CHAPTER: 5

DETERMINANTS OF BANK PROFITABILITY

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The performance of commercial banks in India has come to occupy a central place in the financial landscape with an expansion in business opportunities across the globe and rising expectations of the corporates. There has also been an increase in savings from domestic sector and enhanced purchasing power of the middle-class Indian. High-performance banks and banks dedicated to improving their performance care about profitability-oriented performance measurement and management. Profitability-oriented performance management is necessary, both to know what a bank can do to affect profits and to benchmark the effect of any such moves (PwC, 2011). Profitability can be a robust and inclusive means of measuring bank performance as it captures the diversified earnings of banks through its assets, equities, and income generating activities.

An alarming deterioration in the financial health of Indian banks the mid-80s onwards led to the realization that efficiency of the financial system cannot to be measured by quantitative growth alone and hence there was a need for urgent reforms. The period of reforms saw significant transition in the banking industry with the entry of new private sector banks and foreign banks which infused competition for the Indian players and ushered in the best global practices in the industry. The financial sector reforms of the nineties led to opening up of the economy and its integration with global markets. Computerization and technology advancement in the banking sector have served as a means to minimizing the cost of operations and improving customer services and overall efficiency of the industry. Nevertheless, the nationalized banks could not match the changing pace of the times while the private and foreign banks surpassed their performance. The profitability of the public sector banks as a group remained negative in 1993-94. At the bank level, a higher return can reduce bank fragility to a large extent. Weakness in banks can have severe implications for the banking system, the financial sector, as well as for the economy as a whole.

Increased profitability makes for a sustainable banking sector enabling macroeconomic stability that can finance economic growth and development. The Reserve Bank of India's Financial Stability Report has pointed out an increase in vulnerability of the Indian banks.

Deteriorating profitability as well as asset quality poses elevated risks to the banking sector stability. Weak profitability of commercial banks is a matter of concern as low profits can prevent banks from building cushion against unexpected losses and make them vulnerable to adverse shocks (RBI, 2018). The report also highlights the structural issues related to low profitability of banks particularly high loan loss provisions, debt overhang, increasing costs, and declining revenues.

After the global financial crisis, Indian banks started witnessing major issues of bad loans and bank frauds leading to decline in profitability and bank failures. Overall, the last two decades have been challenging for the Indian banking industry. The Indian banks have had ample scope to grow in an economy with an average growth rate of 7.0 percent. It is desired that banks sustain profitability as it is one of the driving forces of capital accumulation and contributes to economic growth. This demands a need for further investigation on the subject of profitability of banks. It becomes crucial for banks to identify the factors which could enhance profitability or deplete profitability causing possible risks. The banks have to strategically balance between regulations issued by the Reserve Bank of India and the ever-changing needs of the market and customers. At the same time, banks have to be very cautious of their performance, effectiveness, efficiency, and resource utilization.

The recent turbulence and its spillovers in the banking industry provides a strong case for exploring the factors influencing bank profitability in detail. A profitable banking industry is capable of absorbing external negative shocks and simultaneously achieving stability of the financial system. Hence, it is pertinent to undertake a comprehensive study of bank profitability so as to assess and manage risks for ensuring financial stability.

Although the study of profitability of the banking sector has been of great interest in the developed economies, the studies that focus on bank profitability in case of emerging economies are limited in number. An analysis of bank profitability in India could be of immense importance for regulators and policymakers. It becomes significant to examine profitability as an indicator of bank performance. More importantly, it is vital to identify the factors that could enhance the profitability of banks. In this context, some of the questions that need to be answered are – What determines the profitability of banks in India? Is it capital adequacy, or asset quality, or efficiency, or liquidity position of banks? Does size of banks and technology have a significant impact on bank profitability? How well do the banks respond to macroeconomic factors?

The present study carefully investigates and examines the impact of determinants on bank profitability. The focus is on assessing the possible impact of financial, non-financial, and macroeconomic factors on the profitability of scheduled commercial banks in India. Determinant analysis has been carried out to examine the nature and magnitude of relationship between profitability of banks and its determinants; for public sector banks, private sector banks, and foreign banks in India.

The chapter has been divided into *four sections*. *Section 5.1* throws light on the empirical framework of the determinant analysis for the study. *Section 5.2* gives a detailed outline of the methodology engaged for carrying out determinant analysis. Empirical results and findings are reported in *section 5.3*. A brief summary, conclusions and inferences are presented in *section 5.4*.

5.1 Empirical Framework

There exists a vast literature on empirical estimation of determinants of profitability for individual banks as well as bank groups. The literature on determinants of bank profitability is varied in terms of the context, time frame, economies, and bank categories. The studies also differ in methodology adopted, determinants identified, variable definitions, and specifications. A review of literature reveals that different methodologies are used for the determinant analysis of bank profitability. To mention some of them are simple OLS regression analysis, pooled OLS regression analysis, least-square panel regression analysis, GMM estimation on panel data, and cointegration analysis. The studies have identified many variables, dependent variables as well as explanatory variables for determinant analysis. Broadly, the dependent variables representing bank profitability as noted in different studies were return on assets, return on equity, return on average assets, return on average equity, net interest margin, net profits, and economic value-added. In case of explanatory variables of bank profitability; total assets, log of total assets, capital adequacy ratio, previous year profitability, non-performing loans to gross loans, loan loss provision to total loans, total loans to total assets, cost to income ratio, liquid asset to total assets, deposit to total assets, operating cost to total assets, number of bank branches, business per employee, profit per employee, net asset per employee, income per employee, and market concentration were selected for analysis by different studies. Some researchers argue that bank profitability is enhanced by improvements in internal organization and managerial efficiency of the bank

itself; few state that industry-specific factors are integral to the profitability of banks; while a limited number of studies highlight the role of macroeconomic factors in determining bank profitability. Macroeconomic variables taken by studies for determinant analysis are primarily rate of inflation measured by wholesale price index (WPI) or consumer price index (CPI), economic growth rate, and interest rate. Although a large number of financial variables have been used for determinant analysis, there are very few studies that have tried to examine the impact of non-financial variables on the profitability of banks. The present study attempts to address this gap. The study considers non-financial variables along with other bank-specific financial variables and macroeconomic variables to determine their impact on bank profitability.

After reviewing the literature, the present study has identified certain dependent variables representing bank profitability, and a number of independent variables that fall into three categories – financial, non-financial, and macroeconomic variables. The empirical framework has been categorized into three sub-sections. Section 5.1.1 presents a comprehensive review of literature and the studies that have examined the selected determinants of bank profitability. The model and framework for determinant analysis have been described in section 5.1.2. The hypotheses on the nature of relationship between bank profitability and selected determinants; and the functions to be estimated for determinant analysis are stated in section 5.1.3.

5.1.1 Literature Review: Determinants of Profitability

A review of literature has been carried out to identify the indicators of bank profitability (dependent variables) and the factors determining bank profitability (explanatory variables). The dependent and independent variables selected for the determinant analysis get support from a large number of studies on the subject. The variables selected for determinant analysis in the present study are presented below along with the mention of literature that support the selection of the same.

Dependent Variables	*Literature*
Return on Assets	Staikouras and Wood (2004), Athanasoglou, Delis and Staikouras (2006), Sufian and Chong (2008), Alexious and Sofoklis (2009), Alper and Anbar (2011), Ayele (2012), Bhatia, Mahajan and Chander (2012), Naseem et al. (2012), Sufian (2012), Ongore and Kusa (2013), San and Heng (2013), Swamy (2013), Căpraru and Ihnatov (2014), Eze (2014), Ozili (2015), Seenaiah, Rath and Samantaraya (2015), Alshatti (2016), Nessibi (2016), Sinha and Sharma (2016), Shuremo (2016), Topak and Talu (2016), Alyousfi, Saha and Rus (2017), Kawshala and Panditharanthan (2017), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), Al-Harbi (2019), Le and Ngo (2020)
Return on Equity	Athanasoglou, Delis and Staikouras (2006), Alexious and Sofoklis (2009), Alper and Anbar (2011), Ayele (2012), Naseem et. al. (2012), Ongore and Kusa (2013), San and Heng (2013), Swamy (2013), Căpraru and Ihnatov (2014), Eze (2014), Seenaiah, Rath and Samantaraya (2015), Alshatti (2016), Topak and Talu (2016), Alyousfi, Saha and Rus (2017), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018)
Net Interest Margin	Heffernan and Fu (2008), Sufian and Habibullah (2009), Ayele (2012), Naseem et. al. (2012), Tarus, Chekol, and Mutwol (2012), Ongore and Kusa (2013), San and Heng (2013), Căpraru and Ihnatov (2014), Eze (2014), Ozili (2015), Shuremo (2016), Alyousfi, Saha and Rus (2017), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), Al-Harbi (2019), Le and Ngo (2020)
Independent Variables	***Literature***
Capital Adequacy Ratio	Staikouras and Wood (2004), Heffernan and Fu (2008), Dietrich and Wanzanried (2009), Alper and Anbar (2011), Ayele (2012), Bhatia, Mahajan and Chander (2012), Francis (2013), Ongore and Kusa (2013), San and Heng (2013), Swamy (2013), Căpraru and Ihnatov (2014), Ozili (2015), Patria, Căpraru and Ihnatov (2015), Alshatti (2016), Shuremo (2016), Alyousfi, Saha and Rus (2017), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), Le and Ngo (2020)
Log of Total Assets	Staikouras and Wood (2004), Athanasoglou, Delis and Staikouras (2006), Heffernan and Fu (2008), Sufian and Chong (2008), Alexiou and Sofoklis (2009), Sufian and Habibullah (2009), Alper and Anbar (2011), Ayele (2012), Naseem et al. (2012), Sufian (2012), Francis (2013), Ghosh (2013), San and Heng (2013), Swamy (2013), Căpraru and Ihnatov (2014), Patria, Căpraru and Ihnatov (2015), Ozili (2015), Alshatti (2016), Nessibi (2016), Topak and Talu (2016), Alyousfi, Saha and Rus (2017), Kawshala and Panditharanthan (2017), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), Xu, Hu and Das (2019)

