suggested in existing literatures like that of coincident index or forecast of trend values (Dua & Banerji, 2007, 2012) or by application of Hodrick-Prescott filter to segregate the trend component from output. Therefore, we follow the works of

Athanasoglou et al., (2008) and use the logarithmic deviation of real GDP from its segmented trend, to proxy business cycle in our study for India. We collect the data on real GDP from World Development Indicator of World Bank.

Further, we use computed values of Technical Efficiency scores (OTE and PTE) as a control variable. We assume that banks with higher efficiency can better manage their performing loans compared to their peers. Also, such impact of efficiency might differ in case banks become either globally (OTE) or locally (PTE) technically efficient. Such specification of efficiency scores is the same as stated in Chapter III of this thesis.

As stated earlier, data for computation of bank-specific independent and control variables together with data on dependent variables are collected from the Statistical Tables Related to Banks in India (STRBI) of annual publications of Reserve Bank of India[61]. Data on macroeconomic variables (CPI and real GDP) are collected from CMIE Economic Outlook.

5.3. Descriptive Statistics and Correlation:

Table 5.3 and Table 5.4 of Appendix V.2 represents the correlation diagnostics and the descriptive statistics of our study. To begin with the correlation tests among the variables, we use the VIF statistics to check the multicollinearity among our variables that gives a more conclusive proof of existence of multicollinearity than the traditional correlation matrix. The rule of thumb states that any value of VIF of 4 or 5 or above is considered to have high degrees of multicollinearity. Also, such degree of multicollinearity is reinstated by the corresponding values of Tolerance statistics (that is simply 1 / VIF) at 0.20 or below. A careful analysis of our VIF values stated in Table: 5.3 (Appendix V.2.1) show that the maximum VIF value is 2.46 that is far behind the threshold level of 4 or 5. Further, the values of Tolerance statistic corresponding to each variable do not overrun the VIF criteria with a mean VIF of 1.46 that is well within the range of 4. Hence, we proceed ahead with our analysis and present our descriptive statistics next.

A summary of our variables under study in this thesis is given in Table: 5.4 (Appendix V.2.2). We find that over a span of 12 years, ROA has a mean and variability of return slightly above 1, but ROE varies between a large range with average return and variation being almost 10. During the same period NIM has an average value of 3 but relatively small amount of deviation.

[61] https://dbie.rbi.org.in/DBIE/dbie.rbi?site=publications#!4

Similarly, DVR, GDR and EFF (OTE) has average values of 0.171, 0.306 and 0.895 respectively with variations of 0.146, 2.632 and 0.137 respectively. Among others we also find, during the same period starting from 2005-06 CPI has remained considerably high with average value and variation of 100 and 18.78 respectively.

5.4. Unit Root Test results:

Existence of unit root in the dataset might give biased outcome. To root out such issues we perform unit root tests under two different specifications. The traditional Augmented Dickey Fuller (ADF) specification of unit root test is represented by equation (1). Where, d_{it} is the deterministic component, and the ρ_i = 0 confirms that the y process consist of a unit root for each panel i. However, the ADF specification is modified to accommodate testing the presence of unit root for panel data. The test proposed by Levin et al., (2002) as represented by equation (2) requires an auto-generated time series with the restriction of a common sample size and a common auto-correlation coefficient (ρ) for all cross sections (i). This restriction of a common ρ is the basic weakness of Levin-Lin-Chu (LLC) test for unit root. To deal with this problem Im et al., (2003) prescribed a test strategy known as Im-Pesaran-Shin (IPS) test that assumes different ρ for all i. Such a specification (Im et al., 2003) of unit root test is represented in the following equation (3).

$$\Delta y_{it} = \rho_i \, y_{i,t-1} + \acute{z}_{it} \, \gamma_i + \sum_{j=1}^{p} \theta ij \Delta y_{i,t-j} + \alpha_i d_{it} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\Delta y_{it} = \Phi y_{i,t-1} + \acute{z}_{it} \, \gamma_i + \sum_{j=1}^{p} \theta ij \Delta y_{i,t-j} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\Delta y_{it} = \Phi y_{i,t-1} + x'_{it} \, \gamma_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

In order to overcome these issues as discussed above, we present our panel unit root test results under both specifications (Im et al., 2003; Levin et al., 2002) for our study. We use both these specifications of unit root test in our study to check the presence of stationarity in our dataset mainly because, Levin et al., (2002) test permits the variation in intercepts, time trends, higher order autocorrelation and the residual variances, across the cross-section units (P. Das, 2019), whereas Im et al., (2003) calculates the average of individual unit root test statistic by allowing the concurrent stationary as well as non-stationary series and considers heterogenous panels with serially uncorrelated errors (P. Das, 2019). Furthermore, Maddala & Wu, (1999) also argues that IPS test for unit root provides separate estimation for each cross section and averages the final *t* statistics while LLC test gives the test statistics after estimating the model

based on all cross-section units taken together. We employ these two tests to provide a clear picture about stationarity of our dataset. We present the results of our Unit Root tests in Table-5.6 (Appendix V.2). Both LLC and IPS test confirms that all variables are stationary at first difference rather than at level. Hence, we use this specification to evaluate our subsequent estimation models. Athanasoglou et al., (2008) argues that in case the dependent variable is stationary at level while certain independent or control variables contains unit root at level and if inclusion of such independent or control variable is expected to provide insignificant outcome, then a researcher can proceed with the model at level equation. But in our case our main dependent variables (ROA and ROE) along with CPI are stationary at first difference, hence we proceed ahead with our specification of equation at first difference only.

5.5. Methodology:

5.5.1. Static Panel Approach:

One of the commonly used approaches under panel data models is to assume that impact of observed explanatory variables is identical for all cross-section units over time. However, the effects of omitted variables can be expressed into individual as well as time specific effects and into individual time-varying effects. Two techniques under the static panel approach are the Fixed Effects model and the Random effects model. In context of our study the former explains that how the variation of financial performance of an induvial bank differs across other banks. This model also assumes that heterogeneity of an individual bank is constant over the twelve-year period for each bank. This means, that variations in financial performance of banks may arise due to impacts other than the fixed effects and can also depend on other explanatory variables of individual banks. Thus, the regression coefficients are assumed to be same across the cross-sections (banks) over time *t*. We run the fixed effects model based on the following specification:

$$\pi_{it} = c_{it} + \beta X_{it} + \acute{\eta}_i + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

π_{it} is the set of dependent variables used in our study (ROA and ROE)

c_{it} is the constant term (bank-specific effect).

X_{it} is the set of explanatory variables for i^{th} bank over time *t.*

ήi is the fixed effect for i^{th} bank (i = 1,……,71), also known as unobserved effect.

ε_{it} is the error term for bank i at time t, also known as idiosyncratic error.

Thus, under fixed effect model we control for unobserved heterogeneity of i^{th} bank and assume that such heterogeneity of i^{th} bank is constant over time and is correlated with its independent variables.

The random-effect model, on the contrary is characterized by average changes in coefficients within the units. Thus, the estimation procedure under random effects is specified under equation (2):

$$\pi_{it} = c_{it} + \beta X_{it} + (\acute{\eta}_i + \varepsilon_{it}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

π_{it} is the set of dependent variables used in our study (ROA and ROE)

c_{it} is the constant term (bank-specific effect).

X_{it} is the set of explanatory variables for i^{th} bank over time *t.*

ήi represents the random effect for i^{th} bank (i = 1,……,71).

ε_{it} is the within bank error term for bank i at time t.

The term ήi measures the difference of average explanatory variables of i^{th} bank and average of explanatory variables of the entire bank data.

Finally, the selection between the Fixed and Random effects is based on the condition that whether unobserved parameters and other explanatory variables are co-associated. This requires the use of Hausman Test (Hausman, 1978) to decide between these two models where the null hypothesis is that random effects estimator is consistent.

However, given the structure of the variables in our study there might be an omitted variable, or the error term might be correlated over time. Also, we proxy bank performance through its yearly profitability. We argue that such profitability component is a flow variable and consists certain inclusion from its lagged period value that creates a dynamic relationship for the

dependent variable. This problem is also known as endogeneity that provides an estimation result that is biased and this biasness is termed as Nickel's Bias (Nickell, 1981). To overcome this challenge, we resort to Dynamic Panel Estimation techniques.

5.5.2. Dynamic Panel Approach:

Models that tries to study the financial performance of banks encounter several challenges, of which the noteworthy are the problems of endogeneity (Dietrich & Wanzenried, 2014) and persistence of dependent variable (P. P. Athanasoglou et al., 2008). To overcome such issues a dynamic panel estimation process as proposed by Arellano & Bond, (1991) is employed in various existing literatures across the globe (Dietrich & Wanzenried, 2011; Jara- Bertin et al., 2014; Le & Ngo, 2020; Saona, 2016; Tan, 2016b; Yao et al., 2018). Such dynamic panel specification again can be of two types, Difference Generalized Method of Moments (GMM) (Arellano & Bond, 1991) and System GMM (Arellano & Bover, 1995). As Roodman, (2009) argue, to employ either a Difference or System GMM approach requires a framework where there are certain endogenously specified regressors, involves a dynamic relationship whereby the present value of explained variable is influenced by its own lagged value, some of the variables may not be strictly exogenous and finally consists of a panel with a small time period (T) but with large cross-section units (N). In our study most of these conditions such as endogeneity, dynamic relationship, small T (12 years), large N (71) are met, so we resort to the dynamic panel framework as proposed by Arellano & Bond, (1991). Thus, following the works of García-Herrero et al., (2009) and Dietrich & Wanzenried, (2011) the one period lag model is represented by equation (1) as:

$$\pi_{it} = c_{it} + \alpha_{it} + \delta\pi_{i,t-1} + \sum_{b=1}^{B} \beta_b X_{it}^{b} + \sum_{i=1}^{I} \beta_i X_{it}^{i} + \sum_{l=1}^{L} \beta_l X_{it}^{l} + \varepsilon_{it}$$

Where,

π_{it} is the set of dependent variables used in our study (ROA and ROE)

c_{it} represents the constant term (bank-specific effect).

π_{it-1} is the lagged value of dependent variable.

α_{it} represents the impact of focussed explanatory variables on dependent variables (CO, CPI, DVR).

X_{it}^{b} represent the set of key bank-specific control variables (GDR, EA, SIZE [a] or SIZE [b] and NIM).

