School of Economics and Finance
Curtin Business School

Impending Effects of Basel III in the BRICS Economies

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This thesis is presented for the degree of

Master of Philosophy (Economics and Finance)

of

Curtin University

August 2016

Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made. This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature:

Date: 25 August 2016

Dedicated to my parents

Md. Yasin Ali

and

Mst. Zahanara Begum

for their endless love, inspiration, sacrifice and guidance.

Acknowledgements

This thesis is indebted to many helping hands and would not have come into existence without the outstanding supervision from Dr. Anbalagan Krishnan, Associate Professor, Department of Accounting and Director of Academic Quality and Control, Curtin University Sarawak. I am deeply owed to his guidance and appreciative of his outstanding knowledge, constant understanding and patience, and in particular, his confidence and devotion to students.

I also owe a great deal to the contribution of my co-supervisor, Dr. Md. Atiqur Rahman Khan, Associate Dean, Faculty of Business and Senior Lecturer, Department of Finance & Banking, Curtin University Sarawak, who has supported me a lot by giving lessons like an apprentice. This helped me understand how to conduct quality research. It is he who has treated me like a family member and it is for him, I am here!

I am profoundly grateful to my associate supervisor Dr. Md. Shibley Sadique, Dean, Faculty of Business, and Professor, Department of Finance, University of Rajshahi, Bangladesh who has extended his support in massive ways. He has overseen and supervised my research progress including providing guidance on theoretical and empirical aspects of econometrics, methodological issues, and counseling on various matters of my everyday life during the course of my studies. His superb knowledge, friendliness and guidance have been the focal to my spirit, dedication, and persuasion.

I deeply thank my chairperson Dr. Dhanuskodi Rengasamy, Postgraduate Coordinator, and Senior Lecturer, Department of Accounting, Curtin University for his every support and assuming a lot of administrative responsibilities during my studies.

My MPhil study has been supported and funded by the Curtin Sarawak Postgraduate Research Scholarship (CSPRS). I greatly appreciate the financial support from the University, and for this, my thanks specially go to Professor Marcus Man Kon Lee, Dean, Graduate School of Research, Curtin University Sarawak. I am also indebted for his overall assistance during my MPhil studies in Curtin University.

My thanks must also be extended to Florence Singa, Reni Binti Azmi, Jolynn Libai John, Estinomi Rigo Pudun and other staffs and officials of Curtin University for giving me administrative support during my candidature. I appreciate their active support, which ensured a study environment conducive to smooth progression and completion of this thesis.

I would like to extend my gratitude to the honourable teachers of Curtin University as well as the University of Rajshahi and colleagues of the Bangladesh Institute of Bank Management (BIBM) whose active support, motivation and inspiration helped me to complete this thesis. My indebtedness and thanks go to Professor Jonathan Winterton, Dean, Faculty of Business, Curtin University, Sarawak and Associate professor, Dr. Pauline Ho, Deputy Dean, Faculty of Business, Curtin University Sarawak. I would like to express my gratitude to Dr. Kenneth Ray Szulczyk, Head of Department, Finance and Banking, Dr. Abey Philip, and Ceecilia Anthony Das, Senior Lecturers, Curtin University Sarawak for their valuable suggestions to improve the overall quality of the thesis. I am also thankful to Dr. Md. Masud Karim, Associate Professor, Department of Finance, University of Rajshahi, Bangladesh for his mental support and motivation. Indeed, I owe gratitude to all of my teachers who have guided and instilled in me the values of learning at various stages in my life and whose blessings have been influential in bringing me to this point.

I wish to express my indebtedness to S. A. Chowdhury, A. K. Gangopadhaya Chair Professor, BIBM, for his guidance and inspiration. I owe thanks to Dr. Toufic Ahmad Chowdhury, Director General, BIBM, for granting me study leave in order to pursue this MPhil degree. My special thanks go to Dr. Shah Md. Ahsan Habib, Professor and Director Training, BIBM, for assistance, guidance and support.

I am also thankful to anonymous examiners for helpful comments and suggestions, which have helped me to improve the quality of this thesis. Finally, I would like to give thanks to my parents, family members, relatives, and friends for their endless inspiration, sacrifice and support, particularly my wife, Ashrafi Ferdousy (Bithi) who has sacrificed her independence to help me.

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List of Abbreviations

AfDB	African Development Bank
AMA	Advanced Measurement Approach
AT 1	Additional Tier 1
BCBS	Basel Committee on Banking Supervision
BIA	Basic Indicator Approach
BIQM	Bank of Italy Quarterly Model
BIS	Bank for International Settlement
BRICS	Brazil, Russia, India, China and South Africa
CAR	Capital Adequacy Ratio
CAR	Capital to Asset Ratio
CBR	Ratio of Current Account Balance over Nominal GDP
CCA	Contingent Claim Approach
CCB	Capital Conservation Buffer
CCR	Counterparty Credit Risk
CCP	Central Counterparties
CEM	Current Exposure Method
CET 1	Common Equity Tier 1
CFP	Contingency Funding Plan
CGR	Ratio of Current Account Balance over Nominal GDP
COO	Cost of Operation
COF	Cost of Fund
CPI	Consumer Price Index
CVA	Credit Valuation Adjustment
DSGE	Dynamic Stochastic General Equilibrium
EBIT	Earnings Before Interest and Tax
EME	Emerging Market Economies

EPE	Expected Positive Exposure
EU	European Union
FDI	Foreign Direct Investment
G-10	The Group of Ten (Countries)
G-7	The Group of Seven (Countries)
GDP	Gross Domestic Product
GSIB	Global Systematically Important Banks
HHI	Herfindahl Hirschman Index
H_o	Null Hypothesis
HP	Hodrick–Prescott
HQLA	High Quality Liquid Assets
IMA	Internal Model Approach
IMF	International Monetary Fund
IRB	Internal Rating Based
IRC	Incremental Risk Charge (Capital)
IRRBB	Interest Rate Risk in Banking Book
LAR	Liquid Asset to Total Asset Ratio
LCR	Liquidity Coverage Ratio
LDR	Loan Deposit Ratio
LEV	Leverage Ratio
LLP	Loan Loss Provision
LP	Loan Price
MAG	Macroeconomic Assessment Group
MCR	Minimum Capital Requirement
MENA	Middle East and North Africa
MM	Modigliani and Miller
NDB	New Development Bank

NSFR	Net Stable Funding Ratio
OLS	Ordinary Least Square
RHPG	Real House Price Growth
RIR	Real Interest Rate
ROA	Return on Assets
ROE	Return on Equity
RWA	Risk-Weighted Asset
SA	Standardized approach
SME	Small and Medium Enterprise
TCA	Total Capital to Total Asset Ratio
TCE	Tangible Common Equity
TRA	Tier 1 Capital to Risk Weighted Asset Ratio
TRWA	Total Risk-Weighted Assets
UK	The United Kingdom
US	The United States of America
VaR	Value-at-Risk
VAR	Vector Autoregressive
VECM	Vector Error Correction Model
VIF	Variance Inflation Factors
WB	World Bank
WWR	Wrong-Way Risk

Abstract

The emergence of Basel III regulation to strengthen the international banking system was mainly attributed to the global financial crisis in 2007–2008. This crisis witnessed many banks particularly in developed economies experiencing excessive leverage, low capital, and inadequate liquidity buffer, have failed to survive. Hence, regulators believed the overall systematic risks in the financial system must be reduced by stricter regulations. Consequently, the Basel Committee on Banking Supervision (BCBS) reconfigured the new regulation (Basel III) by increasing the capital and liquidity requirements of banks in order to make the financial system more resilient to future financial crises. However, concerns were raised whether this universal rule would be able to protect banks in emerging and less developed economies, particularly in the BRICS (Brazil, Russia, India, China, and South Africa). This thesis attempts to investigate how the capital adequacy and liquidity rules of Basel III affect the resilience of banks in the BRICS economies. Using panel data from 2007 – 2014, the empirical evidence of this thesis shows the Basel III standards significantly increase the resilience (as measured by the Z-Score) of banks. In particular, the results suggest a 10% increase in the capital adequacy ratio (CAR), Tier 1 capital ratio, and leverage ratio increases the resilience by about 2.51%, 0.61%, and 1.2%, respectively. Similarly, for a 10% increase in the net stable funding ratio (NSFR), the resilience of banks increases by 0.11%, 0.09% and 0.18%, respectively in the models associated with CAR, Tier 1 capital ratio, and leverage ratio. Hence, the CAR is sufficiently robust to increase the resilience of banks. The findings of this thesis also reveal the NSFR and the leverage ratio are the most effective to increase the resilience of banks if implemented simultaneously.

Furthermore, this thesis explores the impact of Basel III on the lending rate and GDP by applying panel regression models. The analysis demonstrates Basel III requirements add to the cost burden of the BRICS economies. It is found that holding additional capital and liquid assets increase the opportunity costs of banks. Thus, the extra costs are passed on to borrowers through increased lending rates. This banking behaviour reduces the investment flows into the economy resulting in a contraction in economic activities, which ultimately causes a negative impact on GDP. The empirical evidence of this thesis shows a 10% increase in the Tier 1 capital ratio increases the lending rate of banks by about 1.1%, which is associated with a decline in GDP by about 0.45%, and for a 10% increase in the NSFR the lending rate increases by about 1.18% resulting in a 0.18% decline in GDP.