Cost to Income Ratio	Heffernan and Fu (2008), Alexiou and Sofoklis (2009), Dietrich and Wanzanried (2009), Francis (2013), San and Heng (2013), Căpraru and Ihnatov (2014), Ozili (2015), Patria, Căpraru and Ihnatov (2015), Topak and Talu (2016), Mbekomize and Mapharing (2017), Kohlscheen, Murcia and Contreras (2018), Xu, Hu and Das (2019)
Gross Non-performing Asset Ratio	Ayele (2012), Bhatia, Mahajan and Chander (2012), Ongore and Kusa (2013), Swamy (2013), Căpraru and Ihnatov (2014), Eze (2014), Patria, Căpraru and Ihnatov (2015), Alyousfi, Saha and Rus (2017), Le and Ngo (2020)
Business Per Employee	Badola and Verma (2006), Bhatia, Mahajan and Chander (2012), Maiti and Jana (2017), Boateng (2019), Mahajan (2019)
Liquid Asset Ratio	Bourke (1989), Molyneux and Thorton (1992), Pasiouras and Kosmidou (2007), Alper and Anbar (2011), Alshatti (2016), Shuremo (2016), Alyousfi, Saha and Rus (2017), Kawshala and Panditharanthan (2017)
Previous Year Profitability of Bank	Flamini, McDonald, and Schumacher (2009), Ponca (2012), Djalilov and Piesse (2016), Tan (2016), Sinha and Sharma (2016), Kohlscheen, Murcia and Contreras (2018), Le and Ngo (2020)
Number of Bank Branches	Al-Homaidi et al. (2018), Almaqtari et al. (2018)
Number of ATMs	Le and Ngo (2020)
Economic Growth Rate	Staikouras and Wood (2004), Heffernan and Fu (2008), Dietrich and Wanzanried (2009), Alper and Anbar (2011), Ayele (2012), Naseem et. al. (2012), Ongore and Kusa (2013), Swamy (2013), Ozili (2015), Nessibi (2016), Sinha and Sharma (2016), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), Xu, Hu and Das (2019), Le and Ngo (2020)
Rate of Inflation	Athanasoglou, Delis and Staikouras (2006), Pasiouras and Kosmidou (2007), Heffernan and Fu (2008), Alexiou and Sofoklis (2009), Alper and Anbar (2011), Masood and Ashraf (2012), Naseem et. al. (2012), Acaravci and Çalim (2013), Ongore and Kusa (2013), San and Heng (2013), Jara-Bertin, Moya and Perales (2014), Nessibi (2016), Saona (2016), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Mohanty and Krishnankutty (2018), Le and Ngo (2020)

A large number of studies have tried to examine determinants of bank profitability for different bank categories across different countries. The main indicators of bank profitability (dependent variables) discussed in the literature are Return on Assets, Return on Equity, and Net Interest Margin. The same have also been considered for determinant analysis in the study. The variables influencing bank profitability taken in the study are Financial Variables,

Non-financial Variables, and Macroeconomic Variables. The *Financial Variables* are Capital Adequacy Ratio, Log of Total Assets, Cost to Income Ratio, Gross Non-Performing Asset Ratio, Business Per Employee, Liquid Asset Ratio, and Previous Year Profitability of Bank. The *Non-financial Variables* are Number of Bank Branches and Number of ATMs, while the *Macroeconomic Variables* are Economic Growth Rate and Rate of Inflation.

The independent variables identified on the basis of reviewed literature for analysis in the study have certain expected relationship with bank profitability. Variables like business per employee, previous year profitability of banks, total number of bank branches, total number of ATMs, and economic growth rate tend to share a positive relationship with bank profitability. Variables such as gross non-performing asset ratio, liquid asset ratio, and cost to income ratio are expected to have a negative relationship with bank profitability.

Three of the explanatory variables; namely capital adequacy ratio, log of total assets, and rate of inflation are found to share either a positive relationship or negative relationship with bank profitability. The literature is divided on the nature of relationship of these three independent variables with bank profitability. In case of capital adequacy ratio, Staikouras and Wood (2004), Ongore and Kusa (2013), San and Heng (2013), Căpraru and Ihnatov (2014), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), and Mohanty and Krishnankutty (2018) support a significant positive impact of capital adequacy on bank profitability. A significant negative effect from capital adequacy ratio to bank profitability has been reported by Heffernan and Fu (2008), Dietrich and Wanzanried (2009), and Mbekomize and Mapharing (2017). The present study has hypothesized a positive relationship between capital adequacy ratio and bank profitability on the basis of the study by Kohlscheen, Murcia and Contreras (2018) carried out at the Bank for International Settlements. The study found a significant positive influence of capital adequacy on bank profitability, indicating that highly capitalized banks tend to be more profitable.

The empirical findings on the effect of log of total assets on bank profitability is contradictory for different researchers. There is no consensus on the nature of relationship between the two variables. A number of studies support a significant positive relationship between the log of total assets and bank profitability, namely Staikouras and Wood (2004), Alper and Anbar (2011), San and Heng (2013), Mbekomize and Mapharing (2017), and Al-Homaidi et al. (2018). Besides, there are other studies that support a significant negative impact of log of total assets on bank profitability such as Ghosh (2013), Căpraru and Ihnatov

(2014), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), and Xu, Hu and Das (2019). Kohlscheen, Murcia and Contreras (2018) found that banks with larger asset size are less efficient. In consensus with this finding, the present study too suggests a negative impact of log of total assets on bank profitability.

Studies diverge on the matter whether inflation rate has a positive or a negative effect on bank profitability. Pasiouras and Kosmidou (2007), Masood and Ashraf (2012), Acaravci and Çalim (2013), Jara-Bertin, Moya and Perales (2014), Saona (2016), and Al-Homaidi et al. (2018) support a positive effect of inflation rate on bank profitability. A negative significant relationship between inflation rate and bank profitability has been reported by Heffernan and Fu (2008), and Ongore and Kusa (2013). Despite the conflicting results on inflation rate and bank profitability association, empirical evidence largely advocates a positive connection between the two. In this light, the present study has hypothesized a positive impact of inflation rate on bank profitability.

5.1.2 Determinant Analysis: Model and Framework

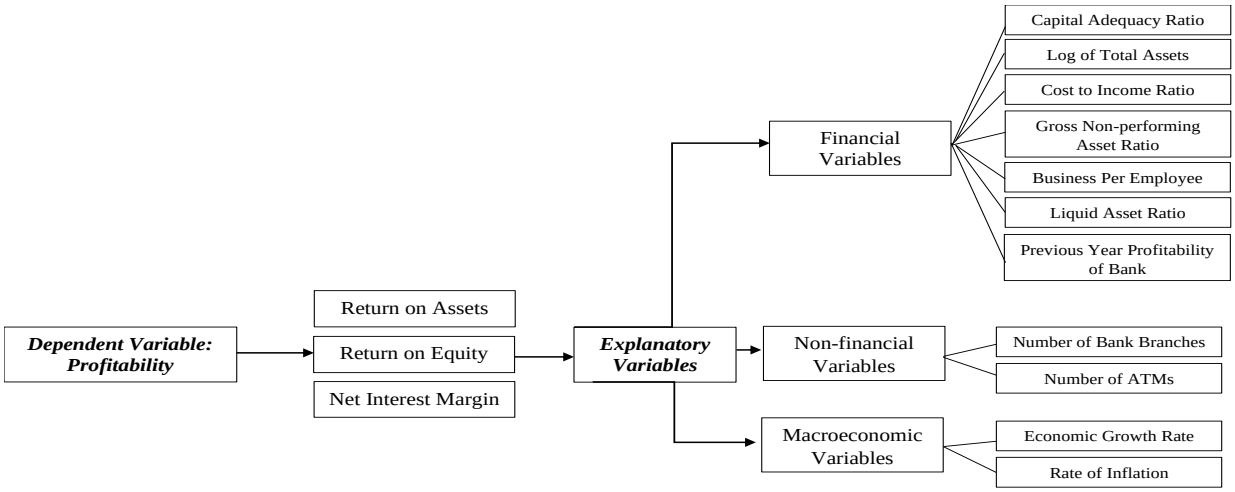
In this section, the overall model for determinant analysis and the framework has been presented.

The Model

The model for determinant analysis is stated as:

Profitability = *f*(Financial Variables, Non-financial Variables, Macroeconomic Variables)

The Framework



5.1.3 Statement of Hypotheses

After critically examining the literature on determinants of bank profitability, a set of hypotheses stating the nature of relationship between profitability of banks and the identified determinants has been formulated. In order to avoid repetition of variable specifications and to economize on space, the variables and their specification have been mentioned in section 5.2.2 under research methodology.