X_{it}^{l} represents a macro-economic control variable in our study (EFF scores with OTE and PTE); and,

X_{it}^{i} represent the impact of a industry specific control variable in our study (CHHI).

Taking the first difference of equation (1) we specify the following model as equation (2):

$$\Delta\pi_{it} = \delta\Delta\pi_{i,t-1} + \Delta\alpha_{it} + \sum_{b=1}^{B}\beta_b x_{it}^{b} + \sum_{i=1}^{I}\beta_i x_{it}^{i} + \sum_{l=1}^{L}\beta_l x_{it}^{l} + \omega_{it}$$

Where,

π_{it} is the set of dependent variables used in our study.

$\Delta\pi_{it-1}$ is the first difference of lagged dependent variable.

$\Delta\alpha_{it}$ will capture the impact of first difference of focussed explanatory variables in our study.

$x_{it}{}'s$ represent the set of first difference of key bank-specific, industry and macro-economic control variable.

The ω_{it} indicates the error term at first difference. This specification is done to eliminate the fixed bank-specific effect, c_{it}. We assume that the error term is not serially correlated with the lag value of dependent variable and our explanatory variables are uncorrelated with future movement of error term.

On the basis of moment conditions, a two-step Difference GMM estimator is proposed by Arellano & Bond, (1991). According to the methodology, at first the components of the model are estimated under the assumption that the error term is independent as well as homoscedastic across the cross-sections over time. Thereafter, in the final step the residuals of the first step are used to provide a consistent evaluation of the variance-covariance matrix.

Thus, our final empirical exercise of this study also applies the Difference GMM estimation technique of Arellano & Bond, (1991). Again, the usual GMM with robust two-step estimation process gives biased outcomes. Windmeijer, (2005) devised a bias-corrected robust estimator for two-step GMM model estimation. Such a specification is known as WC-robust standard error, is also employed in our model.

Further, the results arrived at by employing the GMM estimation procedure with WC-robust estimator is valid only if there is no serial correlation present in the idiosyncratic error terms. For this, the Arellano-Bond test for serial correlation [AR(2)] is reported for every model specification in our study. In the presence of lagged dependent variable, the first difference values of the idiosyncratic error term (~*iid* or follows independently and identically distributed) will be autocorrelated, but that does not imply misspecification of the model. However, from second order onwards such serial correlation should be absent and that justifies the validity of the model (Almaqtari et al., 2019; P. P. Athanasoglou et al., 2008; Dietrich & Wanzenried, 2011; Sarkar & Rakshit, 2021). We also provide similar results in support of goodness of fit of our models. We run our model based on the conclusion of variable specification arrived at, in section 5.4 of this chapter.

5.6. Empirical Results on regression exercise:

5.6.1. Static Panel Estimation Results:

Table 5.7 (Appendix V.2) to Table 5.9 (Appendix V.2) shows the results from our regression exercise (Static and Dynamic Panel). We present results from static panel models in Table 5.7. Although the results provide a hint on the impact of the focused explanatory variables on the indices of bank performance (ROA and ROE), but in the presence of a dynamic relationship the validity of such results are questionable. In Table 5.7 (Appendix V.2) we find that both models show a positive and significant impact of income diversification ratio on bank performance similar to our dynamic panel specifications. Similarly, inflation (CPI) shows a negative and significant impact on bank performance for both models. However, we do not find any statistical significance of CO under the static panel approach. Also, the selection between the Fixed and Random effects model is validated by the Hausman test for both models, that supports Random effects model over Fixed effects (Almaqtari et al., 2019). Furthermore, most of the existing studies on dynamic panel models do not represent the results of static panel estimation, in the light of the argument that since bank profitability is a flow variable and not a year-end outcome, since realization of interest and principal on loans disbursed, continues around the year and such a behavior gives rise to a dynamic relationship. Moreover some studies also argue that in the presence of low changes in certain explanatory variables (in our case it is CO), the static panel model (fixed effects model) tends to give biased results that

cannot be relied upon to draw any useful conclusions (Gupta & Kashiramka, 2020; Suman & Singh, 2021).

Therefore, in the presence of such dynamic relationship there might be an omitted variable that is not captured by the static panel models. Thus it will not be prudent to relax the problem of endogeneity also referred as 'Nickel's Bias ' (Nickell, 1981) under the static panel structure. Moreover, the errors might also have correlation over time. Hence the results arrived at under static panel techniques (either Fixed Effects or Random Effects) tends to provide inconsistent and biased estimates. Such issues justify the use of Dynamic panel estimation techniques to explore the causal relation between our dependent and independent variables.

5.6.2. Dynamic Panel Estimation Results:

Tables 5.8 and 5.9 (Appendix V.2) show the results from our Dynamic Panel Exercise. We provide different specifications for each dependent variable (ROA and ROE). In Table 5.8, we represent the impact of our focused explanatory variables (DVR, CPI and CO) on ROA under every specification, followed by successive inclusion of certain bank-specific and a macroeconomic control variable. Similarly, Table 5.9 presents the estimated model results for ROE. Results of Arellano-Bond tests for zero-autocorrelation [AR (2)] shown at the end of each Tables in 5.8 and 5.9 (Appendix V.2) for every model specification justifies the correct specification of our dynamic panel models. Also, the significance of p-values corresponding to Wald test statistic for all reported model specifications of ROA and ROE also validates the goodness of model fitness. Furthermore, the lagged value of dependent variable that indicates the degree of persistence is positive and statistically significant across all models confirming the use of dynamic panel structure. Again, the number of cross-section units (or banks in our study) is also greater than the number of instruments under every model specification of each table that again provides ample validity of our dynamic panel model estimates.

However, despite the above satisfactory criteria, in the context of correctness of instrumental variables included in the dynamic panel equation the results of Sargan test are important to note. According to Roodman, (2009), the criteria of correctness of instrumental variables used in a dynamic panel exercise is valid only if the Sargan test values are insignificant (that is it should be more than 5% and 10% level of significance), however it is recommended that such p-value should be greater than 0.250 (Roodman, 2009). In our study unlike the analysis with ROA as dependent variable, the result of ROE provides much weak and poor estimation

outcome in terms of robustness of model and goodness of overall fit including the Sargan test. On the contrary the model results with ROA under all specifications (Model I to VIII) provides robust and highly consistent outcome based on all the model fitness criterion. Thus, in this study we find the evidence of ROA as a prime indicator of bank profitability and can be best used to proxy the financial performance of Indian banks.

The results from our model with ROA (Table: 5.8, Appendix V.2) as dependent variable illustrates the following findings:

We find a negative and significant impact of inflation on bank profitability. Such an outcome is consistent in the presence of chronological inclusion of control variables across all model specifications. This might be possibly due to the lack of ability of Indian banks to predict the future movement of inflation effectively that in turn implies that interest rates could not be adjusted to earn higher profits. Also, during our study period of twelve years (2005-06 to 2016-17) the CPI values follow an increasing trend over the years, indicating that interest rates on bank deposits might have increased at a faster rate than those on the loans disbursed, resulting in a negative impact on bank profits and ultimately on their performance, while the reverse may hold true in case of disinflation scenario. Furthermore, this outcome of inflation on bank performance may also hold true given the ability of the customers (in comparison to bank management) to successfully anticipate the inflation, resulting in decreased profits for banks due to asymmetric information. Past studies reveal mixed impact of inflation on bank performance. For instance, Athanasoglou et al., (2008), Flamini et al., (2009) and Dietrich & Wanzenried, (2014) finds strong positive and significant impact of inflation on bank profitability, may be due to the ability of banks to predict future inflation. On the other hand Abel & Roux, (2016), Caporale et al., (2017) and Yao et al., (2018) finds a negative impact of inflation on bank performance. Our estimation results also reveal similar findings in Indian scenario, and such negative impact of inflation is observed to be the same across all model specifications even with successive inclusion of control variables that marks the robustness of our model outcome.

Income diversification (DVR) for banks can be an important measure to insulate their performance over time to safeguard themselves from losses due to increased NPA. We find strong positive and significant relationship between increase in bank performance and income diversification. The DVR is simply the ratio of bank's non-interest income to its total income. Our results highlight that a one unit increase in DVR elevates the bank profitability by

manifolds. Such result hold static even with the successive inclusion on control variables. Moreover, larger banks possess greater degree of loan and product diversification than smaller banks. The recent report on Trend and Progress of Banks in India (Reserve Bank of India, 2019, 2020b) clearly shows a considerable increase in the quantum of other income for Commercial banks in India over the past years, highlighting the importance of income diversification. But in doing so banks tend to lose focus from their normal course of business activities in terms of accepting deposits and lending.

An important finding of this study is the impact of business cycles on bank performance. We find a positive and significant impact of business cycle (CO) on bank performance that is in line with our argument. We argue that bank profitability is consistent with the fluctuating trends of economic cycle. This phenomenon is also known as procyclicality. Every economic or business cycle consists of simultaneous cyclical upswings and downswings, whereby period of downswing or contraction or recession in an economy is coupled with increased risk, that induces banks to increase their provision requirement on the loans disbursed, due to low quality of such loans. Also, during period of downswing banks might have to hold idle funds with them, losing out on potential lending activity leading to deceased profits. While the opposite hold true during phases of economic recovery as demand for credit as well as stock market transactions increases that elevates the interest margin resulting in growth of revenue at an increased rate than costs. In our analysis we find that effect of CO on bank performance is positive and significant across all model specifications and such outcome hold true with inclusion of other control variables. This validates the robustness of our model results arrived herein. Furthermore, during phases of economic recovery the aggregate economic activity (or GDP) also grows and might impact bank deposits as well as loans disbursed. This collectively also influences the bank performance. Hence in the context of the business cycle variable in our study, our findings also hint towards similar behavior of CO in Indian context like that of the pioneering works of Athanasoglou et al., (2008) in the context of Greek banks.