This thesis also assesses the benefits of Basel III regulation by employing models provided by the BCBS. The Basel III literature articulates tighter capital and liquidity regulation would reduce the probability of crises occurring in the implementing countries, and hence, the output (GDP) would be protected which otherwise would have been lost in the event of a crisis. The empirical evidence of this thesis shows an improved capital and liquidity requirement reduces the probability of a crisis and increases the gain in GDP. For a 10% increase in Tier 1 capital ratio, the probability a crisis occurring reduces by 5.03% resulting in a gain in GDP of about 1.54%. In effect, the net benefits of Basel III are positive for the BRICS economies. For instance, a 10% increase in Tier 1 capital ratio provides a net benefit of 1.10% in terms of increasing in GDP and for a 10% increase in NSFR, the net benefits increase by about 0.24%. However, the outcome of this thesis suggests the net benefits are achieved up to a certain level of additional capital requirements, beyond which the marginal benefits are negative. Thus, there is an optimum level of capital enhancement where the benefits are maximised. In summary, Basel III regulation is effective to increase the resilience of banks. The regulation increases GDP albeit with some macroeconomic costs. Nevertheless, the benefits are greater than the costs. Thus, it seems worthwhile to adopt and implement Basel III regulation in the BRICS economies.

Key Words: Banking Regulation, Basel III, Resilience, Financial Crisis, BRICS

JEL Classifications: G21, G28

Chapter 1

Introduction

1.1 Background

Banks around the world are highly sensitive to various risks such as credit, market and operational risks. Banking risks have increased substantially with the increase in financial market volatility and fluctuations (Habib et al., 2012; Delahaye, 2011). In addition, as banks mostly operate on leverage, exposure to risks intensifies the losses to banks, which may cause a bank to fail. That is why; risk management has become extremely important to safeguard banks against financial crises (Hossain, 2012).

As such, in order to increase the *"safety and soundness"* (BCBS, 2004, Part. 4, Clause 811) of globally active banks, the BCBS provides regulatory guidelines, which are commonly referred to as *"Basel Regulation"*. In fact, the BCBS is a committee of banking supervisory authorities, which was formed in 1974 by the leaders of the central banks of the then *G-10* countries (BIS, 2014). Although the policy prescriptions of the BCBS are voluntary and have no legal force, 140 central bank regulators have endorsed the Basel III Accord (BIS, 2014), which makes the Basel III a de facto global regulation for banks. The BCBS aims to increase cross-border cooperation and introduce financial discipline through banking regulation, particularly by setting capital standards for banks (BIS, 2014).

The first set of regulations for banks, the 'Basel I' Accord was introduced in 1988 (BCBS, 1988). However, Basel I focused only on credit risk, whilst other risks such as market and operational risks were ignored. Considering the importance of market and operational risks, the BCBS introduced a new set of standards in 2004, which was referred as the Basel II Accord (BCBS, 2004). However, the Basel II Accord clearly proved to be incapable of protecting banks from the global financial crisis of 2007/08 ("Financial Crisis[1]") (Lall, 2009; Cannata and Quagliariello, 2009; Vallascas and Keasey, 2012).

[1] This thesis uses the term Financial Crisis in order to denote the global financial crisis of 2007-2008.

The financial crisis revealed banks should have robust risk management techniques and they should build capacity to withstand severe disasters (Elizalde, 2007). The foremost reason identified for the failure of banks during the 2007-2008 crises was securitisation[2]. Although securitization is deemed a high-risk transaction, Basel II rated it as a low-risk exposure. This allowed banks to lower the capital requirements even when involved in high-risk securitised transactions (Meissner, 2005). In addition, *subordinated debt*[3] was treated as a component of capital under Basel II. However, it was in fact, a debt instrument and was incapable of absorbing losses, which could have been more effectively accomplished by equity capital in the event of a crisis. Besides, when the market became illiquid during the financial crisis, banks could neither sell the securities nor manage funds from the market, which resulted in a severe dearth of liquidity.

Holding liquidity was not addressed in Basel II, as a result, banks did not have enough liquidity to support their transactions, which subsequently resulted in bank failures. To remedy the situation, the BCBS came up with Basel III in 2010 (BCBS, 2011). The new regulation aimed to create a safer banking system through the rectification of the various flaws that were observed in the financial catastrophe of 2007/08. The new regulation is supposed to strengthen the banking sectors by enhancing the capital and liquidity requirements, which would produce macroeconomic benefits by reducing the future probability of crises (Barrell et al., 2009; BCBS, 2010a; MAG, 2010a; Kato et al., 2010; Dorich and Zhang, 2012). However, due to deleveraging and tighter capital and liquidity requirements, the economy would incur some costs in the short-run. For instance, banks would preferably transfer the costs of holding additional capital and liquidity to borrowers by increasing the lending rate or spread[4]. This could eventually reduce the credit supply in the economy having a negative impact on the economic performance and output (Barrell et al., 2009; MAG 2010a; BCBS 2010a; Yan et al., 2012).

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[2] Securitisation is the process of converting illiquid assets such as loans of banks into securities, which is subsequently sold to the general investors. If those securities are backed (secured) by mortgage, it is referred as mortgage-backed securities.

[3] Subordinated debt is a debt or an obligation of bank, which would be repaid after other obligations are met in the event of bankruptcy/liquidation. Subordinated debt is also known as junior debt.

[4] Spread is defined as the deference between lending rate and deposit rate.

A study by BCBS (2010a) shows historically a banking crisis occurs in a given country every 20 to 25 years, hence, the average annual probability of a crisis varies from 4% to 5% and the discounted output loss ranges from 20% to 100% of pre-crisis GDP. However, Reinhart and Rogoff (2008) have reported 34 banking crises in the BCBS member countries over a period of 25 years, whilst Laeven and Valencia (2008) have found only 24 crises in the same countries over the same period, meaning that the annual probability of a banking crisis in a given country varies from 3.6% to 5.2%. Specifically, in the context of emerging market economies, the annual probability of a crisis fluctuates from 4% to 5% (Walter, 2010). The Basel III regulation, in fact, would help reduce this frequency of crises and ensure a higher welfare in the absence of banking crises by preventing GDP losses.

Indisputably, financial regulations are a critical prerequisite for crises resolution and for the establishment of economic stimulus (Besley, 2006). The BCBS (2010a) argued a healthy banking system would be less prone to crises with immense macroeconomic effects in terms of forgone GDP. As such, compliance with the Basel III Accord is indispensable for emerging market economies (EMEs) including the BRICS (Brazil, Russia, India, China, and South Africa), if they intend to increase their sovereign rating, which would ultimately reduce the costs of sovereign debt/loans (Taylor, 2010). This would ultimately facilitate the BRICS to keep pace with the economic incentives (Besley, 2006).

1.2 Statement of Problem

Attention has been placed on the BRICS economies as these economies have now started to dominate the global economy in terms of trade, banking and mobilization of resources (O'Neill, 2001; Faulconbridge, 2008; Morazán et al., 2012). These five economies combined represent a substantial proportion of the world economy; their combined GDP has been about 20% of the gross world product (IMF, 2013). In addition, the BRICS have established a multilateral development bank known as the "New Development Bank" (NDB), which acts as a substitute for the World Bank (WB) and the International Monetary Fund (IMF) in order to establish greater strategic cooperation within the BRICS countries on common economic developments (Yarygina, 2015). In addition, the arrangement of a contingency reserve plan would perform like the IMF, which grants temporary short-term bailout funds to the economies confronting capital flight and currency crises (Venu, 2014).

The BRICS also have contributed tremendously to the economic development of the world (IMF, 2011; Lin, 2012) through trade relations with other low-income countries, which has accounted for 60% of total world imports (Morazán et al., 2012). Foroohar (2009) has stated the GDP of BRICS might surpass the G7 economies by 2027. The integration of the BRICS economies to other national and regional economies would certainly affect the greater world economy, if the BRICS economies were to fail (Banerjee and Vashisth, 2010; Schuman, 2014; Venu, 2014). Hence, the health of this economic group is very crucial to maintain the well-being of the world economy.

The BRICS did experience an indirect consequence of the financial crisis (Banerjee and Vashisth, 2010) resulting in a slower economic growth, which in turn, had a spill-over effect to other low-income countries (Morazán et al., 2012). Therefore, it is important to protect the BRICS economies by prescribing financial regulations like the Basel III.

However, the issue is whether a universal accord, such as Basel III and its standardised stipulations are appropriate, and would not impose undue burdens on the BRICS economies (Abdel-Baki, 2012; AfDB[5], 2012). Will those requirements be essential for the BRICS economies since their financial systems are relatively shallow and, unlike the US and the UK, unexposed to enormous market risks (Abdel-Baki, 2012; AfDB, 2012)? Therefore, a legitimate question arises as to how pertinent is the reform package of the Basel III to the BRICS and what would be the macroeconomic impact of the tighter regulation on the BRICS economies?

1.3 Motivation for Undertaking the Study

The recipe of risk management under the Basel II framework raised a lot of debate among policy makers and practitioners after the financial crisis (Lall, 2009). The severity and the consequences of the financial crisis brought the issue of financial

[5] AfDB stands for African Development Bank

sector stability and the strengthening of banks to the top of the agenda of policymakers and banking supervisory authorities, particularly in implementing the Basel III norms. In fact, Basel III intends to raise the resilience of banking systems to future economic shocks by strengthening the regulatory standards for holding adequate capital and liquidity (BCBS, 2011). This regulation is likely to *"ensure a level playing field"* (BIS, 2014, p. 1) in all the banking operations across the world. One question to be considered will be the extent to which this universally binding regulation is appropriate for the already highly regulated emerging market economies, particularly the BRICS (Abdel-Baki, 2012; AfDB, 2012). Moreover, the financial system of the BRICS is relatively healthier than in the US and EU markets, (Abdel-Baki, 2012; AfDB, 2012; Watanagase, 2012). Hence, the question is whether the Basel III regulation is relevant for the BRICS economies.