The hypothesized relationship between bank profitability and the selected determinants are listed below:

H1: Bank Profitability [PROF] shares a positive relationship with Capital Adequacy Ratio [CRAR].

H2: Log of Total Assets [Log TA] have a negative effect on Bank Profitability [PROF].

H3: Bank Profitability [PROF] and Cost to Income Ratio [CIR] are inversely related.

H4: Gross Non-performing Asset Ratio [GNPA] tends to have a negative impact on Bank Profitability [PROF].

H5: Bank Profitability [PROF] responds positively to Business Per Employee [BPE].

H6: A rise in Liquid Asset Ratio [LAR] leads to a fall in Bank Profitability [PROF].

H7: Previous Year Profitability of Bank [$PROF_{-1}$] positively affects Current Year Profitability of Bank [PROF].

H8: Number of Bank Branches [BR] and Bank Profitability [PROF] are positively related.

H9: An increase in Number of ATMs [ATM] tends to increase Bank Profitability [PROF].

H10: Economic Growth Rate [GDP] has a positive impact on Bank Profitability [PROF].

H11: The impact of Rate of Inflation [INF] on Bank Profitability [PROF] is positive.

The Functions

The study attempts to identify the impact of financial, non-financial, and macroeconomic variables on bank profitability. The determinant analysis for bank profitability is carried out for bank groups (public, private, and foreign bank groups) as well as for the scheduled

commercial banking sector (represented by all banks selected in the study). Linear and Double-log regression models have been established for the determinant analysis.

Linear Regression Function

$$\mathbf{PROF_i = f\ (CRAR, \ln TA, CIR, GNPA, BPE, LAR, PROF_{-1}, \Delta BR, GDP, INF)} \quad \text{(+ – – – + – + + + +)} \quad \textit{… (1)}$$

where, i = 1, 2, 3
$PROF_1$ refers to Bank Profitability defined as Return on Assets (ROA)
$PROF_2$ refers to Bank Profitability defined as Return on Equity (ROE)
$PROF_3$ refers to Bank Profitability defined as Net Interest Margin (NIM)

To identify the factors that influence or determine bank profitability and to study their relationship, linear regression function (1) is estimated for public, private, and foreign bank groups, for each of the profitability indicators – ROA, ROE, and NIM.

Double-Log Regression Function

$$\mathbf{\ln PROF_3 = f\ (\ln CRAR, \ln TA, \ln CIR, \ln GNPA, \ln BPE, \ln LAR, \ln PROF_{-1}, \ln BR, \ln GDP, \ln INF)} \quad \text{(+ – – – + – + + + +)} \quad \textit{…(2)}$$

$$\mathbf{\ln PROF_3 = f\ (\ln CRAR, \ln TA, \ln CIR, \ln GNPA, \ln BPE, \ln LAR, \ln PROF_{-1}, \ln BR, \ln ATM, \ln GDP, \ln INF)} \quad \text{(+ – – – + – + + + + +)} \quad \textit{…(3)}$$

where, $PROF_3$ refers to Bank Profitability defined as Net Interest Margin

The double-log regression function is estimated to study the direction and magnitude of relationship between bank profitability and the determinants as it yields the value of elasticity. In this case, the bank profitability indicator is NIM alone and the regression is estimated for the scheduled commercial banking sector (inclusive of all banks taken in the study). Two double-log functions have been developed - '*Without the number of ATMs'* (function 2) and '*With the number of ATMs'* (function 3). The objective of including number of ATMs in the model is to understand the impact of technology on bank performance by assessing the magnitude of association between bank profitability and technology adopted by scheduled commercial banks.

The above stated functions are estimated using least square panel regression analysis. The subsequent section presents the research methodology in detail.

5.2 Research Methodology

To examine the determinants of bank profitability for scheduled commercial banks in India, *Panel Regression Analysis* has been employed in the study. The research methodology is presented in four sub-sections. It includes model specification in section 5.2.1, specification of variables used in section 5.2.2, method and technique for model estimation in section 5.2.3, and time period of the study and data sources in section 5.2.4.

5.2.1 Model Specification

Determinant analysis is carried out by estimating Least Square Panel Regression (LSPR) for dynamic model, stated as:

$$Y_{it} = \alpha + \beta_1 X_{it1} + \beta_2 X_{it2} + \beta_3 X_{it3} + \beta_4 Y_{i(t-1)4} + \ldots\ldots + \beta_n X_{itn} + u_{it}$$

where,
Y = Dependent Variable or Bank Profitability
X = Explanatory Variables or Determinants of Bank Profitability
β = Coefficients of explanatory variables
i = Cross-section dimension
t = Time-series dimension

$$u_{it} = \mu_i + v_{it}$$

where,
μ_i = Unobservable individual specific effect
v_{it} = Remainder disturbance

The above stated least square panel regression model is estimated for bank groups as well as the scheduled commercial banking sector. The banks selected in the study in the previous chapter have been taken for carrying out the determinant analysis as well (for bank selection criteria refer Section 4.1 in Chapter 4). *Each bank group is represented by five selected banks; while all the fifteen banks from public, private, and foreign bank groups together represent the scheduled commercial banking sector.* The banks selected from each of the three bank groups in the study are: State Bank of India, Bank of Baroda, Punjab National

Bank, Canara Bank, Bank of India (public sector bank group - PSBG); HDFC Bank, ICICI Bank, Axis Bank, Yes Bank, IndusInd Bank (private sector bank group - PvtSBG); and Citibank, HSBC Bank, Standard Chartered Bank, Deutsche Bank, DBS Bank (foreign bank group - FBG). The above dynamic model is estimated in linear and double-log functional forms. The entire analysis has been carried out with the help of EViews software.

5.2.2 Variable Specification

To identify what determines bank profitability; financial, non-financial, and macroeconomic variables are taken as independent variables. The dependent variable or bank profitability is measured as – return on assets, return on equity, and net interest margin. The dependent and independent variables identified from reviewed literature (refer Section 5.1.1) for the determinant analysis have been presented in Table 5.1 below along with the specification and measurement of variables.

Table 5.1 Specification and Measurement of Variables

Dependent Variables			
Return on Assets		[ROA]	Ratio of net income of bank to average total assets
Return on Equity		[ROE]	Ratio of net profit for the year to the average of capital, reserves and surplus for current and previous years
Net Interest Margin		[NIM]	Ratio of the difference between total interest earned and total interest expended to average total assets for current and previous years
Independent Variables			
Financial Variables	Capital-to-Risk (weighted) Asset Ratio	[CRAR]	Ratio of bank's capital to bank's risk-weighted assets
	Log of Total Assets	[TA]	Logarithmic function of total assets of bank
	Cost to Income Ratio	[CIR]	Ratio of operating cost of bank to its total income
	Gross Non-Performing Asset Ratio	[GNPA]	Ratio of gross non-performing assets to gross advances
	Business Per Employee	[BPE]	Ratio of business (deposits + advances) generated by the bank to total number of employees of the bank
	Liquid Asset Ratio	[LAR]	Ratio of liquid assets of bank to its total assets
	Previous Year Profitability of Bank	[$PROF_{-1}$]	Lagged value of profitability of bank

Non-Financial Variables	Number of Bank Branches*	[BR]	Total number of bank branches
	Number of ATMs	[ATM]	Aggregate of on-site and off-site ATMs of bank
Macroeconomic Variables	Economic Growth Rate	[GDP]	Annual Real GDP Growth Rate
	Rate of Inflation	[INF]	Annual inflation rate based on consumer price index

*Change in number of bank branches (ΔBR) is taken as the explanatory variable in linear regression model for bank group analysis. Total number of bank branches (BR) has been taken as the explanatory variable in the double-log regression models for scheduled commercial banking sector in order to examine the relationship between bank branches and bank profitability and to estimate elasticity.

5.2.3 Method and Technique: Panel Regression Analysis

The study has employed the ***least square panel regression analysis*** for estimating dynamic linear and double-log models. The details of panel regression analysis have been discussed in this section. This is succeeded by the specific steps that are engaged in model estimation and followed by diagnostic tests required for the analysis.

Least Square Panel Regression models are based on panel data. Panel data have space as well as time dimension. Panel data are also referred to as pooled data, as data are pooled from time-series and cross-section observations. Panel data are also called as longitudinal data where a study considers data of a variable or group of subjects over time. It essentially implies movement of data in cross-section units over time.

There are many advantages of using panel regression analysis as against time series analysis or cross-section analysis. According to Baltagi (2005), panel data analysis controls the heterogeneity in individuals, firms, state or country units (i.e. cross-section dimension). Panel data analysis increases the scope for more informative data by combining time series and cross-section observations. It enables more variability in the data by adding cross-section dimension to time series data. There is lesser collinearity among variables, more degree of freedom, and higher efficiency. Panel data analysis is well suited for studying the dynamics of change and allows constructing and testing of complicated behavioural models. Panel data can help to enrich empirical analysis and minimize biases in data. The present study has employed least square panel regression for estimating dynamic models to carry out the determinant analysis of bank profitability. The approach adopted in the study for engaging

panel regression analysis is based on two studies on panel data analysis by Baltagi (2005) and Wooldridge (2010).