Next, we explain the impact of control variables chronologically:

The results on control variables in our study also reveal some interesting findings. Model II, III, V and VIII shows the results of annual growth rate of deposits. We find that an increase in annual growth rate of deposits (GDR) has a negative and statistically significant impact on bank's financial performance (ROA) in Models II and III. This hints towards the poor quality of loans disbursed by banks and indicates that Indian commercial banks are unable to

successfully convert their deposit liabilities into value creating loans, thereby losing on profitability. This outcome might also arise due to a faster growth in disbursed loans that at times oversees the degree of risks associated with such loans , resulting in poor credit quality (Dietrich & Wanzenried, 2011). Moreover, according to the report on Trend and Progress of Banking in India (RBI, 2016), unlike the private and foreign banks there has been a massive 148 percent decline in the profits of public banks, more due to rising NPAs, that might have affected the profitability of Indian banking industry in a negative and significant manner, reflected through the growth rate in deposits. Interestingly we find that when we introduce technical efficiency scores (OTE) as another control variable the impact of growth rate of deposits is although negative but becomes insignificant on profitability in models V and VII, whereas OTE scores are positive and statistically significant. Thus, this finding is in line with our argument of Chapter III. As we argue that banks with higher efficiency are better able to manage their performing loans, our results underline that if banks are globally technically efficient (as indicated by OTE scores equals to 1 in Chapter III) they can significantly contribute towards increased profitability.

We estimate the impact of industry effect by year-on-year changes in Herfindahl Hirschman index (CHHI) over our sample period. Across all our specifications, we do not find any significant impact of changes in industry concentration over the years on bank performance. Although such impact is positive but insignificant. In international context, very few studies find significant impact of HHI on bank performance. Notable among them are the works of Dietrich & Wanzenried, (2011) who finds a minimal but positive and significant impact of HHI on bank profitability before the financial crisis of 2007-08 while such impact becomes insignificant in the post crisis period. Likewise, Molyneux & Thornton, (1992) and Bourke, (1989) also finds a significant impact of HHI on bank profitability. Therefore, in our case we do not find any evidence of role of market structure of Indian banking as a determinant of their profitability. Alternatively, we argue that evidence of structure-conduct-performance (SCP) hypothesis is absent in our study with respect to Indian banking system.

In Model II the coefficient of capital ratio (EA) is positive and statistically significant that indicates sound financial position of Indian banks. But such significance level is very low [at 10% level]. This although indicates that commercial banks with a sound capital ratio can have better access to business opportunities and possess more flexibility to overcome challenges due to unforeseen losses and thus achieves higher profits. Although positive but we do not find any statistical significance of capital ratio in models III, IV and VI. This might be because as banks

employ a proportion of their equity (capital plus reserves) in their lending activities and such chunk of a bank's equity if turns out to be an NPA, then a substantial portion of their equity gets blocked and if similar situation persists in subsequent years, then banks lose on their profitability. Since due to lack of developed capital market in India most of the lending activities are done by Indian Commercial banks, therefore, banks shall concentrate more on increasing their capital base. Hence, unlike the regulatory capital (CRAR)[62] as mandated by RBI, the ability of a bank to increase their owned capital base can exert a positive impact on their financial performance.

Our findings with respect to efficiency reveal a positive and statistically significant impact on ROA in Models I, V, VI and VII. Our finding in this regression exercise hints towards the fact that irrespective of negative impact of annual growth rate in bank deposits, if banks are better able to manage their existing disbursed loans more and can successfully channelize their available resources to profitable investment opportunities, then such interest earning assets can result in increased profitability, which is true and in line with the normal course of operations in banking business. Since we follow a five input and two output model under the Asset approach for computing the technical efficiency of our sample banks, we argue that banks with higher efficiency are mostly better able to manage their existing disbursed loans (or performing loans) that exerts most of the positive impact on their performance. This is because the proportion of performing loans in the output bundle of our dataset is much higher than the value of investment opportunities generated by the banks. This finding is to the best of our knowledge, the first of its kind in Indian context whereby we examine the impact of heterogeneities in efficiency across Indian banks, on their financial performance indicators. Our results also indicate that locally efficient banks (i.e., having PTE scores equal to 1 but OTE score not equal to 1, as already discussed in Chapter III) can elevate their profitability more [0.924, as shown in Model VI] vis-à-vis the globally efficient (i.e., having OTE scores equal to 1) ones [as shown in Models I, V and VII].

Finally, we do not find any statistical evidence of the effect of SIZE (in terms of log of assets) on our main indicator of bank performance in terms of profitability (i.e., ROA). Although positive but the impact of bank size is statistically insignificant on bank profitability. Initially we test the validity of the size variable (log of assets) of individual commercial banks. Thereafter to test robustness of the result we also use the log of total deposits of individual

[62] Capital to Risk Adjusted Ratio

commercial banks as a proxy of bank size. In both the cases we find insignificant impact of size on ROA. One of the reasons for this might be that small-sized banks try to grow at a faster pace by sacrificing their profits whereas private banks of Indian origin as well as foreign banks in India (that are representative of their parent body) are more focused in increasing their market share in India than earning higher profits. This finding is in line with Athanasoglou et al., (2008). However, Sarkar and Rakshit, (2021), finds that the impact of size is positive on bank performance indicators. But such a situation might be applicable up to a certain extent whereby after that increase in bank size is likely to exert a negative impact on bank profitability due to increased administrative cost and operating expenses for large sized banks.

The results from our model with ROE (Table: 5.9, Appendix V.2) as dependent variable although satisfies certain qualifying criteria such as persistence of profit (positive significant lagged value) as well as unaltered statistical significance of DVR, CPI and CO like ROA but provides much poor and inconsistent outcome that are weak in nature. Thus, only those specifications that satisfies the model outcome criteria to some extent, with respect to dynamic panel techniques are represented in our study. In the model exercise with ROE, interestingly we find a negative but insignificant impact of EA on ROE. Since the ROE reflects the attempts of the shareholders to maximize their wealth, it might be possible that certain listed banks in India might have lowered their equity capital to boost their ROE. However, given the weaknesses of the overall model fitness and consistency in terms of model robustness we conclude that between the key indices, ROA qualifies as an important and prime indicator of financial performance of Indian banks, and this again reinstates our argument put forward earlier as regards to the inferiority of ROE as a dependent variable[63] in section 5.2.1 of this chapter and also in Chapter I. Therefore, between ROA and ROE, the former qualifies as the ideal criteria to judge the bank's financial performance in terms of their profitability. Therefore, we verify the robustness of our model results with ROA as dependent variable by inclusion of other control variables, in our study.

We further introduce two more control variables, Net Interest Margin (NIM) and Asset Quality (ASQ) to check the model robustness of our results arrived at with dependent variable ROA in this study. The Net Interest Margin is the ratio between the interest margin (Includes interest

[63] ROA represents a bank's capacity to effectively utilize its bank assets to generate profits. While ROE refers to the return available to the shareholders on their equity invested with the banks, and at times equals to ROA times equity to assets ratio. As analysis of ROE alone ignores the risks coupled with financial leverage, ROA stands out to be a key ratio for measuring bank's financial performance in terms of its profitability. Mainly because financial leverage is at times may be controlled by regulatory authorities.

earned on investments and other interest generating assets like mortgages etc. minus Interest expensed) of banks as scaled by their total assets. This acts as a leading indicator of bank's income. Therefore, an increase in NIM marks elevates the profits of the lender. A positive NIM means that banks are able to effectively channelize their funds to generate returns that offsets their interest expenses. Hence an increase in NIM would mean increase in bank profits. On the other hand, the quality of loans disbursed by the banks proportionate to their total assets is reflected through their asset quality. A positive and significant impact of the same on bank profitability will indicate good condition of loans disbursed by banks that effectively can elevate their profits. However, consistent erosion of asset quality due to increase in NPA has compelled Indian banks to increase their provision requirements that in turn affects their profitability. Thus, a critical analysis of NIM and ASQ of Indian banks is expected to provide further insights as regards to their impact on bank profitability.

We present our results on model robustness in Table: 5.10 (Appendix V.2) of this chapter. We find that the impact of our focused explanatory variables (DVR, CPI and CO) is statistically significant across all model specifications. Here also we do not find any statistical evidence of industry concentration (CHHI) and SIZE on bank performance[64]. Except models III, V and VII we find that the impact of ASQ is statistically insignificant, that clearly highlights the poor loan quality of banks. Such an outcome of ASQ is also sufficiently supported by the insignificant impact of GDR in Model VI, but in the presence of NIM. Moreover, a one unit rise in NIM of banks can sufficiently elevate the bank profits to a significant extent.

The insignificant outcome of ASQ in Models I, II, IV, VI and VIII indicates that banks are unable to transform their deposit liabilities successfully into quality loans. On the other hand, we find an interesting impact of ASQ in the presence of overall (OTE) and pure (PTE) technical efficiencies. As we argue that banks with higher efficiency scores (for OTE as well as PTE) are mainly better able to manage their performing loans, we find statistical evidence of this argument from our results of ASQ as well in Models III, V and VII. The results further indicate that globally (OTE) as well as locally efficient (PTE) banks can also enjoy the benefit of ASQ with increase in their efficiencies. Further the impact of annual growth rate of deposit also turns

[64] According to the Report on Efficiency, Productivity and Soundness of the Banking Sector (RBI, 2008), it is argued that the common accounting measure of efficiency is Net Interest Margin (NIM) for banks, that is popularly used to examine that how much the banks are able to manage their precautionary risk. Hence, under this section of robustness checks, it would not be prudent to exercise both economic measure of efficiency (EFF) and NIM in a single equation. Hence, for Robustness checks the model is not exercised with EFF and NIM rather it is exercised with EFF and ASQ.

out to be insignificant in the presence of efficiency indicating the robustness of efficiency variable like our earlier exercise [Table 5.8].

Although, the effect of EA is insignificant but is indicative of its positive impact on bank performance. Finally, we do not find any statistical evidence in support of bank size and on the theory of structure-conduct-performance hypothesis since size (Model II, III, V and VI) and CHHI (Model II to VIII) turns out to be positive but statistically insignificant.

Besides, the results of Arellano-Bond tests for zero-autocorrelation [AR (2)] for every model specification, significance of p-values corresponding to Wald test statistic for all reported models satisfies the criteria similar to those as mentioned at the starting of section 5.6.2. Here also, the p-value of Sargan test is insignificant with a value over and above 0.250 across all our model specifications that validates the treatment of instrumental variables in our models. Again, the lagged value of dependent variable (ROA) that indicates the degree of persistence of bank profitability is also statistically significant across all specifications for our robustness checks. Furthermore, the number of cross-section units (or banks in our study) is also adequately greater than the number of instruments under every model of the table that again provides ample validity of our dynamic panel model estimates.