In addition, the debate is most empirical investigations on the Basel III regulation focus on the needs of advanced economies (Suttle et al., 2010). Hence, the circumstances of the BRICS and emerging market economies have been overlooked (Suttle et al., 2010) though the BRICS economies have also suffered from the consequences of the global financial crisis of 2007/08 (Banerjee and Vashisth, 2010). Therefore, it is vital to examine the impact of Basel III, particularly to test the solvency (resilience) of banks in the BRICS economies.

Importantly, the role of BRICS in the global financial market as an emerging protagonist is significant and changing rapidly (BBVA[6], 2012; Morazán, et al., 2012). The sustainability of world economic development is largely attributed by the BRICS (IMF, 2011; Lin, 2012). Trade, Foreign Direct Investment *(FDI),* and development financing have also contributed significantly to the economic development of low-income countries (Morazán, et al., 2012), which has minimised the impact of the financial crisis on those economies (Banerjee and Vashisth, 2010).

Apart from this, literature shows the Basel III would lessen the likelihood of crises occurring in the economy by holding adequate capital and liquidity by the banking sector (Barrell et al., 2009; Kato et al., 2010; MAG, 2010a). If a crisis does not strike

[6] BBVA is a research based organisation in UK.

the economy by means of increasing capital, GDP will be saved, which is one of the benefits of tighter regulations. During the crisis period of 2007/08, the GDP growth of China and India declined to 5% from 6% whilst the growth rate of Russia declined to roughly -10% and the GDP growth was also negative for the economy of Brazil (-0.50%) (Banerjee and Vashisth, 2010). Therefore, it is imperative to assess the economic benefits that may be derived by the BRICS through the implementation of the Basel III regulation.

On the other hand, the Basel III regulation makes the financing costly by increasing the opportunity costs of holding higher capital (Osborne et al., 2010; Gambacorta and Marques-Ibanez, 2011). The resulting effects are limited credit requests by borrowers, and contraction of economic activity. Thus, Basel III would also have a negative impact on the economic performance of the BRICS, which needs empirical investigation.

1.4 Research Objectives

The Basel III Accord is a new regulation for banks, which has been developed in response to the financial crisis. Although the regulation has been designed to protect banks, researchers put less focus on the situations faced by developing countries including the BRICS (Suttle et al., 2010). There may be unintended consequences of the Basel III regulation on the BRICS, which merits empirical investigation. Therefore, the broad objective of this thesis is to measure the impending impact of the Basel III guidelines on the BRICS economies.

The specific objectives of the thesis are:

(i) to assess the resilience of banks due to increased capital and liquidity requirements;

(ii) to understand the impact of Basel III compliance on the loan pricing of banks; and

(iii) to measure the macroeconomic costs and benefits of Basel III regulation in the BRICS economies.

1.5 Significance of the Study

This thesis estimates the resilience of banks considering the enhanced capital and liquidity requirements under the Basel III proposal and also shows how the different types of capital such as the capital adequacy ratio *(CAR)*, *Tier 1* capital ratio, leverage ratio, and liquidity ratios (liquidity coverage ratio *(LCR)* and net stable funding ratio *(NSFR))* ensure the solvency of banks. This would be particularly interesting for banks and regulators for specifying target capital ratios that need greater attention.

The BCBS postulates capital and liquidity would increase the lending rate of banks (Angelini et al., 2011). The outcome of this thesis proves those hypotheses of the BCBS and it contributes to the methodological aspects of the loan-pricing model by incorporating the capital and liquidity ratios into the model. Importantly, previous studies (Elliott 2009; Caggiano and Calice, 2011; Slovik and Cournède, 2011; and Santos and Elliott, 2012) have only included the costs of fund, administrative costs, and costs of capital proxied by *ROE* in the loan-pricing model where the assumptions of the BCBS are missing.

Moreover, the estimates of the costs and benefits of Basel III regulation provide important lessons as to the net benefits, which are likely to be achieved up to a certain capital level, after which the benefits are negative. Hence, regulators would be able to set an optimum target-capital-ratio for banks in such a way as to increase the net benefits in terms of increasing GDP. Eventually, the results of this thesis would attract interest from quite a few stakeholders including the central banks, regulators, policy makers, practitioners, and financial economists. It would help formulate specific and tailor-made policies for banks in order to contain the systematic crises, which would ultimately ensure the economic growth.

1.6 Organization of the Study

In order to aid readers of this thesis, each chapter has been inscribed in such a manner that it is more or less self-contained. Thus, some unavoidable repetition might occur in relevant materials between chapters, figures and tables. The remaining part of the thesis is organised as follows. The evolution of the Basel regulation is provided in Chapter 2. The detailed review of previous relevant studies is summarised in Chapter 3 while the empirical models and methodology employed are described in Chapter 4. The detailed analysis of the empirical models and findings are discussed in Chapter 5. Finally, Chapter 6 provides concluding remarks, limitations, and policy recommendations.

Chapter 2

Evolution of Basel Accord

This chapter highlights the evolution of the Basel Accords and is organised as follows. Section 2.1 explains the background of the Basel Committee and Basel Accords. Section 2.2 presents the Basel I regulatory norms while Section 2.3 provides the principles of Basel II. The latest regulatory proposals of the Basel III are described in Section 2.4 after which, Section 2.5 clarifies the Pillars of Basel III to withstand credit, market, operational, and liquidity risks. Section 2.6 portrays a summary of the comparison between Basel II and Basel III Accords whilst Section 2.7 shows the road map of Basel III implementation. Finally, Section 2.8 concludes the chapter

2.1 An Overview

After the abolition of the Bretton Woods System[7] of managed exchange rates in 1973, banks incurred substantial losses because of taking excessive exposures to foreign currencies. Many banks' foreign currency exposure became three/four times higher than their capital, which resulted in significant losses on the unsettled transactions (BIS, 2014).

Consequently, in the event of international financial market turmoil, the central bank Governors of the then *G-10* countries formed a committee known as the Basel Committee on Banking Supervision (BCBS) in 1974 to promulgate banking regulations and to supervise those policy regulations (BIS, 2014; Goodhart, 2011). The policy regulations of the BCBS are commonly referred to as *'Basel Regulation'*. The major focus of the BCBS was on collaboration amongst the central banks in

[7] Bretton Woods System is an international monetary system, which was established by the agreement of 44 members of the IMF in 1944 during a conference held in Breton Woods, New Hampshire. Under this system, all countries fixed their exchange rates in terms of the U.S. dollar and the U.S dollar was fixed to the price of gold at $35 per ounce. As per the agreement, countries kept their currencies fixed but adjustable within ∓1 percent to the dollar. After the abolition of the Bretton Woods, IMF member countries could adopt any form of exchange arrangement except pegging to gold, such as, free float, pegging to another currency/basket of currencies or adopting another currency.

order to ensure financial stability and to increase the efficiency of international banking and the monetary system (Toniolo, 2005).

At the very outset, the Basel regulations were issued to increase cooperation among the member countries. However, 140 regulators (central banks) are now following the prescriptions of the BCBS (BIS, 2014). Thus, the Basel regulations have become an international convergence of capital and liquidity standard for banks (BCBS, 2013). Although the policy prescriptions of the BCBS are voluntary and have no legal enforce (BCBS, 1996; BIS, 2014), internationally active banks across the world follow the supervisory guidelines of the BCBS because Basel regulations provide a comprehensive risk management recipe to the banks (BCBS, 2004). In effect, the risk management capabilities of banks widely increased by the compliance with the Basel regulations.

2.2 Basel I

The first set of regulations, the Basel I, came into effect in 1988 with the aim of strengthening the stability and soundness of the international banking system by managing the capital of banks (BCBS, 1988). In line with the Basel I regulation, globally banks were required to maintain capital of at least 8% of total credit risk-weighted assets (BCBS, 1988). Thus, Basel I exclusively focused on the credit risk though there were other risks in the banking business such as, market and operational risks. There was no recognition of risks related to the term-structure of credit portfolio. Moreover, the regulation recognised neither portfolio diversification effects of credit risk nor credit risk mitigation/the role of collateral. In fact, there were inadequate differentiations of credit risk because Basel I proposed few risk weights for exposures of banks, i.e., 0%, 20%, 50% and 100%. In particular, the Basel I Accord did not differentiate *SMEs* from corporate or *AAA* from *BBB* rated entities, that is, it followed a *one-size fits all* approach.

Hence, Basel I was amended by the BCBS in 1996 in order to incorporate market risk (BCBS, 1996). In that amendment the BCBS stated *"as from the end of 1997, or earlier if their supervisory authority so prescribes, banks will be required to measure and apply capital charges in respect of their market risks in addition to their credit* *risks"* (BCBS, 1996, p. 1). Thus, from 1997 onwards, banks were required to calculate minimum capital requirements considering credit and market risks. However, operational risk of banks remained unrecognized by the Basel I Accord. As a result, the capital adequacy was less secure and vulnerable to define the banks' financial health and resilience. Therefore, the risk management capacity of Basel I was very poor and it became necessary to revise the Basel I Accord.