According to Baltagi (2005), a panel data regression is different from a simple time series or cross-section regression. A panel data regression has a double subscript on its variables, stated as:

$$Y_{it} = \alpha + X_{it}\beta + u_{it}$$

Here, i denotes the units such as households, individuals, firms, state, country, etc., which indicates the cross-section dimension; t denotes time which indicates the time series dimension; α is a scalar (constant term); β is $K \times 1$; and X_{it} is the it^{th} observation on K explanatory variables. The error u_{it} is also known as idiosyncratic error or time-varying error because it represents unobserved factors that change over time and affect Y_{it} (the dependent variable).

The one-way error component model for the disturbances is decomposed as:

$$u_{it} = \mu_i + v_{it}$$

μ_i denotes the unobservable individual specific effect and v_{it} denotes the remainder disturbance.

There are two types of panel data – micro panel and macro panel. Micro panel data has a large cross-section (N) for a smaller time period (T), in which case N > T. Macro panel data has smaller cross-section observations for a longer time period, where N < T. *In this study, macro panel data are taken for determinant analysis.*

The panel data can be classified as balanced and unbalanced panels. When each cross-sectional unit has the same number of time-series observations, the panel is known as a balanced panel. If the number of observations differ among panel members or if the data for a few time periods is not available for any cross-sectional unit, it is an unbalanced panel. *The dataset for the estimation of panel regression models in the present study includes both balanced as well as unbalanced panels.* In the analysis of bank groups, the public sector and foreign bank groups have a balanced panel dataset while private sector bank group comprises of an unbalanced panel. In the analysis for scheduled commercial banking sector, the 'Without ATM' model has an unbalanced panel[1], while the 'With ATM' model has a balanced panel.

Panel data can be used for regression analysis in three ways – pooled ordinary least square approach (Pooled OLS), fixed effect method (or LSDV approach), and random effect method (GLS approach). According to Wooldridge (2010), an independently pooled cross-section is obtained by sampling randomly from a large population at different points in time. In addition, pooled OLS is employed when the cross-section differs for each time series in the sample. Pooled OLS does not consider the time constant unobservable individual specific effect (μ_i), hence the error term is biased and inconsistent. Pooled OLS is suitable when different cross-sectional data are selected for each time period. In panel regression analysis, panel dataset consists of observations of the same cross-section over several time periods. In this study, the cross-sections i.e. the selected banks (public sector banks, private sector banks, and foreign banks) are the same for all the time periods. Therefore, the panel dataset for the study is examined using two models – Fixed Effect Model and Random Effect Model to assess the unobserved effect of panel data with consistent cross-section units for the given time period. *The study considers both fixed effect model and random effect model while estimating the stated functions for panel regression analysis.*

In the fixed effect model (FEM), the unobserved effect μ_i are assumed to be fixed parameters to be estimated and the remainder disturbance v_{it} are stochastic, independent, and identically distributed IID(0, σ^2_v). The explanatory variables X_{it} are assumed to be independent of the v_{it} for all cross-section and time series dimensions. The fixed effect estimator is efficient when the time-varying errors are serially uncorrelated as well as homoskedastic. There is no assumption in fixed effect model regarding the correlation between μ_i and X_{it}. It is an appropriate specification if the focus is on a specific set of cross-sections and the inference is restricted to the behaviour of specific sets of cross-sections (Baltagi, 2005). The fixed effect least square or least square dummy variables (LSDV) suffer from certain limitations – the fixed effect estimator cannot estimate the impact of any time-invariant variables; the estimator also suffers from a significant loss of degree of freedom with large cross-sections; and too many dummies may aggravate the problem of multicollinearity among regressors.

The mechanics of fixed effect estimation with an unbalanced panel is similar to that of a balanced panel. If T_i observation is the number of time periods for cross-sectional unit i, T_i observations are used for time-demeaning. Time-demeaning means subtracting the time mean from each variable in the model and then estimating the results. This procedure is known as 'within transformation'. The fixed effect estimate allows dropping of the unobserved

component and consistently estimating α, giving time-demeaned data. In the case of a balanced panel, one degree of freedom is lost for every cross-sectional observation (N-1) due to time-demeaning from the total number of observations $T_1 + T_2 + \ldots\ldots T_N$. The time-demeaning for missing years in an unbalanced panel yields all zeros and is not used in the estimation. The regression packages make the appropriate adjustment while estimating fixed effects with an unbalanced panel (Wooldridge, 2010). The 'between estimator' is obtained on the cross-sectional equation; the equation is estimated after including an intercept α to identify the variations between Y and X. The *between estimator* ignores the change in cross-sections over time. The estimator is biased when μ_i is correlated with X_{it}. If the assumption stands that time-varying error (u_{it}) is serially uncorrelated and homoskedastic, then fixed effect estimator (fixed effect model) needs to be employed. On the other hand, if the assumption states that unobservable individual specific effect (μ_i) is uncorrelated with explanatory variable (X_{it}), then the random effect estimator (random effect model) is engaged.

The random effect model (REM) is based on the assumption that μ_i is random and uncorrelated with each explanatory variable. In this model, $\mu_i \sim IID(0, \sigma^2_\mu)$, $v_{it} \sim IID(0, \sigma^2_v)$, and the μ_i are independent of the v_{it}. In addition, the X_{it} (explanatory variables) are independent of the μ_i and v_{it}, for all i and t. The random effect model is an appropriate specification if the N individuals are drawn randomly from a large population. Precaution has to be taken while designing the panel to make it representative of the population for which the inferences are made. In this case, N is usually large and the fixed effects model would lead to an enormous loss of degree of freedom.

In random effect model, μ_i is characterized as random and the inference pertains to the population from which the sample is randomly drawn. The assumptions of random effect model are – the individual specific unobserved effect (μ_i) is random and uncorrelated with the explanatory variables; the variance μ_i is constant; there is no perfect linear relationship among the explanatory variables; the expected value of time-varying error (u_{it}) with given explanatory variables in all time periods and μ_i is zero $E(u_{it}|X_{it}\ \mu_i) = 0$; the expected value of μ_i of all explanatory variables is zero $E(\mu_i|X_{it}) = 0$ (Wooldridge, 2010). If the set of assumptions for random effect model holds true, the random effect estimator is asymptotical as N (cross-section) gets large with fixed T (time period). Here, the random effect would be more efficient than pooled OLS or fixed effects.

Wallace and Hussain (1969) estimator is used in balanced panels for estimating random effect model. In unbalanced panels, two methods are used to estimate the random effect model – Swamy and Arora (1972), and Amemiya (1971) procedure (or, Wansbeek and Kapteyn, 1989)[2]. *In the present study, Wallace and Hussain estimator is used to estimate random effect models for balanced panels, while Amemiya or Wansbeek and Kapteyn estimator is used for estimating random effect models for unbalanced panels.* The EViews software package does not allow estimation of random effect model using the Swamy and Arora estimator if the explanatory variables (X_{it}) are more than the cross-section (N) individuals. Therefore, the present study engages Wansbeek and Kapteyn estimator for random effect model for unbalanced panels.

In order to identify the consistent and appropriate model between fixed effect model and random effect model, the basic assumption is tested for random effect model. The basic assumption for random effect model states that the unobserved effect μ_i and explanatory variables X_{it} are uncorrelated. To check whether the assumption is satisfied, Hausman test (1978) is used. There are two caveats of Hausman test. One, strict exogeneity denoted by $E(u_{it}|X_{it}\ \mu_i) = 0$ and $E(\mu_i|X_{it}) = 0$. The other is that μ_i should be constant. Hausman test is examined for the random effect model under the null hypothesis that μ_i and X_{it} are uncorrelated. If the null hypothesis is accepted on the basis of test criterion for the Hausman test, it implies that random effect model is the consistent model between the fixed effect and random effect models. If the null hypothesis is rejected, it implies that μ_i and X_{it} are correlated and fixed effect model is consistent and appropriate model.

Estimation Procedure for Panel Regression Analysis

To assess the impact of financial, non-financial, and macroeconomic variables on bank profitability, least square panel regression analysis is engaged. Prior to developing the models for panel regression, the association between the dependent and independent variables have been observed by estimating Pearson's correlation coefficient (refer appendix II). The entire methodology and steps for analysis are based on Baltagi (2005) and Wooldridge (2010). In accordance to these two studies, the present study has attempted to undertake the panel regression analysis for identifying the determinants of bank profitability. The estimation and analysis of models involve the following steps:

To begin with in the *first step*, the fixed effect and random effect models are estimated for linear and double-log regression equations. The least square panel regression is estimated in a linear functional form for public sector, private sector, and foreign bank groups. The same is estimated in double-log functional form for scheduled commercial banking sector to assess the magnitude of relationship and elasticity.

In the *second step*, the results of fixed effect model and random effect model are tested for cross-section dependency in residuals.

In the *third step*, the results of fixed effect model and random effect model are compared using Hausman test to identify the consistent and appropriate model.

Lastly, the consistent model is discussed further for interpretation and drawing conclusions so as to determine the factors that influence bank profitability.

Diagnostic Tests

A panel regression equation needs to be tested for serial correlation and homoskedasticity in an error component model (Baltagi, 2005; Wooldridge, 2010). The regression must be free from serial correlation in the cross-section and the residuals must be homoskedastic. To test the cross-section dependence in residuals (serial correlation), Breusch-Pagan LM test and Pesaran CD test are applied in the present study. Breusch-Pagan LM test is appropriate when there are smaller cross-sections for a longer time period, while Pesaran CD test is engaged when the cross-sections are sufficiently large for a given time period. Breusch-Pagan LM test is employed for linear regression models estimated for bank groups, and Pesaran CD test is engaged for double-log regression models estimated for the scheduled commercial banking sector.