Overall, our results are in line with the criticisms as discussed in the past studies of Athanasoglou et al., (2008) and Dietrich & Wanzenried, (2011) that hints towards validity of our outcome with respect to ROA as a prime indicator of Indian bank's financial performance. Furthermore, we also find that technical efficiency and business cycles plays a pivotal part to impact the financial performance of Indian commercial banks in terms of their profitability.

5.7. Summing up:

This chapter empirically attempts to bridge up the gap in the context of impact of bank-specific, industry-specific and certain macroeconomic variables on bank performance in terms of their profitability, by analyzing the effect of a set of focused explanatory variables along with certain principal bank-specific, industry specific and macroeconomic factors. There has been much ambiguity between the relationship of certain macro-economic factors as well as key bank-specific variables with bank profitability. Past studies in Indian context do not clearly explain the causes of variations in bank performance due to such factors. The orientation of our study mainly focuses on operative banks in India over a 12-year period from 2005-06 till 2016-17.

From April 2017 onwards the merger in the Indian commercial banks has been initiated due to several reasons of which the main is that of growing NPAs, leading to subsequent increase in provision requirements as well as other mandates resulting in reduced lending capacity for banks. Hence, it is necessary to closely study the key factors that can directly as well as indirectly impact bank's financial performance. A critical analysis of active literatures on bank performance reveals that most of such studies use profitability measures as a common proxy of their financial performance. In this study we highlight two key dependent determinants of bank performance in terms of their profitability (ROA and ROE) and devise our analysis under different specifications. We use the static panel estimation that although provides a hint towards the impact of our focused explanatory variables on bank performance but are more prone to reveal an inconclusive and inconsistent outcome due to the presence of endogenous nature of our dependent variable, since with ample evidence of past studies we also argue that bank profitability is a flow variable and not a year-end outcome. Thus, the past year profits might have some significant impact on current year's bank profits. Such argument is also supported by our estimation by employing a dynamic panel regression technique.

We apply a dynamic panel estimation procedure to examine the issues ignored under the static panel technique. Our results show that the impact of our focused explanatory variables (CO, CPI and DVR) on bank's financial performance are statistically significant and such estimation results are uniform and significant across all specifications with chronological inclusion of control variables in our study. Our study also highlights some important insights into the mechanisms that determine bank's financial performance in terms of its profitability. The findings of this study are likely to be relevant for several aspects. Firstly, we consider a different set of bank-specific and macroeconomic variables to understand several dimensions on bank performance in India. Such variables identified in this study are all computed solely for the purpose of this study that are mostly unique from existing variables used in other Indian studies on bank performance. Secondly, our study also supports that bank profits are persistent over time and tend to be serially correlated that again proves the validity of our choice of estimation technique. Further our model results are also in tune with the criticisms as put forward by past authors highlighting the importance of ROA as a main indicator of bank performance vis-à-vis the variable ROE.

We include the computed value of technical efficiency scores (OTE and PTE) as one of the control variables in our study to observe any variations in our focused explanatory variables. We find that impact of this efficiency variable in the presence of other control variables used

in this study and reveals some interesting outcomes. Our findings show that banks that can better manage their performing loans and are able to successfully channelize their available funds to profitable investment opportunities enjoys a positive and significant impact of their efficiency on financial performance (ROA) and such a variable can act as a vital indicator for bank performance. Initially we observe that the annual growth rate in bank deposits turns out to be negatively significant indicating the inability of banks to convert their deposit liabilities into value creating loans thereby losing on profit opportunities. However, such outcome is although negative but insignificant with the inclusion of efficiency (OTE and PTE) variable that highlights the importance of banks that can better manage their performing loans. Moreover, under the robustness checks we also find that due to the inclusion of efficiency variable banks are also able to achieve a positive benefit of asset quality on their profitability. This again reinstates our argument that banks with higher efficiency can better manage their performing loans. Although an increase in NIM of banks significantly elevates the performance of Indian banks but we do not find any statistical evidence of SIZE, EA, and changes in industry concentration ratio under the robustness checks. Though the impact of these three variables is insignificant but their outcomes are indicative in nature.

Finally, the use of GMM estimation techniques of Arellano & Bond, (1991) provides important insights into the variations in bank performance not only due to key bank-specific and industry-specific variables but also the sensitivity of Indian banks to variations in macroeconomic factors.

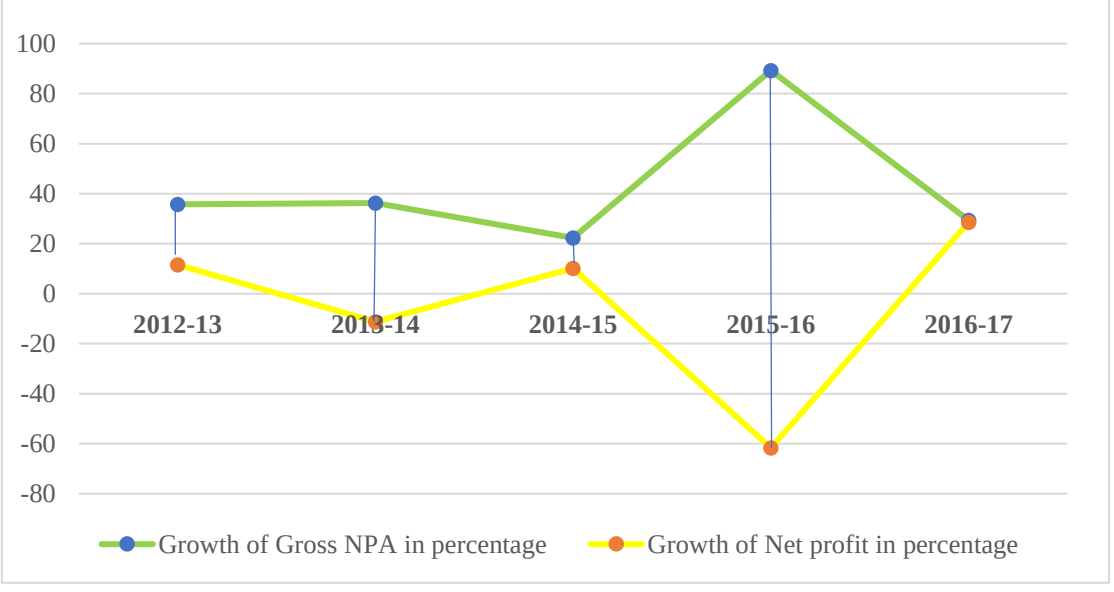
APPENDIX V.1

Data and variables used in the study

A-5.1.1: Table 5.1 – Gross NPA and Net profit of Indian Commercial Banks

Year	Gross NPA (in billion)	Percentage Variation	Net profit (in billion)	Percentage Variation
2012-13	1941	35.8	911.65	11.5
2013-14	2644	36.2	809.1	-11.2
2014-15	3233	22.3	890.78	10.1
2015-16	6119	89.3	341	-61.7
2016-17	7918	29.4	439	28.6

**Source: RBI, 2020*



A-5.1.2: Figure- 5.1: Movement in Net Profit and Gross NPA of Indian Banks

Note: The left-hand side measures the year-on-year growth rate (in percentage) in Gross NPA while the right-hand side measures the growth rate in net profit (in percentage) of Indian Banks from 2012-13 to 2016-17.

**Source: Own calculations based on data from RBI.*

A-5.1.3: Table 5.2- Number of Sample banks:

Number of Banks and Observations by bank category				
	Public Banks	**Private Banks**	**Foreign Banks**	**All**
Number of Banks	26	19	26	71
Number of Observations	312	228	312	852

**Source: Own calculations.*

A-5.1.4: Table 5.3- Description of variables at a glance:

Variables	Measurement	Abbreviation
Return on Asset	Net profit/ Total Assets	ROA
Return on Equity	Net profit / (Capital + Reserves and Surplus)	ROE
Diversification Ratio	Other Income / Total Income	DVR
Bank Size (A)	Log of Total Assets for individual banks	SIZE [a]
Bank Size (B)	Log of Total Deposits for individual banks	SIZE [b]
Annual Growth rate of Deposits	Growth in Total Deposit value over years for individual banks	GDR
Capital Ratio	Ratio of Total Equity to Total Assets	EA
Changes in HHI	Percentage changes in Herfindahl Hirschman index	CHHI
Efficiency	Computed value of Technical Efficiency scores by application of Data Envelopment Analysis	EFF
Inflation Expectations	Consumer Price Index	CPI
Cyclical component	Logarithmic deviation of real GDP from its segmented trend by application of Hodrick Prescott filter	CO
Net interest Margin	Interest earned minus interest expended as scaled down by total assets	NIM
Asset Quality	Ratio of Total Advances to Total Assets	ASQ

Note: Detail of other bank-specific control variables, Asset Quality and Net Interest Margin (NIM) that is the ratio of net interest income to total assets, is explained during the robustness checks of our model.