2.3 Basel II

Subsequently, in addressing the weaknesses of Basel I, the Basel II Accord was developed in 2004 as the new regulation for banks. This regulation (Basel II) was more practical and comprehensive from a risk management perspective. The Basel II regulation consisted of three Pillars (BCBS, 2011). Pillar I (first pillar) was the minimum capital requirement (MCR), which was the improved version of the previous Accord. Pillar I required banks to focus on credit, market, and operational risks in order to calculate the minimum capital requirements (MCR):

$$CAR = \frac{Regulatory\ Capital\ (Tier1 + Tier2 + Tier3)}{TRWA^{8}} \geq 8\% \qquad (2.1)$$

While calculating the minimum capital requirement under Pillar I, banks could apply a number of methodologies. In assessing credit risk-weighted assets for example, Basel II recommended three methodologies which were, the Standardized Approach *(SA),* Foundation Internal Rating Based Approach *(IRB),* and Advanced *IRB* Approach. In the market risk measurement the Standardized Approach *(SA)* and Internal Model Approach *(IMA)* were followed by banks. Likewise, in assessing operational risks, banks were allowed to use the Basic Indicator Approach (*BIA*), Standardized Approach *(SA),* and Advanced Measurement Approach *(AMA).*

Pillar II of Basel II, was the supervisory review process where risks were identified and assessed apart from the risk in Pillar I in a wider perspective. Under Pillar II, national regulators imposed additional capital charge if any material risk was found other than the credit, market, and operational risks. For example, regulators could

[8] TRWA represents total risk-weighted assets for credit, market and operational risks.

impose additional capital charge for residual risk, reputation risk, concentration risk, etc. Hence, the capital requirements for risks under Pillar II were additional to the capital calculated under Pillar I. The Pillar III of Basel II was all about market disclosures, that is, banks were required to disclose all the material information, market outlook and risks exposure to stakeholders, the public, and in the market in order to make the financial market more transparent and resilient (BCBS, 2004).

Principally, the Basel committee focused on the capital base, which is assumed to safeguard banks in the event of unexpected banking losses. In Basel II, the BCBS announced three tiers of capital; *Tier 1 Capital* or *Core Capital* composed of the highest quality capital elements. The components include paid up capital, non-repayable share premium account, statutory reserves, general reserves, retained earnings, minority interest in subsidiaries, non-cumulative irredeemable preference shares and dividend equalization account (BCBS, 2004).

Tier 2 capital or *Supplementary Capital* represents other capital instruments, in which some of the attributes of the Core Capital are missing but contribute to the overall strength and soundness of a bank. These elements include general provisions, asset revaluation reserves, all other preference shares, exchange equalization account, revaluation reserves for securities and subordinated debts (BCBS, 2004).

Apart from the *Tier 1* and *Tier 2* capital, *Tier 3* capital was a new type of capital in the Basel II, which was treated as "additional supplementary capital". *Tier 3* capital or additional supplementary capital consisted of short-term subordinated debt (original/residual maturity less than or equal to five years but greater than or equal to two years). This capital could solely be used to cover market risks capital charge arising from the risk in trading book, interest rate, foreign exchange, and commodity prices. According to the norms of Basel II, the amount of *Tier 2* capital was limited to 100% of the *Tier 1* capital and the support for market risks from the *Tier 3* capital, was limited up to the maximum of 250% of *Tier 1* capital[9] in order to ensure a robust shock absorbent and risk resilient banking system (BCBS, 2004).

[9] *Tier 1* capital was calculated after meeting the credit risk capital requirements.

With respect to Basel I, Basel II was appropriately sensitive to the degree of risk because it assigned diversified risk weights to different exposures. Although the approach of Basel II was very comprehensive in addressing banking risks, it could not protect banks from the severe crisis in 2007/08. However, the question arises as to why the Basel II failed. There is a broad consensus among economists, regulators and practitioners about the fundamentals of Basel II failure, which are given in the following sections:

Table 2.1: Minimum Risk Weights of Assets in the Basel II Accord for Corporations (to be multiplied by 8%)

	AAA to AA-	A+ to A-	BBB+ to BB-	Below BB-	Unrated
Corporations	20%	50%	100%	150%	100%

Source: BCBS (2004)

(i) Table 2.1 shows the unrated risk weights are lower than the lowest graded clients are. This indicates banks would not encourage financially weak corporate clients to be rated to gain benefit from the lowest risk weight bracket because it relieves banks from the higher capital charge. Thus, banks finance many projects or clients, whose risk rating were very high. This put the banks' survival in an extremely vulnerable situation.

(ii) Basel II gave recognition of internal ratings for large banks in the Advanced Internal Rating Based (Advanced IRB) approach. Primarily, in the draft proposal of Basel II, the BCBS proposed to introduce a capital charge for dealing with derivatives; in the Basel literature, it is called the *'W factor'*. However, the committee dropped the so-called *'W factor'* in the final recommendation of Basel II. As such, due to the lower risk weights, banks could lower capital requirements on the exposure of trading books, even though the trading book exposures are extremely risky (Meissner, 2005).

(iii) Apart from this, in order to assess market risk, the BCBS had a plan in the draft proposal of Basel II to introduce a standardised methodology based on a fixed risk parameter but the Committee substituted standardised methods and recognised the Value-at-Risk (VaR) model for measuring the market risk (Lall, 2009). This created an opportunity to underestimate the potential risks.

(iv) In addition, the BCBS had a plan in the draft proposal to assign risk weights on securitised (subprime mortgage) transactions. However, later on, the Committee introduced lower risk weights for rated tranches and allowed for greater use of internal ratings. In internal ratings (Foundation IRB approach), banks mostly depend on historical default rates which is not an accurate predictor of future default rates (Meissner, 2005). Thus, the BCBS allowed banks to calculate their own capital requirements based on their own models.

(v) Moreover, in the event of a crisis such as the subprime mortgage crisis, assets that were not correlated previously tended to be correlated and generated larger financial losses than anticipated (Meissner, 2005). Internal ratings gave banks an opportunity to decrease capital requirements without lowering risks. Therefore, these treatments for market risks and securitisation caused the Basel II to fail to provide a very comprehensive approach to risk management in the global financial crisis of 2007/08. Another weakness of the Basel II was in the definition of capital. The regulator considered subordinate debt as a component of *Tier 3* capital, but it did not give sufficient support during the financial crisis due to the fact that debt instruments are liabilities for banks.

2.4 Basel III

Under these circumstances, Basel III[10] emerged in 2010. The detail Basel III framework is provided in Appendix 2.1. This regulation is an upgraded version of Basel II, and globally, banks have started to implement the Basel III norms from 2013 (Gatzert and Wesker, 2011). The motivation of the Basel III regulation is to increase the financial stability of international banks in order to withstand future economic and financial crises, including the effects of financial contagions by

[10] Before the Basel III framework was finally proposed, enhancement to Basel II (popularly known as Basel 2.5) was introduced in 2009. In this document, the BCBS enhanced the regulatory framework of Basel II in the area of securitisation and more specifically for dealing with resecuritisations. In fact, the new capital requirement was introduced to regulate exposures in the Trading Books (see BCBS, 2009).

improving the transparency and market disclosures of capital base. There are many novel ideas in the Basel III regulation, such as a focus on the quality and quantity of regulatory capital; tighter liquidity requirements; a non-risk-based leverage ratio; risk coverage under stress scenario; a capital conservation buffer, a counter cyclical capital buffer, and restrictions on systematically important banks and financial institutions (Gatzert and Wesker, 2011). The salient features of Basel III are presented below:

(i) The new regulation redefined the capital requirement, which is much tighter than the previous Basel II regulation. Banks are now required to maintain more reserves starting from January 1, 2015, where *Common Equity Tier 1* (*CET 1*) (common shares and retained earnings) requirements were raised from 2% to 4.5%. The BCBS also increased the mandatory *Tier 1* capital[11] requirement from 4% to 6% and this has been implemented by the banks since 2015.

(ii) Basel III has introduced a new type of capital known as 'capital conservation buffer' (*CCB*). The capital conservation buffer is 2.5%, which is an additional capital reserve (buffer) to withstand future periods of stress. The buffer would bring the *Total Common Equity Tier 1* capital requirement to 7% (from 4.5% of *CET 1*). The aim of building an additional buffer is to *"strengthen the resilience of the banking sector"* so that banks can use those capital stocks in times of stress. The phase-in has commenced from January 1, 2016, and would be complete by January 1, 2019. Importantly, the capital conservation buffer (*CCB*) must be fulfilled by the *CET 1* capital after deductions (BCBS, 2011).

(iii) The new Basel III norms require national regulators not only to ensure the compliance of banks with the Basel III requirements but also to regulate the credit volume in the economy. If the credit volume increases faster than the GDP, regulators may increase the capital requirement for the systematically important banks by increasing Countercyclical Buffers, which varies from

[11] *Tier 1* capital comprises common equity *Tier 1* and additional *Tier 1* (*AT1*) capital components.

0% to 2.5% (BCBS, 2011). If banks breach to build this buffer, a certain percentages of earnings must be retained, as outlined in Table 2.2.

Table 2.2: Retention of Earnings when Countercyclical Buffer Breaches

Minimum Capital Conservation Buffer (when subject to 2.5% countercyclical capital requirement for individual bank)	
Common Equity Tier 1 Capital Ratio	Minimum Capital Preservation Ratio (as percentage of earnings)
4.5% - 5.75%	100%
> 5.75% - 7.0%	80%
> 7.0% - 8.25%	60%
> 8.25% - 9.5%	40%
> 9.5%	0%

Source: BCBS (2011)

(iv) As the *Tier 3* or additional supplementary capital of Basel II (*subordinate debt)* did not protect banks in the recent financial crisis, it has been abolished from the Basel III capital regulation. Thus, the subordinate debt would not be considered a component of capital under the Basel III norms.