According to Verbon (1980) and Baltagi (2005), the application of cross-section GLS weights with error component procedure allows for heteroskedasticity in the individual effects modelled as a simple function of 'p' time-invariant variables. It estimates a feasible GLS specification correcting for heteroskedasticity and contemporaneous correlation between cross-sections. In the present study, the fixed effect models are estimated keeping the cross-section fixed and assigning GLS weights to cross-section. The random effect models are estimated keeping cross-section random and assigning GLS weights to cross-section (Panel-Corrected Standard Error) to address the problem of heteroskedasticity.

5.2.4 Time Period of the Study and Data Sources

The time period covered for the analysis of determinants of bank profitability ranges from 2001-02 to 2018-19. Except for Yes bank, rest all banks have a data set for a period of eighteen years from 2001-02 to 2018-19. Yes bank commenced its business in 2004 and hence the data set for this bank ranges from 2004-05 to 2018-19. Number of ATMs is taken to assess the impact of technology on bank profitability. The data for number of ATMs is available from the year 2004-05 and hence the data set for the same ranges from 2004-05 to 2018-19.

Secondary data is engaged for examining the determinants of profitability of scheduled commercial banks in India. Annual observations of financial, non-financial, and macroeconomic variables have been considered. The data required for analysis have been sourced from various issues of the Reserve Bank of India publications such as Statistical Tables Relating to Banks in India, Reports on Trend and Progress of Banking in India, and the World Bank database.

5.3 Empirical Results

Empirical outcome of determinant analysis for public sector bank group is presented under sub-section 5.3.1, private sector bank group in 5.3.2, and foreign bank group in 5.3.3. The results for scheduled commercial banking sector are tabulated in sub-section 5.3.4, followed by discussion and inferences.

The panel regression models estimated in the study have met the required assumptions of absence of serial correlation or no cross-section dependency in residuals; homoskedasticity in residuals; exogeneity in the model; and absence of multicollinearity in independent variables. The selected models do not have issues of severe multicollinearity as the correlation coefficient between independent variables have been found to be less than 0.8 (refer appendix II). In addition, variance inflation factor (VIF) were also found to be in the range of 1 to 10.

5.3.1 Public Sector Banks

The linear regression functions for examining the determinants of bank profitability for public sector banks has been estimated for all the three profitability indicators – return on assets (ROA), return on equity (ROE), and net interest margin (NIM). The results are presented in Table 5.2.

Table 5.2 Determinants of Profitability of Public Sector Banks

Independent Variables	**Dependent Variables**					
	ROA		**ROE**		**NIM**	
	FEM	**REM**	**FEM**	**REM**	**FEM**	**REM**
Constant	13.35* (4.14)	1.67*** (1.90)	265.34* (4.41)	44.34* (2.62)	4.40*** (1.71)	0.67 (0.90)
CRAR	0.11* (3.94)	0.10* (2.90)	1.39** (2.47)	1.49** (2.38)	0.02 (1.02)	0.02 (0.90)
ln TA	-2.11* (-3.97)	-0.22*** (-1.79)	-38.78* (-3.95)	-4.04*** (-1.64)	-0.65 (-1.61)	-0.10 (-0.85)
CIR	-0.02** (-1.99)	-0.009 (-0.60)	-0.74* (-2.66)	-0.31 (-1.08)	0.03* (3.16)	0.03* (3.11)
GNPA	-0.07* (-6.06)	-0.05* (-4.22)	-1.26* (-5.72)	-1.27* (-4.99)	0.01 (1.07)	0.02** (2.21)
BPE	0.006** (2.16)	-0.003* (-3.19)	0.09*** (1.85)	-0.08* (-3.58)	0.002 (0.84)	-0.001 (-0.79)
LAR	-1.68 (-1.41)	-0.12 (-0.10)	-48.67** (-2.13)	-9.47 (-0.41)	-1.64*** (-1.64)	-1.44*** (-1.64)
$PROF_{-1}$	0.04 (0.45)	0.14 (1.38)	0.02 (0.23)	0.08 (0.85)	0.50* (4.76)	0.65* (8.44)
ΔBR	0.00002 (0.51)	0.00001 (0.36)	0.0001 (0.25)	0.0004 (0.51)	-0.00005 (-0.11)	-0.00001 (-0.22)
GDP	0.007 (0.38)	-0.02 (-0.84)	-0.08 (-0.20)	-0.63 (-1.38)	-0.03 (-1.58)	-0.03** (-1.76)
INF	0.02 (1.56)	0.02 (1.50)	0.29 (0.97)	0.24 (0.69)	0.03* (2.47)	0.04* (2.89)
R^2	***0.85***	***0.78***	***0.84***	***0.79***	***0.86***	***0.83***
Adjusted R^2	***0.82***	***0.75***	***0.81***	***0.77***	***0.84***	***0.80***
S.E. of Regression	***0.29***	***0.31***	***5.26***	***5.85***	***0.20***	***0.20***
F-statistic	***29.32****	***27.14****	***26.76****	***29.38****	***32.58****	***36.79****
Brusch-Pagan LM test	***16.91^{NCS}***	***26.72^{CS}***	***16.28^{NCS}***	***31.02^{CS}***	***13.44^{NCS}***	***12.99^{NCS}***
Hausman Test	**FEM is Consistent**		**FEM is Consistent**		**FEM is Consistent**	

* = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%, NCS = No Cross-Section Dependence in residuals, CS = Presence of Cross-Section Dependence in residuals, S.E. of regression for ROA and NIM are fitted at 95% prediction interval and for ROE is fitted at 85% prediction interval.

The following observations are drawn from Table 5.2:

- Hausman test is used to identify the consistent model between fixed effect and random effect models. In case of linear functions estimated for ROA, ROE as well as NIM, the null hypothesis is rejected on the basis of test criterion and fixed effect model is found to be consistent. The fixed effect model is appropriate for all the three profitability indicators and is considered for further analysis.

- **The overall test results for fixed effect model of ROA** has turned out very well with high R^2 and adjusted R^2. The explanatory power of the equation as measured by adjusted R^2 is 0.82 with independent variables explaining 82% of variation in ROA. The F-value is 29.32 and is significant at 1%. The standard error estimate of the equation is small. There is no cross-section dependence in residuals as measured by Brusch-Pagan LM test with a value of 16.91.

- All the explanatory variables in the model confirm to the hypothesized relationships with return on assets. CRAR, BPE, $PROF_{-1}$, ΔBR, GDP and INF share a positive relationship with ROA; while Log TA, CIR, GNPA and LAR have a negative impact on ROA.

- Two of the financial variables, namely CRAR and BPE have been found to have a positive significant influence on ROA. A unit change in these variables tends to change ROA positively.

- There exists a significant negative relationship between ROA and the following financial variables – Log TA, CIR and GNPA. Log TA has a high coefficient value of -2.11 indicating that a large size of total assets of public sector banks tends to have a negative effect on banks' ROA. An increase in CIR and GNPA also tend to reduce ROA of banks.

- LAR, ΔBR, GDP and INF share a weak relationship with ROA although these variables have confirmed to the expected signs.

- Previous year bank profitability ($PROF_{-1}$) does not have a significant impact on current year bank profitability (ROA).

- **The test results for ROE** reveal a high R^2 of 84% and adjusted R^2 of 81%, implying that the determinants explain more than 80 percent variation in ROE. The standard error of the regression is in the 85% prediction interval range. The value of F-statistics is 26.76, significant at 1% level. According to Brusch-Pagan LM test, there is no cross-section dependence in the residuals.

- All explanatory variables except GDP confirms to the predicted signs. However, the non-financial and macroeconomic variables such as ΔBR, GDP and INF share an insignificant relationship with ROE.

- CRAR and BPE have a significant positive impact on ROE. A unit change in CRAR and BPE will lead to an increase in ROE by 1.39 and 0.09, respectively.

- Other financial variables as Log TA, CIR, GNPA and LAR share a significant negative relationship with ROE. A rise in each of these variables leads to a fall in ROE. There is a high coefficient value of -48.67 of LAR and -38.78 of Log TA. A high liquid assets to total assets ratio and a large asset size tend to reduce ROE of banks.

- Though previous year profitability has the expected sign, it does not share a significant relationship with current year profitability for ROE, as seen in the case of ROA.

- **The test results in case of NIM** is good with high adjusted R^2 of 0.84. The standard error of the regression is low, F-statistics is significant at 1% level and the model is free from cross-section dependence in residuals.

- The variables that turned out to be significant are – CIR, LAR, $PROF_{-1}$ and INF. CIR, $PROF_{-1}$ and INF have a strong positive influence on NIM.

- LAR has a significantly negative impact on NIM with a coefficient value of -1.64. In case of public sector banks, a unit increase in LAR leads to more than proportionate fall in NIM.

5.3.2 Private Sector Banks

The results of determinant analysis for private sector banks are presented in Table 5.3, followed by discussion of results.