**Source: Own presentation*

APPENDIX V.2

Results of the study

A-5.2.1: Table 5.4- Correlation Diagnostics:

Checks for multicollinearity in dataset		
Variable	**VIF**	**1/VIF**
SIZE (log of Total Assets)	2.43	0.411860
EA	2.46	0.406110
DVR	1.41	0.710351
CPI	1.16	0.858969
EFF (OTE)	1.09	0.914885
CO	1.06	0.945490
GDR	1.05	0.954436
CHHI	1.04	0.963839
NIM	1.28	0.780450
ASQ	1.63	0.611840
Mean VIF	1.46	

Note: For notation of variables in the results table see Appendix: A-V.1.3: Table 4.2. We find similar VIF results with ROE as a dependent variable.
**Source: Own calculations*

A-5.2.2: Table 5.5- Descriptive Statistics:

Variables	Observations	Mean	Median	Std. Dev.
ROA	852	1.198	1.060	1.364
ROE	852	10.322	11.201	9.619
DVR	852	0.171	0.126	0.146
CPI	852	100.423	101.350	18.777
CO	852	0.045	0.103	0.483
GDR	852	0.306	0.166	2.632
CHHI	852	-0.387	-0.907	2.587
EA	852	0.144	0.079	0.155
EFF (OTE)	852	0.895	0.941	0.137
SIZE (log of Total assets)	852	4.375	4.609	1.012
SIZE (log of Total deposits)	852	4.173	4.495	1.157
NIM	852	3.036	2.857	1.065
ASQ	852	0.524	0.581	0.154

Note: For notation of variables in the results table see Appendix: A-V.1.3: Table 5.2.
**Source: Own calculations*

A-5.2.3: Table 5.6- Unit Root test results:

Variables	Levin et al., (2002)		Im et al., (2003)	
	At level	At first difference	At level	At first difference
ROA	0.0639	-14.650***	1.537	-9.256***
	(0.526)	(0.000)	(0.938)	(0.000)
ROE	0.584	-13.120***	2.794	-9.497***
	(0.720)	(0.000)	(0.997)	(0.000)
DVR	-5.788***	-4.127***	-4.023***	-10.182***
	(0.000)	(0.000)	(0.000)	(0.000)
CPI	-4.698***	-19.467***	7.045	-11.788***
	(0.000)	(0.000)	(1.000)	(0.000)
CO	-18.528***	-30.433***	-8.119***	-11.130***
	(0.000)	(0.000)	(0.000)	(0.000)
GDR	-6.587***	-16.284***	-6.819***	-14.203***
	(0.000)	(0.000)	(0.000)	(0.000)
CHHI	-8.715***	-18.692***	-3.461***	-8.731***
	(0.000)	(0.000)	(0.000)	(0.000)
EA	-13.397***	-17.746***	-4.230***	-10.252***
	(0.000)	(0.000)	(0.000)	(0.000)
EFF (OTE)	-33.833***	-19.309***	-4.755***	-12.839***
	(0.000)	(0.000)	(0.000)	(0.000)
EFF (PTE)	-20.180***	-13.920***	-6.721***	-12.430***
	(0.000)	(0.000)	(0.000)	(0.000)
SIZE (log of Total assets)	-15.554***	-8.734***	-2.837***	-4.406***
	(0.000)	(0.000)	(0.002)	(0.000)
SIZE (log of deposits)	-17.300***	-6.756***	-4.366***	-5.482***
	(0.000)	(0.000)	(0.000)	(0.000)
NIM	-10.616***	-17.324***	-3.108***	-10.407***
	(0.000)	(0.000)	(0.000)	(0.000)
ASQ	-5.689***	-8.817***	-1.776**	-8.785***
	(0.000)	(0.000)	(0.038)	(0.000)

Note: ***p<0.01; **p<0.05; *p<0.10. For notation of variables see Appendix: A-V.1.3: Table 5.2.
**Source: Own calculations*

A-5.2.4: Table 5.7- Static Panel results:

Variables	Model I (with ROA)	Model II (With ROE)
	Coeff.	Coeff.
	(p-value)	(p-value)
ΔDVR(it)	5.238***	18.525***
	(0.000)	(0.000)
ΔCPI(it)	-0.017***	-0.072*
	(0.001)	(0.055)
ΔCO(it)	-0.054	-0.291
	(0.351)	(0.471)
_cons.	0.032	-0.484
	(0.484)	(0.137)
Number of cross sections	71	71
Number of observations	781	781
Wald chi2	133.24	35.10
(p-value)	(0.000)	(0.000)
Hausman Test (p-value)	0.999	0.923

***p<0.01; **p<0.05; *p<0.10. P-values are given in parentheses.

For notation of variables see Appendix: A-V.1.3: Table 5.2.

**Source: Own calculations*

A-5.2.5: Table 5.8- Dynamic Panel results (Dependent Variable- ROA):

Two-step Robust Difference GMM Arellano-Bond Estimator Results (With Windmeijer Corrected Robust Standard Error)								
Variables	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
	(p-value)	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**
$\Delta ROA_{(it-1)}$	0.342***	0.319***	0.328***	0.319***	0.338***	0.340***	0.335***	0.318***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\Delta DVR_{(it)}$	3.737***	3.176**	3.177***	3.209***	3.244**	3.725**	3.255**	3.729***
	(0.000)	(0.018)	(0.009)	(0.002)	(0.015)	(0.002)	(0.014)	(0.000)
$\Delta CPI_{(it)}$	-0.035***	-0.035***	-0.035***	-0.034***	-0.034***	-0.030***	-0.035***	-0.036***
	(0.001)	(0.003)	(0.002)	(0.004)	(0.002)	(0.004)	(0.002)	(0.000)
$\Delta CO_{(it)}$	0.172**	0.219***	0.221***	0.253***	0.210***	0.211***	0.195***	0.235***
	(0.032)	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)	(0.005)	(0.001)
$\Delta GDR_{(it)}$		-0.025*	-0.274**		-0.020		-0.018	
		(0.061)	(0.048)		(0.297)		(0.215)	
$\Delta CHHI_{(it)}$	0.035	0.037	0.038	0.032	0.040	0.031	0.042	0.035
	(0.163)	(0.201)	(0.179)	(0.220)	(0.139)	(0.219)	(0.130)	(0.172)
$\Delta EA_{(it)}$		2.421*	1.922	2.071		1.913		
		(0.058)	(0.138)	(0.146)		(0.161)		
$\Delta EFF_{(it)}$ [a]	0.752**				0.589*		0.629*	
	(0.037)				(0.078)		(0.073)	
$\Delta EFF_{(it)}$ [b]						0.924**		
						(0.027)		
$\Delta SIZE_{(it)}$ [c]		0.725				0.804	0.194	
		(0.317)				(0.259)	(0.777)	
$\Delta SIZE_{(it)}$ [d]				-0.534				-0.598
				(0.342)				(0.111)
Nos. of Obs.	781	781	781	781	781	781	781	781
AR(2) [e] p-value	0.326	0.322	0.297	0.289	0.323	0.358	0.335	0.292
Number of cross-sections	71	71	71	71	71	71	71	71
Nos. of instruments	30	36	33	33	33	36	36	30
Sargan-Test [f] (p-value)	0.325	0.315	0.304	0.286	0.278	0.341	0.359	0.410
Wald-Test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: ***p<0.01; **p<0.05; *p<0.10. (i) For notation on variables see Appendix: A-V.1.3: Table 5.2.
(ii) Regression is normally represented by Y = a + bX. Where X is the key variable used to explain variation in Y (dependent variable). The 'a' is simply a constant that shows the upward movement along the vertical axis to understand the effect of X on Y (based on coefficient b). Here X is on horizontal axis and Y is on vertical axis. Here, we assume that total effects of X start on Y from origin (0,0) itself.
a. Computed value of Overall Technical Efficiency (OTE) scores under Chapter III.
b. Computed value of Pure Technical Efficiency (PTE) scores under Chapter III.
c. Computed value of Bank size using Log of Total Assets for individual banks over the sample period.
d. Computed value of Bank size using Log of Total Deposits for individual banks over the sample period.
e. Arellano-Bond test for serial autocorrelation at second order where *H0: no autocorrelation.*
f. Test for over-identification of restriction where *H0: Over-identifying restrictions are valid.*
**Source: Own calculations.*

A-5.2.6: Table 5.9- Dynamic Panel results (Dependent Variable- ROE):

Two-step Robust Difference GMM Arellano-Bond Estimator Results (With Windmeijer Corrected Robust Standard Error)++		
Variables	**I**	**II**
	Coeff.	**Coeff.**
	(p-value)	**(p-value)**
$\Delta ROE_{(it-1)}$	0.029***	0.219***
	(0.000)	(0.000)
$\Delta DVR_{(it)}$	19.411***	19.453***
	(0.006)	(0.009)
$\Delta CPI_{(it)}$	-0.277**	-0.307***
	(0.028)	(0.009)
$\Delta CO_{(it)}$	2.342***	2.601***
	(0.003)	(0.004)
$\Delta GDR_{(it)}$	-0.082	0.754
	(0.144)	(0.347)
$\Delta CHHI_{(it)}$	0.307	0.362
	(0.373)	(0.305)
$\Delta EA_{(it)}$	-5.361	-3.639
	(0.161)	(0.322)
$\Delta EFF_{(it)}$ [a]		6.662*
		(0.075)
$\Delta EFF_{(it)}$ [b]	10.336*	
	(0.073)	
Number of Observations	781	781
AR(2) [c] p-values	0.327	0.263
Number of cross-sections	71	71
Number of instruments	43	43
Sargan-Test statistics (p-value) [d]	0.200	0.163
Wald-Test (p-value)	0.000	0.000

Note: ***p<0.01; **p<0.05; *p<0.10 (i) For notation of variables in the results table see Appendix: A-V.1.3: Table 5.2.

(ii)Regression is normally represented by Y = a + bX. Where X is the key variable used to explain variation in Y (dependent variable). The 'a' is simply a constant that shows the upward movement along the vertical axis to understand the effect of X on Y (based on coefficient b). Here X is on horizontal axis and Y is on vertical axis. Here, we assume that total effects of X start on Y from origin (0,0) itself.

a. Computed value of Overall Technical Efficiency (OTE) scores under Chapter III.
b. Computed value of Pure Technical Efficiency (PTE) scores under Chapter III.
c. Arellano-Bond test for serial autocorrelation at second order where *H0: no autocorrelation.*
d. Test for over-identification of restriction where *H0: Over-identifying restrictions are valid.*

++ Other model estimation results with ROE as dependent variable gives poor outcome and does not satisfy the goodness of model fitness under the criteria of Dynamic Panel Procedures, hence only those models that satisfy the criteria in all respect are reported in case of ROE as dependent variable. Although these reported results are too weak in comparison to ROA in the context of overall model fitness. Such poor results of ROE may be related to the explanation provided in section 5.2.1 of this chapter and also in Chapter I. Hence among the indicators of bank profitability between ROA and ROE, ROA qualifies as the primary indicator of bank profitability.