(v) In securitisation transactions and in off-balance sheet exposures, banks built up extremely high levels of leverage which was a prime cause of financial losses during the most recent global financial crisis. Thus, the Basel III has introduced a leverage ratio to restrict leverage in the banking sector. The leverage ratio is calculated as:

$$Leverage\ Ratio = \frac{Tier\ 1\ Capital}{Total\ Assets} \tag{2.2}$$

The ratio must be at least 3% of total assets. The total assets would be calculated taking the balance sheet assets and 10% of off-balance sheet exposures and this would not be risk-based. Thus, the capital requirement would be supplemented by a non-risk-based leverage ratio (Metha, 2012).

Researchers, academicians and regulators believe this ratio would certainly give protection against *"model risk and measurement error"*[12] (BCBS, 2011). In effect, the leverage ratio would be implemented from 2017.

(vi) Taking lessons from the global financial crisis, Basel III has also introduced liquidity requirements, namely, the liquidity coverage ratio (LCR) and the net stable funding ratio (*NSFR*) (BCBS, 2013). The liquidity coverage ratio (LCR) takes the following form and must be equal to or greater than 100 percent:

$$LCR = \frac{Stock\ of\ HQLA}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calendar\ days} \quad (2.3)$$

where,

The total net cash outflows over the next 30 calendar days = Total expected cash outflows − Min (total expected cash inflows; 75% of total expected cash outflows)

The stock of high-quality liquid assets *(HQLA)* represents *'level 1 assets'* and *'level 2 assets'*. The *'level 1 assets'* as defined by BCBS (2013a) includes cash; central bank reserves; marketable securities representing claims on or guarantees by sovereigns, central banks, IMF, non-central bank public sector entities, etc; and debt securities issued by sovereigns or central banks. The *'level 2 assets'* represent marketable securities subject to 20% risk-weights as per the definition of the BCBS and corporate bonds rated *AA*- and above. Thus, the *LCR* is a short-term liquidity indicator and requires banks to provide sufficient liquidity in a one-month horizon in the form of 'unencumbered high-quality assets' in order to survive in a severe liquidity stress scenario (BCBS, 2011; BCBS, 2013a; BCBS, 2015). The implementation of the *LCR* has already been started from 2015.

[12] Model risk and measurement error arises when a financial model is used to measure a bank's risk but the model fails to capture the risks involved or may have errors in measuring it. Kiema and Jokivuolle (2014) argued that severe model risks associated with low-risk loans reduce banks' stability or resilience.

(vii) The second liquidity measure, net stable funding ratio (*NSFR*) is calculated as follows:

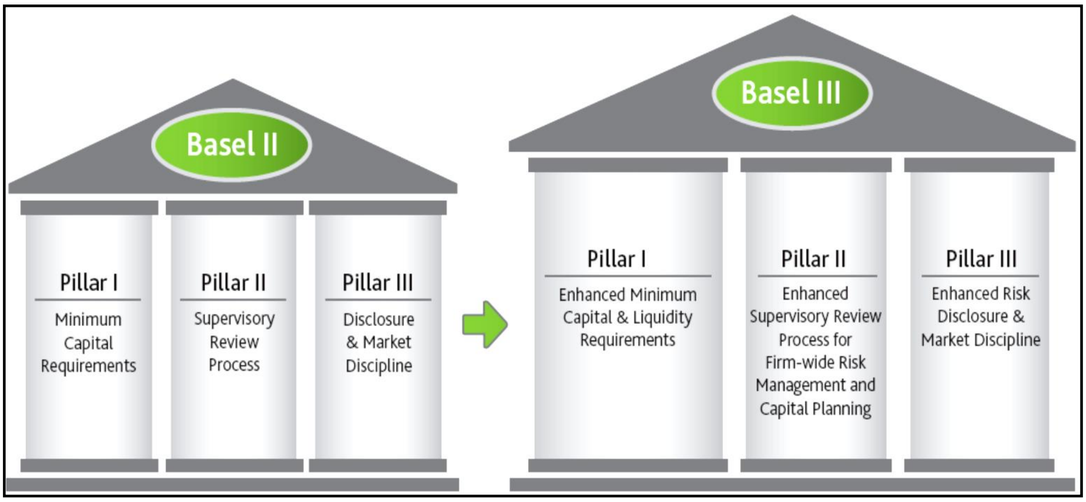
$$NSFR = \frac{Available amount of stable funding}{Required amount of Stable funding} \quad (2.4)$$

The ratio is calculated over a period of a one-year horizon (BCBS, 2014). The motivation of incorporating the *NSFR* is to protect banks by limiting dependence on short-term funding and increase the base of long-term funding sources in order to ensure the resilience of banks and the banking system (BCBS, 2011; BCBS, 2013a; BCBS, 2015). The purpose of introducing the *NSFR* is to ensure at least a minimum funding from the more stable liabilities of the transactions in investment banking, off-balance sheet exposures, securitisation, etc. (BCBS, 2013). In fact, it is introduced to minimize the funding risk arising from the mismatch between assets and liabilities (King, 2013). Therefore, Basel III aspires banks will have an enormous amount of liquidity to withstand the crises period in a situation of serious liquidity disruptions. Even if, banks incur losses due to any unexpected shocks the strong capital base of banks would help them avoid bankruptcy.

2.5 Pillars of Basel III to Withstand Credit, Market, Operational, and Liquidity Risks

As mentioned earlier, Basel III is an upgraded version of the Basel II regulation. In fact, *"Basel III was remodelled to supplement the Basel II rather than supplant it"* (Hazarika and Dubey, 2014, p. 1). Basel II consisted of three pillars (Pillar I, Pillar II, and Pillar III), which were redesigned and strengthened (especially Pillar I with enhanced minimum capital and liquidity requirements) with the pillars of Basel III by addressing the situation in the aftermath of the financial crisis. The following Figure 2.1 illustrates how the enhanced framework of Basel III looks like compared to Basel II.

Figure 2.1: Enhanced Pillars of Basel III



Source: Irwin (2011)

The Basel III framework appears much stronger than the Basel II Accord. The newly introduced forward-looking approach of the model would help better manage a system-wide risk and the new disclosure requirements would likely make the financial markets more transparent. The three pillars of Basel III were designed in such a manner as to consider both the micro and macro aspects of risk management in banks. Table 2.3 provides a more precise picture of the three pillars of Basel III.

Table 2.3: Novel Key Elements in the Pillars of Basel III for Withstanding Credit, Market, Operational, and Liquidity Risks

Risk Category	Pillar I	Pillar II	Pillar III
	Capital and Risk Coverage	**Risk Management and Supervision**	**Market Discipline**
Credit Risk	**Capital:** ▪ Introduction of quality capital (*Tier 1* & *Tier 2*); ▪ Raised minimum requirements of *Tier 1* capital to 4.5% of *RWA* **Risk Coverage:** ▪ Counter party credit risk; ▪ Risks in exposures to central counterparties *(CCPs)*.	▪ Modelling of economic capital; ▪ Enhanced firm-wide stress testing	▪ Enhanced disclosure of capital; ▪ Disclosures of business and economic outlooks.

This Table is continued on the next page

Table 2.3: (Continued)

Risk Category	Pillar I Capital and Risk Coverage	Pillar II Risk Management and Supervision	Pillar III Market Discipline
Market Risk	**Capital:** ▪ Introduction of capital conservation buffer *(CCB)* of 2.5% of *RWA*; ▪ Introduction of counter cyclical buffer of 0% to 2.5% of *RWA*. **Risk Coverage:** ▪ Extensively higher capital for trading book and derivatives exposures; ▪ Incorporation of stressed Value-at-Risk *(VaR)* modelling to mitigate pro-cyclicality.	▪ Covering the risk of off-balance sheet activities and securitisation exposures; ▪ Management of large exposures and concentration risk; ▪ Stress testing and simulations; ▪ Managing Portfolio & limits; ▪ Interest rate risk in the banking book *(IRRBB).*	▪ Disclosure requirements related to securitisation exposures and off-balance sheet activities.
Operational Risk	**Risk Coverage:** ▪ Strengthening the treatment of capital for securitisation and resecuritisations. Banks are required to conduct more rigorous credit analysis of externally rated securitisation exposures. ▪ A non-risk-based leverage ratio serves as an additional safeguard along with the risk-based capital requirement. Also controls system-wide creation of leverage.	▪ Giving incentives to better manage risk and returns; sound compensation practices; valuation practices; stress testing; accounting standard for financial instruments; and corporate governance. ▪ Contingency funding planning (CFP) and legal risk.	▪ Disclosure on securitisation ▪ Comprehensive explanation of the calculation of regulatory capital ratios.