Table 5.3 Determinants of Profitability of Private Sector Banks

Independent Variables	Dependent Variables					
	ROA		ROE		NIM	
	FEM	REM	FEM	REM	FEM	REM
Constant	2.10* (3.79)	1.80** (2.58)	41.51* (6.10)	36.06* (3.80)	0.20 (0.25)	-0.09 (-0.13)
CRAR	0.06** (2.61)	0.05** (2.32)	-0.12 (-0.53)	-0.03 (-0.12)	0.05** (2.39)	0.06* (2.97)
ln TA	-0.12 (-0.98)	-0.03 (-0.26)	-2.08*** (-1.69)	-1.58 (-1.06)	0.09 (0.50)	0.02 (0.18)
CIR	-0.04* (-2.84)	-0.03*** (-1.90)	-0.59* (-3.92)	-0.57* (-3.09)	0.01 (0.86)	0.03** (1.98)
GNPA	-0.14* (-5.54)	-0.12* (-4.75)	-1.32* (-4.80)	-1.11* (-3.36)	-0.02 (-1.25)	-0.04*** (-1.64)
BPE	-0.001 (-0.80)	-0.003*** (-1.90)	-0.02 (-1.21)	-0.02 (-1.21)	-0.002 (-1.13)	-0.001 (-0.54)
LAR	-0.19 (-0.16)	-0.77 (-0.53)	4.00 (0.32)	14.22 (0.81)	-0.91 (-0.75)	-0.73 (-0.51)
$PROF_{-1}$	0.44* (4.66)	0.35* (3.23)	0.35* (4.56)	0.39* (3.43)	0.56* (5.69)	0.58* (7.04)
ΔBR	-0.0001 (-0.54)	0.00007 (0.30)	-0.00006 (-0.02)	0.0002 (0.07)	-0.0001 (-0.72)	-0.0001 (-0.46)
GDP	0.01 (0.55)	0.01 (0.70)	0.17 (0.85)	0.18 (0.58)	0.003 (0.16)	-0.007 (-0.30)
INF	-0.01 (-1.07)	-0.02 (-1.60)	0.08 (0.59)	-0.09 (-0.42)	-0.01 (-0.92)	-0.01 (-0.65)
R^2	***0.73***	***0.52***	***0.75***	***0.51***	***0.92***	***0.76***
Adjusted R^2	***0.67***	***0.46***	***0.70***	***0.44***	***0.90***	***0.72***
S.E. of Regression	***0.29***	***0.31***	***3.85***	***4.03***	***0.28***	***0.29***
F-statistic	***12.99****	***7.92****	***14.71****	***7.56****	***58.19****	***22.75****
Brusch-Pagan LM test	***13.87^NCS***	***16.73^NCS***	***16.79^NCS***	***13.23^NCS***	***15.67^NCS***	***19.33^CS***
Hausman Test	**FEM is Consistent**		**FEM is Consistent**		**FEM is Consistent**	

* = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%, NCS = No Cross-Section Dependence in residuals, CS = Presence of Cross-Section Dependence in residuals, S.E. of regression for ROA and NIM are fitted at 95% prediction interval and for ROE is fitted at 85% prediction interval.

The important highlights from Table 5.3 are:

- Hausman test criterion found fixed effect model to be consistent for all the three profitability indicators – ROA, ROE, and NIM; and it is selected for further discussion.

- **The overall explanatory power of ROA** is found to be satisfactory with R^2 of 73% and adjusted R^2 of 67% for private sector banks. The standard error of regression is quite low at 0.29. The overall significance of the model reported by F-statistics is significant at 1% level. The Brusch-Pagan LM test suggests absence of cross-section dependence in residuals.

- Three of the explanatory variables – BPE, ΔBR and INF do not confirm to their a priori expected signs. Also, these variables are found to share an insignificant negative relationship with ROA.

- CRAR, CIR and GNPA share a strong and significant relationship with return on assets. CRAR impact ROA positively. However, an increase in CIR and GNPA tends to have a negative influence on ROA.

- Log TA, LAR and GDP have a weak impact on ROA, although they confirmed to their expected signs.

- Previous year profitability of private sector banks has a significant positive impact on its current year profitability (ROA).

- **The overall test results for fixed effect model of ROE** is good with an adjusted R^2 value of 0.70 indicating that the determinants explain 70% variation in ROE. The standard error for the model is in the range of 85% prediction level. There is no cross-section dependency in residuals and F-statistics stands significant at 1%.

- All the explanatory variables except CRAR, BPE, LAR and ΔBR confirm to their hypothesized signs.

- Of the explanatory variables – Log TA, CIR and GNPA share a strong negative relationship with ROE. A unit increase in Log TA, CIR and GNPA will lead to a significant fall in ROE.

- Each of these six variables – CRAR, BPE, LAR, ΔBR, GDP and INF have an insignificant association with ROE. CRAR, BPE and ΔBR have a negative impact on ROE, while LAR, GDP and INF have a positive impact.

- $PROF_{-1}$ has a significant positive effect on ROE at 1% level.

- **The regression results for the profitability indicator NIM** yields a high adjusted R^2 value of 0.90. Standard error of regression is low, F-statistics is significant at 1% level and there is no cross-section dependency in residuals.

- Except for CRAR and $PROF_{-1}$ rest all the explanatory variables are found to share an insignificant relationship with NIM. CRAR and $PROF_{-1}$ have a strong positive impact on NIM of private sector banks.

5.3.3 Foreign Banks

The results of linear functions for examining the determinants of bank profitability for foreign banks are presented in Table 5.4.

The following observations are made from Table 5.4:

- Hausman test criterion found fixed effect model to be more consistent and appropriate for all the profitability indicators – ROA, ROE, and NIM. The fixed effect model is the consistent model and is discussed here.

- **The results for ROA** equation for foreign banks yield 63% R^2 values and 56% adjusted R^2 values. The value of standard error of the regression is 0.59. The value of F-statistics is significant at 1% level, and there is no cross-section dependence in residuals.

- Except for CRAR, ΔBR and GDP rest of the explanatory variables are consistent with their expected signs.

- Majority of the explanatory variables have an insignificant impact on ROA, only three financial variables – CRAR, CIR and GNPA share a significant negative relationship with ROA. Log TA, LAR, ΔBR and GDP influence ROA negatively although

insignificantly. BPE and INF are insignificant in explaining changes in ROA but influence latter positively.

- Though weak, current year profitability of foreign banks shares a positive relationship with its previous year profitability.

- **The fixed effect model of ROE** for foreign banks reveals a high R^2 of 80% and adjusted R^2 of 76%. The prediction interval is 85% for standard error of regression. The Brusch-Pagan LM test indicates no cross-section dependence in residuals. The F-statistics value is 20.91 and is significant at 1% level.

- Explanatory variables such as Log TA, CIR, GNPA, LAR, $PROF_{-1}$ and ΔBR confirm to their hypothesized relationships with ROE for foreign banks.

- The non-financial variable, ΔBR has a significant and positive impact on ROE.

- CRAR, CIR, GNPA and GDP share a negative significant relationship with ROE. Although insignificant, Log TA, BPE, LAR and INF have a negative influence on ROE.

- $PROF_{-1}$ of foreign banks has an insignificant positive impact on current year profitability (ROE).

- **The overall test results of NIM** is good with 0.68 adjusted R^2 value. There is a low standard error of regression, significant F-statistics value at 1% level, and absences of any cross-section dependency in residuals.

- All the explanatory variables share a weak relationship with NIM except for CRAR and $PROF_{-1}$. CRAR has a significant and negative impact on NIM, while previous year profitability ($PROF_{-1}$) has a strong positive influence on current year profitability (NIM) of foreign banks.

Table 5.4 Determinants of Profitability of Foreign Banks

Independent Variables	Dependent Variables					
	ROA		ROE		NIM	
	FEM	REM	FEM	REM	FEM	REM
Constant	6.67* (3.01)	4.14* (2.19)	64.32* (4.48)	41.15* (3.13)	3.91** (2.34)	1.63 (1.25)
CRAR	-0.06* (-3.44)	-0.06* (-3.02)	-0.53* (-4.50)	-0.46* (-3.43)	-0.02*** (-1.92)	-0.03 (-1.59)
ln TA	-0.47 (-1.21)	0.02 (0.08)	-3.49 (-1.42)	0.06 (0.03)	-0.43 (-1.40)	-0.11 (-0.56)
CIR	-0.02** (-2.02)	-0.01 (-1.26)	-0.47* (-5.42)	-0.37* (-3.71)	-0.0006 (-0.05)	0.01 (1.21)
GNPA	-0.11* (-4.17)	-0.10* (-3.14)	-1.19* (-6.86)	-1.05* (-5.16)	-0.0006 (-0.28)	-0.01 (-0.51)
BPE	0.00001 (0.01)	-0.001*** (-1.89)	-0.01 (-1.49)	-0.02* (-3.02)	0.0002 (0.21)	-0.0008 (-1.03)
LAR	-0.47 (-0.57)	-0.28 (-0.27)	-3.91 (-0.70)	-4.16 (-0.64)	0.07 (0.09)	-0.39 (-0.40)
$PROF_{-1}$	0.12 (1.18)	0.23** (2.08)	0.04 (0.47)	0.17*** (1.87)	0.71* (8.39)	0.87* (10.04)
ΔBR	-0.005 (-0.57)	-0.002 (-0.18)	0.13** (2.23)	0.14** (2.10)	-0.007 (-1.01)	-0.01 (-1.50)
GDP	-0.05 (-1.35)	-0.08*** (-1.79)	-0.41*** (-1.63)	-0.50*** (-1.73)	0.01 (0.49)	-0.02 (-0.40)
INF	0.008 (0.27)	-0.02 (-0.76)	-0.19 (-1.09)	-0.29 (-1.60)	-0.007 (-0.30)	-0.02 (-0.81)
R^2	***0.63***	***0.48***	***0.80***	***0.69***	***0.73***	***0.73***
Adjusted R^2	***0.56***	***0.41***	***0.76***	***0.65***	***0.68***	***0.70***
S.E. of Regression	***0.59***	***0.63***	***3.67***	***3.97***	***0.57***	***0.59***
F-statistic	***8.63****	***6.96****	***20.91****	***16.66****	***13.94****	***20.74****
Brusch-Pagan LM test	***11.9NCS***	***11.47NCS***	***8.53NCS***	***8.76NCS***	***6.78 NCS***	***8.20 NCS***
Hausman Test	**FEM is Consistent**		**FEM is Consistent**		**FEM is Consistent**	

* = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%, NCS = No Cross-Section Dependence in residuals, CS = Presence of Cross-Section Dependence in residuals, S.E. of regression for ROA and NIM are fitted at 95% prediction interval and for ROE is fitted at 85% prediction interval.