**Source: Own calculations.*

A-5.2.7: Table 5.10- Checks for Model Robustness (Dependent Variable- ROA):

Two-step Robust Difference GMM Arellano-Bond Estimator Results (With Windmeijer Corrected Robust Standard Error)								
Variables	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
	(p-value)	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**	**(p-value)**
$\Delta ROA_{(it-1)}$	0.347***	0.258***	0.322***	0.368***	0.314***	0.275***	0.328***	0.302***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)
$\Delta DVR_{(it)}$	4.362***	4.257***	2.948**	3.994***	3.485***	4.338***	3.621***	4.153***
	(0.000)	(0.000)	(0.020)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)
$\Delta CPI_{(it)}$	0.017***	-0.036***	-0.027*	-0.026*	-0.026**	-0.032***	-0.029***	-0.030***
	(0.009)	(0.002)	(0.074)	(0.079)	(0.015)	(0.007)	(0.007)	(0.008)
$\Delta CO_{(it)}$	0.186*	0.223***	0.177**	0.251***	0.192***	0.254***	0.185***	0.247***
	(0.098)	(0.009)	(0.033)	(0.001)	(0.004)	(0.002)	(0.006)	(0.001)
$\Delta GDR_{(it)}$			-0.024		1.934	0.012		
			(0.185)		(0.195)	(0.629)		
$\Delta CHHI_{(it)}$		0.043	0.040	0.003	0.042	0.029	0.042	0.034
		(0.180)	(0.187)	(0.907)	(0.123)	(0.372)	(0.117)	(0.212)
$\Delta EFF_{(it)}$ [a]			0.988**					
			(0.046)					
$\Delta EFF_{(it)}$ [b]					0.755**		0.824**	
					(0.044)		(0.044)	
$\Delta SIZE_{(it)}$ [c]			0.819		1.126	1.067		
			(0.386)		(0.173)	(0.241)		
$\Delta SIZE_{(it)}$ [d]		0.165						
		(0.666)						
$\Delta EA_{(it)}$			2.091		1.934	1.342	1.174	0.262
			(0.204)		(0.195)	(0.307)	(0.428)	(0.807)
$\Delta ASQ_{(it)}$	-0.024	-0.188	1.689*	-0.542	1.979*	0.115	1.728*	0.326
	(0.970)	(0.804)	(0.052)	(0.518)	(0.053)	(0.887)	(0.073)	(0.684)
$\Delta NIM_{(it)}$	0.699***	0.607***		0.726***		0.708***		0.705***
	(0.000)	(0.000)		(0.000)		(0.000)		(0.000)
Number of Obs.	781	781	781	781	781	781	781	781
AR(2) [e] p-value	0.819	0.596	0.424	0.976	0.403	0.767	0.372	0.702
Number of cross-sections	71	71	71	71	71	71	71	71
Number of instruments	44	36	60	64	39	42	36	36
Sargan-Test [f] (p-value)	0.411	0.426	0.523	0.298	0.323	0.268	0.329	0.431
Wald-Test (p-Value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Note: ***p<0.01; **p<0.05; *p<0.10 (i) For notation of variables in the results table see Appendix: A-V.1.3: Table 5.2. Since NIM is often referred to as the accounting measure of efficiency for banks (RBI, 2008), hence exercising both economic and accounting measure of efficiency in a single equation will not be logical. Hence the robustness check for model with efficiency scores is not reported in this case.

(ii) Regression is normally represented by Y = a + bX. Where X is the key variable used to explain variation in Y (dependent variable). The 'a' is simply a constant that shows the upward movement along the vertical axis to

understand the effect of X on Y (based on coefficient b). Here X is on horizontal axis and Y is on vertical axis. Here, we assume that total effects of X start on Y from origin (0,0) itself.

a. Computed value of Overall Technical Efficiency (OTE) scores under Chapter III.

b. Computed value of Pure Technical Efficiency (PTE) scores under Chapter III.

c. Computed value of Bank size using Log of Total Assets for individual banks over the sample period.

d. Computed value of Bank size using Log of Total Deposits for individual banks over the sample period.

e. Arellano-Bond test for serial autocorrelation at second order where *H0: no autocorrelation.*

f. Test for over-identification of restriction where *H0: Over-identifying restrictions are valid.*

**Source: Own calculations.*

CHAPTER VI

CONCLUSION AND POLICY RECOMMENDATIONS

6.1. Revisiting our study:

Indian banking industry is subject to vigorous changes in the recent past more due to the increasing threat of NPAs. Post introduction of Economic Policy of 1991, that opened new avenues for private and foreign players to start banking business in India besides the existing public sector banks Indian banking sector is exposed to an ever-increasing competitive environment. According to a report (IBEF, 2017), during the stretch of 12 years (2006-2017) the overall bank deposits has grown at a CAGR of 12.03 percent and by March 2017 it amounted to USD 1.54 trillion. This scenario tends to indicate the higher disposable income and increased rate of savings. But the Asset Quality Report of Indian banks during 2015-16 reveals that interest earnings of Indian banks suffered a steady decline vis-à-vis rise in provisions and contingencies due to increase in poor asset quality resulting from NPAs out of the disbursed loans. Besides, the banking industry has continuously encountered threats due to the Asian Financial Crisis of 1997-98, the Sub-Prime lending crisis of 2007-08, different aspects of banking fraud, cyber-crimes, scenario of demonetization and others. Despite the extensive set of stringent rules implemented by the RBI there is a constant erosion of asset quality in the India banking industry due to growing NPAs. The report of Trend and Progress of Banking in India (RBI, 2016) too indicates that unlike the private and foreign banks operating in India the public sector banks have reported a landslide loss of 148 percent. The rate of increase in gross NPAs is steady during 2012-13 to 2016-17, but such a rise is significantly high during 2013-14 and 2015-16. However, in 2016-17 the rate of increase in NPA is comparatively lower that has led to slight increase in net profits of banks (Chapter IV). Therefore, given such a challenging scenario we intend to look into the key internal as well as external factors that significantly relates to bank's financial performance.

Following the different past works from an active body of literatures measuring financial performance of commercial banks we proxy such financial performance for Indian banks using two popular profitability measures ROA and an alternative measure ROE. Based on critical analysis of different existing and past studies we also argue ROA to be the primary measure of bank profitability due to the fact that ROE suffers from certain shortcomings due to the

presence of financial leverage effects and hence an analysis of ROE alone may not possibly give true outcomes. Further, due to limitations of the sample period owing to the availability of data and merger of Indian commercial banks we restrict our study over a period of 12 years (2005-06 to 2016-17).

Thus, we identify a set of focused explanatory variables in this study and examine its impact on bank's financial performance in the presence of other control variables under different model specifications. Besides certain bank-specific control variables our study also includes a control for industry concentration and a macroeconomic variable. We also compute the bank-level technical efficiency by using the DEA technique to conduct an in-depth study of the financial performance of Indian banks in the presence of their relative efficiency measures. In doing so we also draw a comparative analysis of such efficiency scores with the prevailing accounting measures of CAMELS rating index and highlight the key weaknesses in such rating index.

Since we proxy bank's financial performance in terms of their profitability, we argue that such measures of profitability (ROA and ROE) are a flow variable that has a dynamic relation with its own lagged value. Hence to deal out with the weaknesses of traditional static methodologies of panel data techniques that tends to give biased conclusions under such dynamic structure (Gupta & Kashiramka, 2020; Suman & Singh, 2021), we apply the difference GMM technique (Arellano & Bond, 1991) to evaluate our model results. Our analysis outcome reveals that besides the direct bank-specific factors, the external (industry specific and macroeconomic variables) factors too have significant impact on the financial performance of Indian commercial banks. Overall, our study considerably warrants the importance of ROA as the prime variable to proxy bank profitability and also highlights the importance of movement in business cycles that too plays a key role in determining financial performance of Indian banks.

6.2. Conclusion:

We use bank-wise yearly data from the STRBI of Reserve Bank of India and empirically evaluate that how the selected bank-specific, industry specific and macroeconomic indicators impact the financial performance of Indian Commercial banks. Following the works from an active body of literatures on bank performance we also proxy the financial performance of Indian banks using profitability ratios. Our study highlights the importance of ROA as a prime indicator of bank profitability that successfully gives the true picture of financial performance

of Indian banks. Further we also highlight the reasons of weaknesses in ROE as a measure of profitability due to the presence of leverage effects and therefore an analysis of ROE alone might not yield true conclusions in the context of financial performance of Indian banks. Given the dynamic nature of our dependent variables (ROA and ROE) to encounter the problem of endogeneity we employ a Two-Step Difference GMM estimation technique in this study (Arellano & Bond, 1991). Two main contributions of this study is the use of a novel variable to proxy the movement of business cycles (CO) in India and use of computed value of technical efficiency scores (OTE and PTE) to examine their impact on bank profits, besides using other bank specific, industry and macroeconomic factors. Apart from measuring the impact of our principal explanatory variables (DVR, CPI and CO) on indicators of bank-profitability we also estimate the effect of certain key control variables like yearly growth of bank deposits (GDR), capital ratio (EA), bank level technical efficiencies (EFF), bank size (SIZE) and changes in industry concentration ratio (CHHI). We also extend our study to check the model robustness of these preliminary findings through the inclusion of two additional control variables, NIM and ASQ of Indian commercial banks. The result of this study clearly indicates the superiority of ROA as the prime indicator of bank's financial performance and warrants the weaknesses of model outcomes using ROE as dependent variable.

Our findings (with ROA as dependent variable) highlight that out of the set of principal explanatory variables DVR and CO positively impact the financial performance of Indian banks whereas an increase in CPI has a negative impact on bank performance. We also find that compared to the traditional banking activities of disbursing loans and advances the income diversification ratio (DVR) elevates bank profitability by a manifold. Such findings are also consistent in the presence of subsequent inclusion of control variables under different model specifications. The results from inclusion of control variables also reveal some interesting observations too. We find that a rise in the yearly growth rate of bank deposits exerts a negative impact on bank performance that highlights the poor quality of loans disbursed and indicates that Indian banks are unable to successfully convert their deposit liabilities into value creating loans and subsequently loses on profitability. Such an outcome also reinstates the report outcome on Trend and Progress of Banking in India (RBI, 2016), that shows a massive 148 percent decline in profits of public sector banks unlike the private and foreign banks. Interestingly we find that when we introduce technical efficiency scores (OTE and PTE) as another control variable the impact of growth rate of deposits is although negative but becomes insignificant on profitability. Thus, it supports our argument in favor of bank level efficiency,

that if banks are better able to manage their performing loans, it increases their profits. We find a positive but very low statistical significance of capital ratio (EA) on bank performance but such outcome although is positive but does have a consistent statistical significance in the presence of other control variables. We examine the effect of industry concentration by the year-on-year changes in Herfindahl Hirschman index (CHII), but we find no statistical evidence of impact of market structure on performance of Indian banks. Likewise, we do not find and statistical evidence of bank size (SIZE) on bank performance. In this study we devise bank size using log of assets as our initial measure and use an alternative measure as log of deposits. Both these measures turn out to be statistically insignificant across our model specifications. This might be because in an effort by the small-sized banks to grow at a faster pace they tend to sacrifice their profits whereas private banks of Indian origin and the foreign banks in India are more inclined to increase their market share in India than earning higher profits.