This Table is continued on the next page

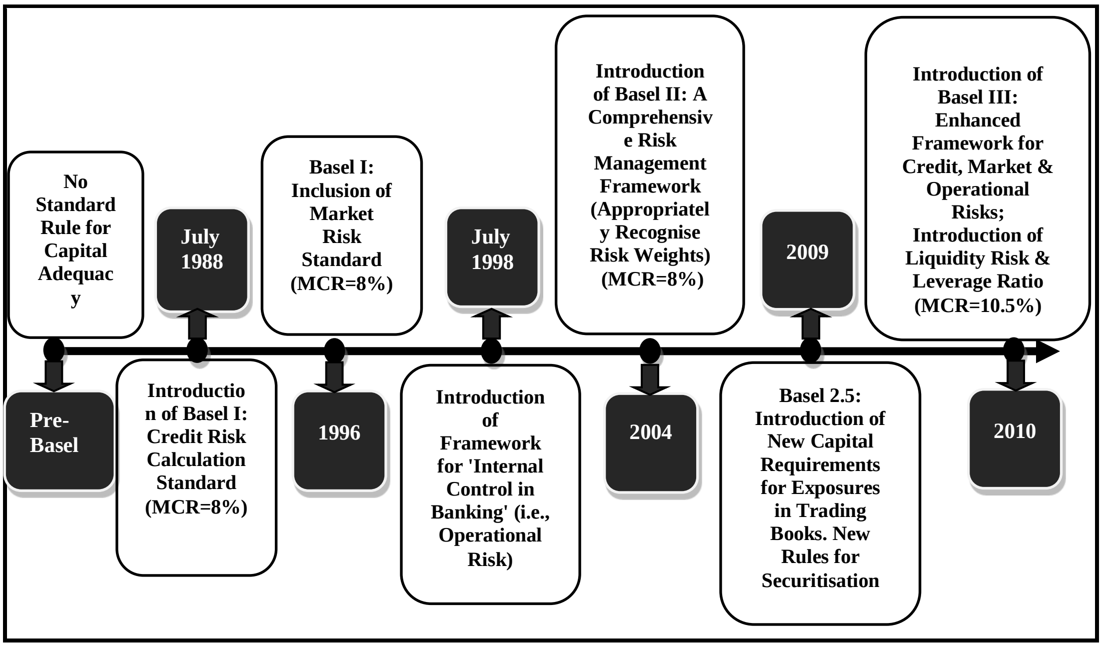
Table 2.3: (Continued)

Risk Category	Pillar I Capital and Risk Coverage	Pillar II Risk Management and Supervision	Pillar III Market Discipline
Liquidity Risk	**Liquidity coverage ratio *(LCR)*** ▪ Requires bank to ensure high quality liquid assets in a 30-day stress scenario. **Net stable funding ratio *(NSFR)*** ▪ Requires bank to use stable sources of funding in a 1-year horizon.	▪ Principles of sound liquidity risk management and supervision; ▪ Supervisory monitoring standards defined.	▪ Increasing the frequency of pillar 3 reporting.

Source: Based on Hazarika and Dubey (2014) and various BCBS documents

Therefore, Basel III has been finalised by many prudent policy efforts. This regulation has been amended and modified from time to time to address the relevant risks by incorporating pragmatic risk management tools, which are forward-looking in nature. In order to provide a snapshot of the important dates when an amendment and/or a new set of rules was incorporated, a pictorial view of the evolution of Basel III is depicted in the following timeline (Figure-2.2).

Figure 2.2: Evolution of Basel III



Source: Based on Hazarika and Dubey (2014) and Various BCBS Documents

2.6 Basel II and Basel III Compared

Many similarities have been observed between the Basel II and Basel III regulations, such as recognition of risks under Pillar I and Pillar II, and the methodology of minimum capital calculation. However, there are some aspects where Basel III differs from Basel II. A comparative analysis of the two regulations has been summarised in Table 2.4.

Table 2.4: Comparisons between Basel II and Basel III Regulations

Ratios	Basel II	Basel III
Capital Requirements		
Common Equity Tier 1 Capital Ratio (CET 1) $= \frac{Common\ Equity\ Tier\ 1\ Capital}{Total\ Risk\ Weighted\ Assets}$	2%	4.5% (Common equity after deductions) Implementation schedule is as follows (Before 2013 = 2%, 1st January 2013 = 3.5%, 1st January 2014 = 4%, 1st January 2015 = 4.5%)
Tier 1 Capital Ratio $= \frac{Total\ Tier\ 1\ Capital}{Total\ Risk\ Weighted\ Assets}$	4%	6%
Total Capital Ratio = Capital Adequacy Ratio (*CAR*) $= \frac{Tier\ 1\ Capital + Tier\ 2\ Capital}{Total\ Risk\ Weighted\ Assets}$	8%	8%
Capital Conservation Buffer (CCB)	There is no capital conservation buffer.	2.5% Implementation Schedule: (Before 2016 = 0%, 1st January 2016=0.625%, 1st January 2017 =1.25%, 1st January 2018 = 1.875%, 1st January 2019 = 2.5%)

This Table is continued on the next page

Table 2.4: (Continued)

Ratios	Basel II	Basel III
Capital Requirements		
Countercyclical Capital Buffer	There is no Countercyclical Capital Buffer	0% – 2.5% (Depends on the macroeconomic situations. Phase in has been started since January 2016. The full implementation will be enforced from January 2019) Phase in schedule is as follows: (Before 2016 = 0%, 1st January 2016 = 0.625%, 1st January 2017 = 1.25%, 1st January 2018 = 1.875%, 1st January 2019 = 2.5%)
Leverage requirement		
Leverage Ratio $= \frac{Tier\ 1\ Capital}{Total\ Exposure}$	There is no leverage ratio	≥ 3%
Liquidity requirements		
Liquidity Coverage Ratio (*LCR*) $= \frac{High\ Quality\ Liquid\ Assets}{Total\ net\ cash\ outflows\ over\ the\ next\ 30\ calendar\ days}$	There is no liquidity coverage ratio	≥ 100%
Net Stable Funding Ratio (*NSFR*) $= \frac{Available\ amount\ of\ stable\ funding}{Required\ amount\ of\ Stable\ funding}$	There is no net stable funding ratio	≥ 100%

Source: BCBS (2004), BCBS (2011) BCBS (2013a) and BCBS (2014)

Table 2.4 demonstrates the minimum requirement for common equity capital (the highest quality capital), which has been increased from 2% to 4.5%. The overall *Tier 1* capital requirement (*CET 1*[13] plus *AT 1*[14]) has also been raised from 4% to 6%. While the minimum total capital requirement will remain at the current level of 8%, when combined with the capital conservation buffer *(CCB),* the total requirement would increase to 10.5% as prescribed in the Basel III regulation.

2.7 Road Map of Basel III Implementation

Globally, the implementation of the new rules of Basel III began in 2013 and is scheduled to be fully implemented by 2019[15]. In order to illustrate the complete execution phase, a road map is depicted in Table 2.5.

Table 2.5: Road Map of Basel III

Capital Requirement	2011 (Basel II)	2012	2013	2014	2015	2016	2017	2018	2019 (Basel III)
Minimum common equity capital ratio	2%	2%	3.5%	4%	4.5%	4.5%	4.5%	4.5%	4.5%
Capital conservation buffer	0%	0%	0%	0%	0%	0.625%	1.25%	1.875%	2.5%
Minimum common equity plus capital conservation buffer	2%	2%	3.5%	4%	4.5%	5.125%	5.75%	6.375%	7.0%
Phase-in of deductions	0%	0%	0%	20%	40%	60%	80%	100%	100%
Minimum Tier 1 capital ratio	4%	4%	4.5%	5.5%	6%	6%	6%	6%	6%
Minimum total capital ratio	8%	8%	8%	8%	8%	8%	8%	8%	8%
Minimum total capital plus conservation buffer	8%	8%	8%	8%	8%	8.625%	9.25%	9.875%	10.5%

Source: BCBS (2011) and Latham and Watkins (2011)

[13] *CET 1* comprises common equity and retained earnings.
[14] *AT 1* refers to other qualifying financial instruments which have the common equity attributes.
[15] The new standards will be fully enforced from 2019. However, banks will be allowed to phase-out non-qualifying instruments up to 2023.

In fact, the Basel III regulation will be phased-in over a twelve-year period and be fully effective by 2023 by the phasing-out[16] of non-qualifying instruments. A summary of the phase-in period is depicted as follows (Al-Darwish et al., 2011; Latham and Watkins, 2011; BCBS, 2011; BCBS, 2013a; BCBS, 2014; BCBS, 2015):

- Increased tighter capital requirements:
  - Raising the minimum common equity capital ratio: 2013 –2014.
  - Newly introduced capital conservation buffer: 2016 –2018.
  - Application of countercyclical capital buffer: 2016 –2018.
  - Phase-in of deductions from core *Tier 1* capital: 2014 –2017.

- A tighter definition of qualifying capital instruments: phase-out of non-qualifying instruments from 2013 to 2023.
- The higher capital requirement for banking book exposures: commencing ended in 2010.
- Increased capital requirements for trading book exposures: commencing ended in 2010.
- Newly introduced leverage ratio: supervisory monitoring ended 2012, parallel run from 2013 – 2018; migration to Pillar 1 capital requirement in 2018; banks are required to disclose the leverage ratio from 1st January 2015.
- New liquidity ratios (BCBS, 2013a; BCBS, 2014):
  - Liquidity coverage ratio (*LCR*): observation period 2011 – 2014, commencement of new standard in 2015.
  - Net stable funding ratio (*NSFR*): observation period 2012 – 2017, commencement of new standard in 2018.

[16] Capital instruments that no longer qualify as *Tier 1* or *Tier 2* capital would be phased-out over a 10-year horizon starting from 2013.

2.8 Conclusion

It is certainly true the Basel Accords are critically important for banks. The Accords, particularly Basel II, obviously has helped banks to identify, measure, and mitigate various risks (Cannata and Quagliariello, 2009; McAleer, et al., 2012). Risk management, in fact, gained momentum after the implementation of Basel II, albeit showing major flaws in some cases during the global financial crisis in 2007/08.

Nevertheless, the new regulation (i.e. Basel III) has been reconfigured to capture all the relevant risks such as credit, market, operational, liquidity, concentration, strategic, residual, environmental, and securitisation risks to make the banking system more resilient by increasing enhanced capital and liquidity requirements. The newly introduced leverage ratio will contain a system-wide expansion of leverage and the new liquidity ratios (*LCR* and *NSFR*) are expected to reduce the systematic crises in the global economy which would provide macroeconomic benefits in the long-run. However, the actual impacts of the regulation may only be known after the completion of the phase-in period in 2018. Until then, regulators are required to rely on the impending effects of Basel III regulation to formulate further policies for banks and enforce them.