5.3.4 Scheduled Commercial Banks

To assess the impact of financial, non-financial, and macroeconomic variables on bank profitability for the scheduled commercial banking sector, dynamic regression models using double-log functional form have been estimated. Here, the determinant analysis has been carried out for the *Scheduled Commercial Banking Sector* represented by the selected banks from public, private, and foreign bank groups taken in the study.

Two double-log equations have been estimated – *'Without the Number of ATMs'*, and *'With the Number of ATMs'.* The second model is estimated to capture the impact of technology on profitability of commercial banks in India. These two regressions yield the estimates for elasticity and highlight the nature and magnitude of relationship between the explanatory variables and bank profitability.

Table 5.5 Determinants of Profitability of Scheduled Commercial Banks

Independent Variables	Dependent Variable: ln NIM			
	Without ATM		With ATM#	
	FEM	REM	FEM	REM
Constant	0.50** (1.90)	0.48 (0.89)	0.52 (1.39)	0.005 (0.008)
ln CRAR	0.03 (0.71)	-0.17 (-1.35)	0.09*** (1.66)	-0.17 (-1.23)
ln TA	-0.14* (-1.94)	0.04 (0.35)	-0.25* (-2.67)	0.28** (2.08)
ln CIR	0.08 (1.50)	0.04 (0.32)	0.12*** (1.88)	-0.02 (-0.11)
ln GNPA	-0.02* (-1.95)	-0.03 (-1.43)	-0.04* (-3.48)	-0.02 (-0.98)
ln BPE	-0.01 (-0.38)	-0.05 (-0.95)	-0.01 (-0.42)	-0.21** (-2.36)
ln LAR	-0.03 (-1.55)	-0.05 (-1.40)	-0.03*** (-1.70)	-0.06 (-1.09)
ln $PROF_{-1}$	0.62* (13.61)	0.87* (11.47)	0.60* (13.64)	0.84* (9.28)
ln BR	0.07** (2.34)	-0.01 (-0.42)	0.04 (1.20)	-0.15** (-2.31)
ln ATM	–	–	0.07* (3.25)	0.08** (2.50)
ln GDP	-0.01 (-0.56)	-0.02 (-0.57)	-0.03*** (-1.62)	0.002 (0.04)
ln INF	-0.01 (-0.64)	-0.003 (-0.09)	-0.04** (-2.42)	-0.01 (-0.36)
R^2	***0.91***	***0.67***	***0.92***	***0.59***
Adjusted R^2	***0.90***	***0.65***	***0.91***	***0.57***
S.E. of Regression	***0.19***	***0.21***	***0.15***	***0.20***
F-statistic	***102.13****	***49.49****	***96.50****	***26.55****
Pesaran CD test	***0.80^{NCS}***	***2.89^{CS}***	***0.58^{NCS}***	***2.85^{CS}***
Hausman Test	**FEM is Consistent**		**FEM is Consistent**	

Note: Linear regressions were also estimated but the double-log regressions turned out to be better fitted and appropriate for analysis. # Time period for analysis of 'Without ATM' model is 2001-02 to 2018-19. For the 'With ATM' model, the period ranges from 2004-05 to 2018-19 since data for ATM is available from 2004-05 onwards. * = Significant at 1%, ** = Significant at 5%, *** = Significant at 10%, NCS = No Cross-Section Dependence in residuals, CS = Presence of Cross-Section Dependence in residuals, S.E. of regression for Log NIM for both the models are fitted at 95% prediction interval.

The broad observations made from Table 5.5 are as follows:

- On the basis of Hausman test criterion, the fixed effect model is found to be consistent for both 'Without ATM' and 'With ATM' models for the scheduled commercial banking sector. Fixed effect models are discussed here.

- **The test results for the Without ATM regression model** yield high R^2 and adjusted R^2 values. The independent variables explain 90% variation in NIM. The standard error of the regression is low and the F-statistic value is significant at 1% level. As the cross-section units are sufficiently large for the given time period in case of scheduled commercial banks. The presence of serial correlation in the residuals is tested by Pesaran CD test; it confirms the absence of cross-section dependence in residuals for the model.

- CIR, BPE, GDP and INF do not confirm to their a priori signs, while CRAR, TA, GNPA, LAR, $PROF_{-1}$ and BR are consistent with the hypothesized signs.

- TA, GNPA, $PROF_{-1}$ and BR share a significant and strong relationship with NIM. An increase in $PROF_{-1}$ and BR will bring about an increase in NIM, whereas an increase in TA and GNPA will reduce NIM for the scheduled commercial banks.

- The explanatory variables CRAR, CIR, BPE, LAR, GDP and INF are found to be weak determinants of NIM. CRAR and CIR share a positive relationship with NIM, while BPE, LAR, GDP and INF share a negative relationship.

- The elasticity of NIM to the explanatory variables ranges between 0.01 and 0.62. A less than one elasticity of NIM to all the determinants indicates that NIM is relatively less sensitive to changes in the explanatory variables taken in the model. The elasticity of NIM to $PROF_{-1}$ and TA is 0.62% and 0.14%, respectively in response to a percentage change in the two financial variables. A 1% change in CIR and BR brings about 0.08% and 0.07% change in NIM for scheduled commercial banks.

- **The overall test results for With ATM model** has turned out very well with high R^2 and adjusted R^2. The adjusted R^2 is 0.91, standard error of the regression is small and F-statistic is quite large and significant at 1% level. There is no cross-section dependency in residuals for the model.

- Except for CIR, BPE, GDP and INF, all other explanatory variables have confirmed to their hypothesized signs.

- CRAR, CIR, $PROF_{-1}$ and ATM have a strong positive association with NIM. TA, GNPA, LAR, GDP and INF have a negative yet significant impact on NIM. Only two explanatory variables, BPE and BR are found to be insignificant in explaining NIM of scheduled commercial banks.

- In this model, NIM is found to be relatively inelastic to change in the explanatory variables. The elasticity values of NIM with $PROF_{-1}$, TA and CIR are 0.60%, 0.25%, and 0.12%, respectively. NIM responds positively by 0.09% to a percentage increase in CRAR. The number of ATMs is found to be a significant explanatory variable of NIM, a 1% increase in number of ATMs will lead to 0.07% increase in NIM for scheduled commercial banks.

5.4 Conclusion

The objective of the present chapter is to identify important determinants of bank profitability. The emphasis is on assessment of possible impact of financial, non-financial, and macroeconomic factors on the profitability of banks and examination of nature and magnitude of their relationship. Determinants of bank profitability have been examined for public, private, and foreign bank groups (five banks in each group); and also for the scheduled commercial banking sector (represented by all fifteen banks taken in the study).

On the basis of a comprehensive review of literature, the indicators of bank profitability (dependent variables) and the factors determining bank profitability (explanatory variables) have been identified for analysis. Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM) are the measures of bank profitability. To assess the impact of financial, non-financial, and macroeconomic variables on bank profitability, the following variables are engaged in analysis: capital adequacy ratio, log of total assets, cost to income ratio, gross non-performing asset ratio, business per employee, liquid asset ratio and previous year profitability of bank are the financial variables. Number of bank branches and number of ATMs are non-financial variables, while economic growth rate and rate of inflation are the macroeconomic variables.

Least-square panel regression has been engaged for determinant analysis for the time period 2001-02 to 2018-19. Linear and double-log regression models are estimated to arrive at fixed effect and random effect models. To identify the consistent or appropriate model between the two, Hausman test is used. The fixed effect model has been found to be the consistent model for all the regressions estimated for analysis.

Important findings from the empirical results are:

- Capital adequacy ratio (CRAR) and bank profitability share a positive significant relationship for public sector banks, private sector banks, and scheduled commercial banking sector. This is consistent with the results of Staikouras and Wood (2004), Ongore and Kusa (2013), San and Heng (2013), Căpraru and Ihnatov (2014), Al-Homaidi et al. (2018), Kohlscheen, Murcia and Contreras (2018), and Mohanty and Krishnankutty (2018). These studies provide evidence that highly capitalized banks tend to be more profitable. The elasticity of bank profitability with respect to CRAR is 0.09 percent. The regression results for foreign banks in the present study arrive at a negative association between CRAR and bank profitability. This is in accordance with Heffernan and Fu (2008), Dietrich and Wanzanried (2009), and Mbekomize and Mapharing (2017). These studies found that banks with high capital adequacy ratio suffer from falling profitability.