We extend our analysis to evaluate the impact of two additional control variables, Net Interest Margin (NIM) and Asset Quality (ASQ) on ROA in the presence of the already specified variables as discussed above. Our analysis indicates that a one unit rise in NIM of banks significantly boosts their performance across the different specifications. On the contrary the ratio of total loans to total assets (ASQ) turns out to be positive but insignificant in the presence of NIM but is positive and significant in the presence of technical efficiency scores (OTE and PTE). As we argue that banks with higher efficiency are better able to manage their performing loans, we find statistical evidence of this argument from our results of ASQ across our stated models. The results further indicate that globally (OTE) as well as locally efficient (PTE) banks can also enjoy the benefit of ASQ with increase in their efficiencies.

The above discussions empirically warrant *our first objective of this study* and confirms that not only the bank-specific factors, but certain industry specific and macroeconomic variables also play a significant role to impact the financial performance of Indian banks.

We also perform an in-depth analysis of bank level technical efficiency in Chapter III of this study by employing the DEA technique. Our findings indicate that towards the end of the terminal year of our sample period (2016-17) there is ample scope of improvement in OTE among the Indian banks. As we compute an input oriented technical efficiency, it indicates that Indian banks can further reduce their inputs to the extent of 16.99 percent with a simultaneous increase in their outputs. Also, the OTE sores obtained under the CCR model is decomposed

into two different mutually exclusive components that are non-additive in nature, the Pure Technical Efficiency (PTE) and Scale Efficiency (SE). The value of PTE scores are obtained using the same dataset (similar to OTE) by employing the BCC model of DEA technique. Like OTE scores, towards the end of the terminal year of our sample period we find that the extent of PTIE is 8.5 percent. Thus, 8.5 percentage points out of 16.99 percent of overall technical inefficiency (OTIE) as stated above can be primarily allocated to managerial inefficiency. We also find a consistent decrease in efficiency (OTE and PTE) across the public and private banking sectors in India vis-à-vis the foreign banks over our sample period of 12 years. For instance, as on 2016-17 as per OTE scores, out of 20 globally efficient banks (out of our overall sample of 71 Indian commercial banks) only 3 banks belong to the public bank group (out of our sample of 26 public banks) while only 2 belong to private group (out of our sample of 19 private banks) as compared to 15 foreign sector banks (out of our sample of 26 Foreign banks). Similarly, as per PTE scores, 6 public banks and 4 private banks are found to be locally efficient vis-à-vis 21 foreign banks. Thereafter we also analyze the scale efficiencies of our sample banks and find that a significant proportion of OTIE is due to SIE towards the end of our sample period. Thus, our analysis of technical efficiencies in the context of Indian banks explains *our second objective* that results from Chapter III of this study and adequately warrants the decision of the Government of India towards consolidation of the major public sector banks to retain a few but healthier banks in the Indian banking sector.

Finally, as we argue that bank profitability is procyclical in nature i.e., it is consistent with the fluctuating trends of economic cycle, we find sufficient outcome in support of our such argument. The fundamental nature of economy of every nation consists of simultaneous trends of cyclical upswings and downswings. During period of downswing banks might have to hold idle funds with them, losing out on potential lending activity leading to deceased profits. While the opposite hold true during phases of economic recovery as demand for credit as well as stock market transactions increases that elevates the interest margin resulting in growth of revenue at an increased rate than costs. We find that effect of business cycles on bank performance is positive and significant across all model specifications and such outcome holds true with inclusion of control variables. This validates the robustness of our model results arrived herein. Furthermore, we also find hint of the fact that during phases of economic recovery the growth in aggregate economic activity (or GDP) positively impacts bank deposits as well as loans disbursed. Hence, this finding successfully satisfies *our third objective of this study* and

concludes that changes in overall cyclical component significantly impacts the financial performance of Indian banks.

6.3. Policy recommendations:

During our entire study period the Indian banking industry has been exposed to many challenges. Noteworthy among them are the financial crisis of 2008, the demonetization phase of 2016, increasing share of NPA resulting in consistent decline in bank profits, fraud in banking industry etc. In this study we highlight that certain macroeconomic factor alongside the bank-specific variables can provide significant insights to understand the performance of Indian banking industry. For instance, the positive impact of growth in national income during the recovery phases of business cycle on bank profits of indicates the need for much more well-formulated plans to channelize such growth potentials towards broadening the lending and deposit activities of Indian banks. Increase in inflation expectations poses significant problems not only for the citizens of the nation but also hinders improvement in performance of Indian banks. The Government of India in consultation with RBI during June 2016 decided to set the target inflation rate at 4 percent (with an upper limit of 6 percent and lower base of 2 percent) to ensure the price stability measures in the Indian economy. Further, though RBI announced retention of such rates for a 5 year period (from April 1, 2021 to March 31, 2026) in its Monetary Policy report of April 2021, the October 2021 issue again predicts fluctuations in inflation rates in upcoming quarters (RBI, 2021a, 2021b). Therefore, it is desirable to have suitable fiscal and monetary policy in place not only for the benefit of common people but also to enhance the bank profitability.

Increase in bank level efficiencies at local as well as at global level, might yield gains for Indian banks, more due to their attempt to attain the optimal scale of operations. Towards the end of our sample period the merger of public banks started in our country with the merger of SBI with its own associate banks, followed by subsequent consolidation of other public sector banks over the years. In a developing economy like India, where still a significant category of people does not have proper access to banking services, preparation of effective plan of operations is utmost essential to expand the banking system to cover the unbanked areas with the aim of including more people within the banking network. Such task can be best performed by the public banks, whereby the resulting mergers may give these public banks additional cushion in terms of increase in the abilities of these merged banks to sustain the cost of expansion and

deliver financial services more efficiently. As regards to the impact of bank size on their performance, the decision of bank mergers may prove to be beneficial in the near future since such mergers are expected to enable banks to enjoy the positive synergies resulting in enhanced efficiency levels in the industry through reduction of unessential activities and lowering the volume of NPAs. But we cannot predict anything conclusive at this point of time.

Furthermore, to deal out the adverse impact of rising NPA in the future the idea of 'bad bank' may prove to be useful too in Indian context. Although the Insolvency and Bankruptcy Code (IBC) passed in 2016 (with subsequent amendments in the following years) appears to be an excellent piece of regulation but owing to disruptions due to the ongoing pandemic (since March 2021) there are many more cases on Gross NPAs that awaiting their inclusion. An analysis of data from the Insolvency and Bankruptcy Board of India (IBBI) reveals that till September 2020 out of the 4008 cases, 2066 cases are successfully dealt with. However, out of the 1942 cases that were pending without a solution, 1442 cases were 270 days old. Despite the IBC infrastructure together with the legislative adjustments is capable to perform in the near future but to tackle the present stock of GNPAs just the IBC might be too much time consuming, leading to adverse consequences for Indian economy. Therefore, there is a significant necessity for a one-time resolution to tackle the existing enormous amount of stressed assets. Such a structure (idea of bad banks) is likely to benefit the banks in the upcoming days too. This idea of a 'bad bank' has already been experimented with the Stressed Asset Stabilization Fund (SASF) in 2004 to deal with the substantial portion of stressed assets of IDBI[65]. Such an exercise in the near future can provide respite to the banks as well as NBFCs through strategic deal out of their stressed assets (NPAs) in their books of accounts and subsequent recovery in part of such assets. Besides the case of IDBI, the bad bank has also recorded international success stories across several nations consistently, starting with Malaysia. A detail mechanism of the 'bad bank' along with the international evidence is mentioned in Appendix VI.1 of this chapter.

In India the public banks are still unable to enjoy a level playing field and thus have become inefficient over the years. The operations and mechanisms of the public sector banks (PSBs) are mostly under the Government vigilance as these banks are set up either under the State Bank of India Act or bank nationalisation acts instead of Companies Act; the operations and professional resolutions of PSBs are often subject to scrutiny by either the Central Bureau of

[65] https://www.livemint.com/Industry/cM5Rb5szBMFPAyYMNiVq1N/Lessons-from-IDBIs-experiment-with-a-bad-bank.html

Investigation (CBI) or Central Vigilance Commission (CVC) or by the Comptroller and Auditor General (CAG), that their private and foreign counterparts are free from. Also, the operational autonomy related to various matters like those of Mudra (Micro Units Development and Refinance Agency) loans as well as phone banking are too subject to daily interventions from higher authorities, restricting the PSBs from carrying spontaneous business operations.

The report by P.J. Nayak Committee (Nayak Committee, 2014) too also highlights these governance issues and provides insights to address these issues in the near future.

6.4. Limitations of the study:

One of the major limitations of this study is the selection of sample size. From April 2017 the Ministry of Finance, Government of India in consultation with the RBI decided to consolidate the public sector banks with the view of retaining a few but healthier banks. This exercise commenced with the merger of SBI with its associate banks, followed by subsequent consolidation of other public sector banks. Accordingly, following the budget announcement of Honorable Finance Minister of India Smt. Nirmala Sitharaman in 2019, 10 public sector banks are merged into 4 banks with effect from 1st April 2020[66]. As a result of such merger there has been a drastic change in the asset size, market share as well as performance of these merged banks and commenting on such changes might be still too early to reach any conclusive outcome. On the flip side, ignoring these merged banks that once happened to be significant players of Indian banking industry may not also yield true conclusions at this point of time. Hence, we restrict our sample size till 2016-17 only. Furthermore, the backward extension of our sample size is also dependent on the availability of data and variables used in this study. We find that such backward extension of our sample size beyond 2005-06 results in some of variables to be unavailable or inapplicable. Therefore, we conduct our study over a period of 12 years (2005-06 to 2016-17) with a sample of 71 Indian Commercial banks or 852 bank-years.