Chapter 3

Review of Literature

The previous chapter (Chapter 2) described the evolution of the Basel Accords. In particular, the chapter delineated different norms of the Basel III regulation and presented a pictorial view of the comparisons of the Basel II and Basel III standards. Finally, a road map was depicted in the previous chapter to show the implementation phase of the Basel III norms. This chapter, however, synthesises the current literature on Basel III, relevant to this thesis. The literature has been organised on the objectives of the thesis and is structured as follows: Section 3.1 furnishes an introductory note on the Basel III literature. Literature related to the resilience of banks has been discussed in Section 3.2, whereas the literature on the impact of Basel III on lending rate/spread has been described in Section 3.3. Section 3.4 depicts the previous empirical works of the costs and benefits of Basel III regulation, and finally, gaps in the existing literature are delineated in Section 3.5.

3.1 Introduction

Policy-makers, economists, and practitioners singled out the capital structure requirement of Basel II as one of the major causes of bank failures in the most recent financial crisis. The capital maintained by banks as per the Basel II regulation was clearly insufficient to safeguard banks during the global financial crisis (Cannata and Quagliariello, 2009; Nowak, 2011). Thus, it was felt the global financial architecture needed to be strengthened, standardised and resilient to withstand the major shocks of any impending global crisis (Lall, 2009; BCBS, 2010b; IIF, 2011; IMF, 2010).

In response to this criticism, the BCBS came up with a revised capital and liquidity regulation, called Basel III, to protect banks from adverse shocks during a major financial crisis. The Basel III regulation are expected to reduce systemic risks of banks and build resilient banking systems by increasing the quantity and quality of bank capital and liquidity standards (Reisen, 2008; Calice, 2010; Caggiano and Calice, 2011; Wellink, 2011). In effect, capital requirements improve financial stability by decreasing banks' incentives to undertake excessive risks ex ante, and by making banks even more competent to absorb losses ex post. In the following sections, the existing literature relevant to the research objectives, e.g., the resilience of banks, the impact of Basel III on loan pricing, and the costs and benefits of Basel III have been discussed.

3.2 Literature related to Resilience of Banks

The relationship between capital strength and the resilience of the banking sector is complex as revealed by the global financial crisis. In order to analyse the risk taking behaviours of banks, Laeven and Levine (2008) have used a *Z-score* model to explore the solvency of banks (risk taking) due to regulatory capital requirements. The study defined the *Z-score*[17] as a return on assets *(ROA)* plus the capital to asset ratio *(CAR)* divided by the standard deviation of return on assets [$\sigma(ROA)$]. According to Laeven and Levine (2008), a higher *Z-score* confers the banks are more stable. The authors have estimated the *Z-scores* of 288 banks across 48 countries covering a sample period of 1999 to 2004. The study included bank level as well as country level variables such as capital to asset ratio, cash flow, revenue growth, size (total asset), loan loss provision, liquidity, per capita income and deposit insurance. The study suggests the banks' solvency increases by 0.3 standard deviations when the capital ratio is raised by one standard deviation.

However, the *Z-score* model[18] has been applied differently by Abdel-Baki (2012) to determine the association between the Basel III requirements and bank credit growth using data from the period 2004 to 2009 in 47 emerging market economies. In this study, the *Z-score* is explained as the *"number of standard deviations by which bank credit growth would drop from the mean to accommodate the necessary restructuring of bank assets* in *order to comply with the Basel III requirements (capital, liquidity and leverage)"* (Abdel-Baki, 2012, p. 10). Three types of independent variables have been employed in the study i.e. vector of Basel III

[17] The formula for calculating Z-score as defined by Laeven and Levine (2008) is: $\frac{Returnonasset(ROA)+Capitaltoassetratio(CAR)}{\sigma(ROA)}$.

[18] Abdel-Baki (2012) has defined *Z-score* as *"{(average credit growth/GDP) + recapitalization + (liquidity enhancement/GDP)} divided by {standard deviation of (credit growth/GDP growth), i.e. σ (C/Y))"* (p. 10).

compliance (*Tier 1* capital ratio, *LCR*, *NSFR* and leverage ratio); vector of country characteristics measured by inflation, exchange rate, employment growth and sovereign rating; and vector of bank characteristics measured by bank size (proxied by equity), loan-deposit ratio *(LDR)* and loan loss provisioning *(LLP).* The study reveals a high *Z-score* is associated with banks having the higher levels of capital, which suggest higher capital levels ensure the solvency of banks. However, Abdel-Baki (2012) has recommended not imposing leverage ratios upon the nations of emerging market economies because when the leverage ratio is removed from the model, the robustness of the model improves. Hence, the resilience of banks does not deteriorate if emerging economies are exempted from the requirement of leverage ratio.

Blundell-Wignall and Roulet (2012) have used distance-to-default as a measure of resilience. They have considered a panel sample of 94 banks over the period 2004 – 2011. The study takes into account market beta of each bank, house prices, relative size, leverage, derivative exposure, trading assets, wholesale funding and Tier 1 capital ratio. The findings of the study by Blundell-Wignall and Roulet (2012) suggest Tier 1 capital has no impact on the resilience of banks but leverage ratio provides strong support.

Vallascas and Keasey (2012) have used the contingent claim approach *(CCA)* to assess the default risk of banks in the aftermath of financial crisis. The analysis has been carried out on a sample of 153 banks in 17 European countries covering the period 1992 – 2008. The study has incorporated micro-prudential variables, such as total assets as a proxy for bank size, ratio of total asset to country GDP, non-interest income over operating income, ratio of primary liquidity to total asset, ratio of retail deposits to total debt, off-balance sheet items over total assets, ratio of asset to book value of equity as well as capital adequacy ratio (*CAR*). Control variables such as, the ratio of market value of equity to book value of equity, the Herfindahl Hirschman Index (*HHI*) of bank asset concentration, real GDP growth rate and rate of inflation are also included in the analysis. Vallascas and Keasey (2012) have concluded the enforcement of liquidity requirements and placing an embargo on the banks' leverage ratio would improve the resilience of banks to systematic shocks.

Using a similar approach as Laeven and Levine (2008), Chalermchatvichien et al. (2014) have also investigated the risk taking attitudes of banks by employing the *Z-score*[19] model. They have analysed data from 68 banks in 11 East Asian countries from the period 2005 to 2009. The countries sampled are Malaysia, Thailand, Singapore, South Korea, Hong Kong, Indonesia, China, the Philippines, Japan, Sri Lanka, and India. This study has used variables such as, ownership structure, *NSFR*, *EBIT*, loan loss provision, Tobin's Q (calculated by adding the "*market value of equity with book value of liabilities divided by the book value of total assets"*, p. 41), deposits, GDP, per capita income, and dummy variables representing trend. The study has found an increase in capital strength by one standard deviation reduces the risk of banks (the resilience of banks increased through the improved *Z-scores*) by 5.37%.

The empirical evidence related to the liquidity standards of Basel III provides important lessons to banks. In fact, regulators, policy makers, and banks are concerned about the varying degrees of impacts of the liquidity coverage ratio (*LCR*) and net stable funding ratio (*NSFR*) on the solvency of banks. Few empirical works have shed light on this evidence to improve the knowledge in this arena. For instance, Angora and Roulet (2011) have used a logit model to test the financial distress of the U.S. and UK banks. The sample period of the study was 2005 to 2009 and consisted of 781 banks. In order to assess the financial distress of banks, Angora and Roulet (2011) have used two Basel ratios; the *NSFR* and the capital adequacy ratio (*Tier 1* plus *Tier 2* capital divided by the total risk-weighted asset). The study has also included other variables such as the ratio of loan loss provision to total asset, the natural logarithm of the total asset as a proxy for the bank size, the annual GDP growth rate and management efficiency measured by the cost-income ratio in the logit model. Angora and Roulet (2011) have suggested the imposition of *NSFR* reduces the distress, consequently, improves the resilience of banks.

[19]The same model of Laeven and Levine (2008) have used by Chalermchatvichien et al. (2014) to calculate Z-score and is defined as *"the return on assets (ROA) plus the capital-asset ratio divided by the standard deviation of asset returns"* i.e., $\frac{Returnonasset(ROA)+Capitaltoassetratio(CAR)}{\sigma(ROA)}$ (Chalermchatvichien et al., 2014, p. 34)

Employing data from 2005 to 2012 for 2079 banks in 128 countries of Africa, Asia-Pacific, Europe, Middle East and North Africa (MENA), Central Asia and Western Hemisphere, Gobat et al. (2014) has demonstrated the impact of the net stable funding ratio (*NSFR*) on banks' operations. They have used the latest (2014) methodology of the BCBS to calculate the *NSFR* and apply a sensitivity test to understand the impact of liquidity on the solvency of banks. The results of Gobat et al. (2014) have shown banks, which have fallen short in keeping the threshold level of *NSFR* are likely to weaken the resilient capability, which might in turn cause insolvency of banks.

Applying data from about 11,000 banks in the US and UK from 2001 – 2009 and employing the probit model, Vazquez and Federico (2015) have investigated the liquidity structure (i.e., *NSFR*) in order to understand the implications for the financial stability of banks. The study has included the capital to asset ratio, net stable funding ratio *(NSFR)*, asset growth, the share of trading revenue to total revenue, the proportion of off-balance sheet asset and a *Z-score* (solvency) as the explanatory variables in the model. The results of the study have shown a 19.2% increase in *NSFR* causes a 1.6% decline in the probability of bank failure (i.e., increase solvency). Similarly, a 4.6% increase in capital to asset ratio increases the banks' solvency by 0.8%.