- Total assets (Log TA) is found to be a significant determinant of bank profitability. It has a negative influence on bank profitability for all the bank groups (public, private, and foreign banks) and for the scheduled commercial banking sector. Ghosh (2013), Căpraru and Ihnatov (2014), Kohlscheen, Murcia and Contreras (2018), Mohanty and Krishnankutty (2018), and Xu, Hu and Das (2019) also found a significant negative impact of total assets on bank profitability. They found that banks with larger asset size are less profitable, while small and medium sized banks exhibit higher overall performance and profitability. A 1 percent increase in total assets leads to a decline in bank profitability by 0.25 percent for scheduled commercial banks.

- Cost to income ratio (CIR) has a negative yet significant impact on ROA and ROE for public, private, and foreign banks. Studies by Heffernan and Fu (2008), Alexiou and Sofoklis (2009), Dietrich and Wanzanried (2009), San and Heng (2013), Căpraru and Ihnatov (2014), Ozili (2015), Patria, Căpraru and Ihnatov (2015), Topak and Talu

(2016), Mbekomize and Mapharing (2017), Kohlscheen, Murcia and Contreras (2018), and Xu, Hu and Das (2019) have arrived at similar conclusion. They suggest higher operating costs to trigger a fall in profitability of banks. The regressions where profitability is measured as NIM, CIR is seen to have a positive influence on bank profitability. However, this positive association between NIM and CIR is insignificant. A positive elasticity of 0.12 percent has been observed for scheduled commercial banks. Only one study by Francis (2013) concludes a similar relationship between cost to income ratio and bank profitability.

- Higher gross non-performing assets (GNPA) tend to reduce profitability of banks. A significant fall in profitability in response to rising GNPA is observed for the bank groups in the study, in particular for ROA and ROE. Similar association between GNPA and bank profitability have been reported by Ayele (2012), Bhatia, Mahajan and Chander (2012), Ongore and Kusa (2013), Swamy (2013), Căpraru and Ihnatov (2014), Eze (2014), Patria, Căpraru and Ihnatov (2015), and Alyousfi, Saha and Rus (2017). The studies suggest that high non-performing assets adversely affect the profitability of bank. Lower the gross non-performing asset ratio, better is the bank's health. An argument by Le and Ngo (2020) study states that a high level of GNPA may cause banks to increase their net interest margins to compensate for default risk and to maintain their profitability. In the present study, bank profitability as measured by NIM is found to share a significant negative relationship for scheduled commercial banking sector. However, bank profitability is relatively inelastic to GNPA with a value of 0.04 percent.

- Bhatia, Mahajan and Chander (2012), and Mahajan (2019) support a positive association between business per employee (BPE) and bank profitability. The studies infer that positive relationship between BPE and bank profitability highlights the efficiency of human resources in relation to the core business of banks. Conversely, studies by Badola and Verma (2006), Maiti and Jana (2017), and Boateng (2019) arrived at a negative effect of BPE on profitability of banks. In the present study, BPE has a positive impact on profitability of public sector banks and foreign banks, confirming to its a priori sign. Although the private sector banks and scheduled commercial banking sector have witnessed a negative association between BPE and

profitability, it is very insignificant. NIM responds negligibly to changes in BPE with an elasticity value as low as 0.01 percent.

- Liquid asset ratio (LAR) is largely found to have a negative impact on bank profitability. This determinant has turned out to be statistically significant in case of public sector banks and the scheduled commercial banking sector. However, the elasticity value between LAR and profitability is low at 0.03 percent. Studies like Bourke (1989), Molyneux and Thorton (1992), Pasiouras and Kosmidou (2007), Alshatti (2016), Alyousfi, Saha and Rus (2017), and Kawshala and Panditharanthan (2017) also support the negative influence of LAR on bank profitability indicators. The studies suggest that holding of higher amount of liquid assets would involve opportunity cost of higher returns, while insufficient liquidity would drain out profitability of banks.

- Current year profitability of banks (PROF) responds positively to previous year profitability ($PROF_{-1}$). A 1 percent increase in previous year profitability of scheduled commercial banks brings about a 0.60 percent increase in current year profitability. Flamini, McDonald and Schumacher (2009), Ponca (2012), Djalilov and Piesse (2016), Sinha and Sharma (2016), Tan (2016), Kohlscheen, Murcia and Contreras (2018), and Le and Ngo (2020) also confirm the positive association between current year and previous year bank profitability.

- The non-financial explanatory variables taken in the study are number of bank branches and number of ATMs. Number of bank branches is found to have a significant and positive impact on bank profitability of scheduled commercial banking sector. Profitability responds positively by 0.04 percent to 1 percent change in number of bank branches. Studies by Al-Homaidi et al. (2018) and Almaqtari et al. (2018) also support a positive association between number of bank branches and profitability of banks. However, the present study has arrived at a negative but then insignificant relationship between bank branches and profitability in certain cases of bank groups.

  Number of ATMs is found to have a positive and significant influence on profitability of banks. This outcome is consistent with the results of Le and Ngo (2020). Although relatively inelastic, bank profitability increases by 0.07 percent to 1 percent increase in number of ATMs.

- In case of macroeconomic variables, economic growth rate (GDP) has been found to be relatively an insignificant variable in explaining bank profitability. The impact of economic growth rate on profitability has been found to be positive in some cases, as for private sector banks and foreign banks. This confirms to the hypothesized sign in the study. The studies that suggest a positive association between bank profitability and economic growth rate are Heffernan and Fu (2008), Dietrich and Wanzanried (2009), Alper and Anbar (2011), Ayele (2012), Naseem et al. (2012), Swamy (2013), Sinha and Sharma (2016), Ozili (2015), Nessibi (2016), Kohlscheen, Murcia and Contreras (2018), Xu, Hu and Das (2019), Al-Homaidi et al. (2018), and Le and Ngo (2020). Majority of these studies also fail to confirm a significant impact of economic growth rate on bank profitability.

  The inflation rate (INF) and bank profitability relationship has turned out to be positive and insignificant for major part of the determinant analysis. However, in the case of public sector banks, inflation rate is found to influence profitability (NIM) positively and significantly. This positive association confirms to the expected sign in the study and is consistent with the literature reviewed, to name some of them, Athanasoglou, Delis and Staikouras (2006), Alexiou and Sofoklis (2009), Alper and Anbar (2011), Naseem et al. (2012), San and Heng (2013), Nessibi (2016), Mbekomize and Mapharing (2017), Al-Homaidi et al. (2018), Mohanty and Krishnankutty (2018), and Le and Ngo (2020).

  Profitability of scheduled commercial banks is quite insensitive to changes in economic growth rate as well as to inflation rate with an elasticity of as low as 0.03 percent and 0.04 percent, respectively. Besides, the nature of relationship between macroeconomic variables and bank profitability is found to be contrary to the proposed hypothesis and are also insignificant.

The results of the determinant analysis in the present study suggest that financial variables such as CRAR, Log TA, CIR, GNPA and LAR have a significant impact on bank profitability besides confirming to their a priori signs. BPE and $PROF_{-1}$ are found to be insignificant determinants although they are consistent with their hypothesized relationship with PROF. The non-financial variables, ΔBR and ATM have a significant and positive influence on bank profitability and confirm to their expected signs. Overall, the

macroeconomic variables have not been witnessed to be significant in explaining bank profitability.

The results for the ‘With ATM’ model for scheduled commercial banking sector reveals that all the explanatory variables share a relatively inelastic (e<1) relationship with bank profitability ranging between 0.01 and 0.60. Profitability for scheduled commercial banks in India is not very sensitive to changes in the financial variables, non-financial variables, and macroeconomic variables taken in the study. Yet, financial variables and non-financial variables do bring about noticeable and significant changes in profitability of banks.

Notes

1. Yes bank is one of the fastest growing private sector banks in India. It has an asset size of Rs. 3,08,826 crores and an extensive branch network of 1,127 branches (as on March 2019). It is an important bank amongst the private sector banks and cannot be ignored for the determinant analysis in the study. As Yes bank commenced its business in India in 2004, data for the bank is not available for the period 2001-02 to 2003-04. This makes the panel dataset for private sector banks as a group an unbalanced panel. Yes bank is also included in the analysis of scheduled commercial banking sector for 'Without ATM' model. Hence, this too is an unbalanced panel dataset.

2. The application of Amemiya procedure in EViews is generalized by Wansbeek and Kapteyn in 1989 to deal with unbalanced or incomplete panels. So, in EViews Amemiya method is named as Wansbeek and Kapteyn estimator (Baltagi, 2005).

3. The Prob (F-statistic) for all estimated models is 0.000, indicating that F-statistic is significant at 1% level.

4. This table is a summary of the critical values and level of significance of t-test. The time period taken for estimating the models for PSBs, FBs, and SCBs (Without ATM) is from 2001-02 to 2018-19. The models for PvtSBs and SCBs (With ATM) are estimated for the period 2004-05 to 2018-19.

Critical Values of 't': Percentage Points of t-Distribution						
Models	**No. of Obs. (n)**	**No. of Explanatory Variables (k)**	**Degree of Freedom [= n-(k+1)]**	**Level of Significance**		
				1%	**5%**	**10%**
PSBs	85	10	74	2.378	1.666	1.293
PvtSBs	82	10	71	2.381	1.667	1.294
FBs	85	10	74	2.378	1.666	1.293
SCBs (Without ATM)	252	10	241	2.341	1.651	1.285
SCBs (With ATM)	210	11	198	2.345	1.653	1.286

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