Moreover, the foreign banks operating in India are representative of their parent body in foreign nations. These banks are under the operative mandate and regulations of the Reserve Bank of India. However, over the years of our sample size the entry and exist of foreign banks in Indian

[66]https://www.livemint.com/industry/banking/merger-of-10-public-sector-banks-to-come-into-effect-from-today-10-points-11585632469446.html

baking industry is very frequent that creates unbalanced sample of banks in every year. For instance some of the noteworthy institutions like, Doha Bank Q.P.S.C commenced its business in India from 2014, Emirates NBD Bank (P.J.S.C) started from 2017, First Abu-Dhabi Bank (P.J.S.C) commenced its operations in India from November 2015, Industrial and Commercial Bank of China started its business in India from September 2011 whereas UBS AG bank that started its business in February 2008 exited the Indian banking industry in 2016. Therefore, to deal out the issues of unbalanced dataset, we consider a balanced sample of 71 Indian Commercial banks that are fully operative during our sample period of 12 years.

Further, the input-output bundle considered in the study for computing the relative efficiency of the sample banks are not exhaustive. Depending on the approach of DEA applied these input-output combinations changes too. We only considered our computation as per the Assets based sub-approach under the Intermediation approach as proposed by Sealey Jr & Lindley, (1977).

Finally, this study can also be conducted based on other variables that are not considered in this thesis. For instance, the impact of bank-specific variables like liquidity ratio (liquid assets to total assets); cost to income ratio (total operating expenses to total income); loan loss provisions to total assets; ratio of net NPA to net advance, labour productivity (profit per employee) etc., industry specific variables like market share or use of cross-section dummy variables to denote ownership or government control together with other macroeconomic variables like lending interest rates, unemployment rate, exchange rates and others. Further, contrary to certain existing literatures on bank performance (Dietrich & Wanzenried, 2011, 2014; Sarkar & Rakshit, 2021) that uses a three dependent factor to proxy bank profitability (ROA, ROE and NIM) whereby ROA is the prime variable for bank profits, we consider only ROA and ROE in this study as we use NIM (Net interest Margin) and ASQ (Asset Quality ratio) as a separate control variable to check our model robustness.

6.5. Scope for future research:

The idea of dynamic relationship in Indian banking industry can be successfully extended to investigate different nature of banking operations. For instance, we can study the determinants of bank's stability through construction of a Z-score index for Indian Commercial banks or examine the determinants of NPA of India banks, since an NPA of the past years might yield a persistent impact on the subsequent years as the realization of principal and interest ceases.

Moreover, we can also investigate the uncertainty in bank's earnings through the interactions of certain bank-specific and macro-economic variables, together with the analysis of policy related uncertainty (EPU Index) on bank's earnings risk.

Furthermore, the component of business cycle used in this analysis can also be split up into sample years where the output gap (i.e., logarithmic difference of real GDP from its segmented trend) is positive and when the output gap is negative. The results of such exercise will be interesting to investigate to understand that whether banks are able to insulate themselves during phases of economic downswings.

Finally, the scope of research in Indian banking industry is emerging with time and can highlight the different aspects in terms of bank's performance. Moreover, effective policies catering to monitor the diversification of banking business is also essential to implement effectively to safeguard banks from risks of insolvency. Besides, focus should be there on the effective mechanism of 'bad banks' to reduce the burden of NPAs in a bank's books of accounts in near future since, NPA will keep arising as an ex-post facto variable challenging the profitability of Indian banks.

Overall, the financial performance of Indian commercial banks is necessary to analyze to understand the significant impact of different variables that can either directly or indirectly induce policymakers to frame functional fiscal and monetary policies with the view of restoring the sustainability of existing banks in India.

To end with, we quote a few lines that again highlight the importance of the role of Indian banking industry as a vital contributor towards the nation's economic growth (Ahluwalia, 2002):

"Thank God, in joy and sorrow, to deposit and borrow,
Banks are there.
Otherwise, the question would be funny,
To keep and get money,
How and Where?"

- Shri Montek Singh Ahluwalia
(Former Deputy Chairman of Planning Commission of India)

APPENDIX VI.1

The idea of Bad Bank in India

A-6.1.1: Mechanism and proposed structure of a Bad Bank

In this section we try to provide a brief overview of Bad Bank based on the budget announcement of our Honorable Finance Minister Smt. Nirmala Sitharaman, several reports published in this context and also on the basis of the Malaysian success story of managing the stressed assets (Azmi and Razak, 2014; Narayan, 2021) :-

Objectives: In the context of small instances of stressed assets or NPA in form retail loans pertaining to a single lender are usually adequately handled by the lending institution whereas in case of increased amount of NPAs, the design of a 'Bad Bank' in India can serve the following purposes:

- To take out large chunks of Gross NPAs from the books of commercial banks and accumulate them in an organization that is specifically designed and funded to tackle such distressed loans.
- To discharge the commercial bank's lending eco-system so that they can continue with their traditional banking business of lending to boost the economic growth of India rather than having unending commitment to resolve on matters of GNPAs.
- To include more cases of distressed assets under a single ownership window to ensure the sustainability of banks and induce faster resolutions plans to resolve such issues of NPAs.

Moreover, to comply with the above stated objectives in place the following considerations are essential to abide by for smooth functioning of the 'Bad Bank':

- Such institutions should be managed by professionals having prior experience in dealing with stressed assets.
- The GNPAs should be transferred from a commercial bank to a 'Bad Bank' at a fair price that is required to be determined before such transfer is initiated. However, if GNPAs are transferred at a too low value then the retrieval process may yield supernormal profits to buyers. Such a situation may pose problems if potential buyers belong to private sectors. On the flip side if such transfer value is exorbitantly high then it will simply result in shift of the burden of such distressed asset from one entity to

another without any timely resolution. E.g., the case of experiment with IDBI bank in 2004.

- Bad Banks should be designed in such a manner that the resulting outcome is sustainable to assure productivity and jobs. Thus, the head of such institution should ensure involvement of all participants of the institution so that time bound resolution is a natural outcome instead of liquidation of the stressed entity. In case if the stressed assets belong to the specified sectors like infrastructure, power and energy, mining, metals, real estate and construction, aviation and shipping, the Government of India is a key participant for any potential outcome. This necessitates involvement of the government for a Bad Bank.
- Such a Bad Bank should not be established as an entity with perpetual lifetime rather the objective should be to provide a one-time solution over a period of say five years after which it can be discontinued.

Mechanism and Process of a Bad Bank:

We denote the 'Bad Bank' as *Bank X* that can be established either in the form of a government owned Asset Reconstruction Company (ARC) and is adequately resourced in the same manner similar to the recapitalization of Public Sector Banks by Government through issuance of specified Government of India (GOI) recap bonds. For instance, say a sum of ₹. 1 lakh crore is provided for 'Bank X' against the issuance of GOI recap bonds. Such an amount is expected to support the buying of stressed assets within a range of ₹. 2 lakhs to ₹. 3 lakh crores with the presumption of a price that is 33% to 50% lower than the market value of the stressed assets intended to be purchased.

Bank X shall have the capacity to consider the resolution of all distressed assets of the Indian financial sector eco-system. The information related to such stressed assets across all lenders is easily available from the Central Repository of Information on Large Credits (CRILC) for banks as well as for NBFCs.

Now suppose the *Bank X* proceeds further for buying the distressed assets at a 'fair price' arrived at after thorough review and expert opinion at its end. For instance, *Bank X* may offer ₹. 40 for every ₹.100 of a certain real estate and construction sector loan at face value. Those financial institutions (FIs) that have such loan assets on their record may accept to sell such loan assets at ₹. 40, paid for by *Bank X* in GOI recap bonds. However, the FIs can reject this

offer for the offered price being not satisfactory. Under such a situation those FIs will be mandated to write-down the distressed asset in their books to at least ₹. 36 or at a price that is 10% below the bid-price offered.

On the contrary if the offer of *Bank X* is accepted by the FIs then accordingly *Bank X* proceeds further to recover ₹. 60 [100-40] from the distressed asset by way of resolution within stipulated time. In such cases if *Bank X* can recover an amount more than ₹.40 say if the full amount of ₹.60 is recovered then *Bank X* will be liable to transfer a certain proportion (say 80%) of the excess amount recovered [i.e., ₹.60 - ₹.40] or 80% of ₹.20 or ₹.16, back to the FIs that sold their distressed assets. But if the recovery is less than ₹. 40 [i.e., amount transferred at the time of takeover] then such loss should be solely borne by *Bank X*.

Table 6.1 (Appendix VI.2) stated below shows lists the international evidence of the concept of Bad Banks across the nations. In line with the budget announcement of 2021, we also argue that given its international success the said idea can be implemented in India too at least on a trial basis for some time.

APPENDIX VI.2: Overview of Global Evidence on Bad Bank

A-6.2.1: Table 6.1- International Evidence of Bad Banks:

Important points	COUNTRIES					
	Malaysia	**Ireland**	**Thailand**	**Korea**	**Indonesia**	**China**
AMC Type	Public	Public and Private	Public and Private	Public and Private	Public	Public
Name of National AMC	Danaharta	NAMA	SAM BAM (listed in 2019)	KAMCO	IBRA	Cinda and Huarong (listed). Provisional AMCs: China Orient, Great Wall, Galaxy
Number of National AMCs	1	1	2	1	1	4+1+n
Established	1998	2009	2001	1997	1998	1999
Status as on November 2020	Inactive	Live	Live	Live	Inactive	Live
Regulation or Law	Danaharta Act	NAMA Act	AMC Decree	KAMCO Act	Banking law number 10 of 1998	Government banking reform.
Functionalities	Handled almost 3000 NPA accounts over its tenure with a resolution rate of 58 percent that is much higher than the 20 to 50 percent range that prevailed in Asia for similar agencies.	Mainly focused on large real estates. NAMA accounted for undertaking 12000 loans at a price of €31.8 billion across 5 banks and adapted a unanimous resolution approach for the debtors.	Focused on seeking resolution at bank, national and investor level and had the power to sell foreclosed loan assets to third parties.	Focused on corporate restructuring and acquiring NPAs. During its tenure KAMCO purchased 30000 worth of NPAs at a par value of US$92 billion with recover rate of 20-50 percent.	Focused on buying NPAs from target banks. Till November 2020 it is able to sell 60 percent of such stressed assets with a recovery rate of 22 percent.	Aimed at reducing NPAs of banks with a country level effort. Till November 2020 it has a recovery rate of 33.6 percent while cash recovery rate was 22.4 percent.

Source: Own presentation based on Deloitte Report and other sources on idea for Bad Banks in India (Deloitte, 2020). Accessed on January 2022.

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