3.3 Literature on the Impact of Basel III on Lending Rate/Spread

The significant role of capital and liquidity holdings of banks in line with the requirements of Basel III is evident. Empirical studies show the impact of a higher capital requirement, principally, increases the lending rate. The marginal cost of increasing equity is translated into a higher lending rate for which banks tend to reduce the volume of lending (BCBS, 2012). Hence, it is important to quantify these effects to determine the accurate size of an increase in the minimum capital levels.

The debate surrounding the effects of increased capital on lending has been assessed by several studies. Elliott (2009), for instance, has estimated the effects of increased capital requirements on lending in the U.S. The study has postulated the interest rates on loans depend on the required rate of return on equity, cost of deposit, and administrative and other expenses. Elliott (2009) has contended if the equity level increases by 4%, the lending rate goes up by 0.77%. However, his study strongly recommends the U.S. banking sector could offset the costs of higher capital requirements on loans through a number of strategies, such as reducing costs of deposits or decreasing costs of operations, and interestingly, he has suggested these adjustments would not cause a disaster in the banking system.

The Macroeconomic Assessment Group (MAG)[20] (2010a), however, has used Dynamic Stochastic General Equilibrium (DSGE), Semi-structural and Vector Autoregressive (VAR) models to measure the macroeconomic impact of Basel III. The MAG (2010a) has evaluated 97 models submitted by 17 member countries of Bank for International Settlements (BIS). The MAG (2010a) has shown the increased capital requirements increase the lending spread by 0.15% and reduce the lending volume by 1.4%. They have also shown a 25% increase in banks' liquidity increases the lending spread by 0.14% and decreases the lending volume by roughly 3.2%. This study has implied lending rates are likely to increase in the Basel III implementing countries, which in turn will reduce the lending volume in the economy.

The BCBS (2010a) has examined how the lending spread and outputs are affected by the norms of Basel III. The sample size of the study consisted of 6660 banks covering the period 1993 to 2007 in 13 member countries of the BCBS. In order to measure the impact of additional capital requirements on lending rates, return on equity *(ROE)* and cost of deposits have been considered. The assessment of the BCBS (2010a) has revealed a 1% increase in the capital adequacy ratio increases the spread on loans by 0.13% and the additional costs of holding liquid assets increase the spread by 0.25%. The BCBS (2010a) has also pointed out the *ROE* of banks reduces with the increase in capital adequacy ratio and hence, in order to offset the higher costs of fund, banks would need to increase the spread on loans to keep *ROE* invariable.

[20] *"Macroeconomic Assessment Group (MAG) was established by Financial Stability Board and Basel Committee on Banking Supervision in 2010. The members of MAG consist of macroeconomic modelling experts from central banks and regulators in 15 countries and a number of international institutions. Stephen Cecchetti, Economic Adviser of Bank for International Settlements (BIS) was the chair of the Group" (*Macro Economic Assessment Group (MAG), 2010b, p. 1)

In a similar vein, King (2010) has demonstrated the impact of additional capital and liquidity requirements on the lending spread by analysing data from the period 1993 to 2007 in the US and Euro Zone. The study has scrutinised balance sheet and income statement identities along with the return on equity *(ROE),* the regulatory capital ratio defined as capital to *RWA*[21], and the net stable funding ratio *(NSFR).* The study has proposed in order to meet a 1% increase in capital, banks would need to increase the lending spread by around 0.15%. On the same token, banks are required to increase the spread by about 0.24% in order to maintain the *NSFR* requirement of Basel III.

Using data from 1976 – 2008, Kashyap et al. (2010) have estimated a panel regression model to capture the impact of higher capital requirements on large banks in the US. The study has pointed out banks would gradually phase-in the higher capital requirements because raising new equity is more costly than the internally generated fund. The study concludes the lending rate would increase up to 0.45% for a 10% increase in the capital requirements.

In order to understand the impact of tighter capital on the lending spread in African Countries, Caggiano and Calice (2011) have also employed a panel regression model covering the period from 2001 – 2008. The sample of the study consists of 1061 African banks. Caggiano and Calice (2011) have considered the capital to total asset ratio, return on equity *(ROE)* and real interest rate in the lending spread model. The study has found a 1% increase in capital ratio increases the lending spread by around 0.84%.

Employing the same model used as Elliott (2009), Santos and Elliott (2012) have concluded the average lending rate of banks is expected to rise by 0.28% in the United States, 0.17% in Europe and 0.08% in Japan in the long run due to the estimated increase in regulatory costs of Basel III. The study has again estimated the funding cost would increase by 2% in Europe, 1.25% in Japan, and 2% in the U.S for holding liquidity in accordance with the Basel III requirements.

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[21] Capital ratios can be defined in two ways based on the banks' balance sheet; one is accounting capital and the other one is regulatory capital. Accounting capital ratio is the ratio of the total equity to risk-weighted asset whereas regulatory capital ratio is defined as regulatory capital (*Tier 1* plus *Tier 2*) divided by risk-weighted assets (*RWA*).

Using a cointegration test on quarterly bank-level data from 1997:Q1 - 2010:Q2 from twelve UK banks, Yan et al. (2012) have assessed the effects of Basel III on lending rates. The study has explained for a 0.10% increase in capital, the lending spread increases by 0.50%. The effect is greater in the case of increased liquidity requirement of banks; a 1% increase in net stable funding ratio results in an increase of spread by 10%.

Parcon-Santos and Bernabe (2012) have exploited the VAR model using data from 2001 – 2008 to show the macroeconomic effects of Basel III in the Philippines. The study has suggested a 1% increase in capital ratio increases the lending spread by about 3.08%.

Applying scenario analysis on the Modigliani and Miller (MM) proposition, Cummings and Wright (2015) have shown the evidence of the effects of higher capital requirements on the funding costs of banks in Australia. The study has suggested that for a 5% increase in the capital to asset ratio, the borrowing costs to bank customers (i.e. the lending rate of banks) would increase by 0.20%. Cummings and Wright (2015) have raised concerns that the magnitude of this increase in borrowing costs might have undesirable consequences on the economic activity in Australia.

3.4 Literature on the Macroeconomic Costs and Benefits of Basel III Regulation

The capital position of banks is a key determinant of credit growth in an economy (BCBS, 2012). A higher capital requirement increases the strength of the credit delivery channel and healthier capitalised banks are capable of supplying further credit to the economy (Francis and Osborne, 2009), which eventually accelerates the GDP growth. Moreover, higher capital and liquidity requirements ensure financial stability in the economy by reducing the probability of a crisis (Osborne et al., 2010; Kato et al., 2010). Although the cost of additional capital is seen to increase the lending spread, the net benefits of holding a higher amount of capital are positive (Osborne et al., 2010; Caggiano and Calice, 2011). Similar studies on the macroeconomic impact of tighter capital regulation have been documented by Barrell et al. (2008; 2009), Bank of Canada (2010), the BCBS (2010a), the MAG (2010a;

2010b), Wong et al. (2010), Caggiano and Calice (2011), Elliott et al. (2012), Parcon-Santos and Bernabe (2012), and Yan et al. (2012).

Using DSGE, Semi-structural and VAR models, the MAG (2010a) has assessed the impact of Basel III on the macroeconomic conditions of 17 member countries the BCBS. The results have shown for a 1% enhancement in capital ratio[22], GDP drops from the baseline by about 0.19% in four and half years. This is synonymous to decline in the annual GDP growth rate by 0.04%. However, the MAG (2010a) did not assess the macroeconomic benefits associated with Basel III.

Employing the same methodology utilized by the MAG (2010a), the BCBS (2010a) has estimated the macroeconomic costs and benefits of stronger capital and liquidity reforms. The analysis of the BCBS (2010a) has shown raising capital ratio by 1% renders a 0.09% decline in GDP relative to baseline. On the other hand, a 1% increase in capital ratio decreases the likelihood of a financial crisis from 4.6% to 3% and a gain in GDP of around 0.96%. Therefore, the net benefit of higher capital is about a 0.87% increase in GDP.

Angelini et al. (2011) have conducted a study on the assessment of the long-term economic costs of tighter capital and liquidity standards in terms of economic performance and fluctuations. Using the Dynamic Stochastic General Equilibrium (DSGE) model, semi-structured and vector error correction models (VECM), Angelini et al. (2011) have evaluated 13 models submitted by the BCBS member countries; Canada, France, Germany, Italy, Japan, the Netherlands, Spain and the United States. Essentially, Angelini et al. (2011) have suggested a 1% increase in capital to asset ratio from 7% to 8%, the economy contracts by about 0.09% and for a 25% increase in liquid assets to total assets ratio, GDP reduces by 0.08%. Moreover, for a 1% increase in the capital to asset ratio, the improvement of the standard deviation (fluctuation) of GDP is about 1%. Hence, the economic performance improves due to an increase in the capital ratio.

[22]The MAG (2010a) has used tangible common equity (TCE) to total risk-weighted asset ratio in the model.

Addressing the Italian economy, Locarno (2011) has presented evidence of regulatory impacts by assessing the costs associated with transforming to Basel III. Using the Bank of Italy Quarterly Model *(BIQM)* - a semi-structural large-scale macroeconomic model covering data from 2011:Q1 – 2022:Q4, the study states for a 1% increase in the tangible common equity *(TCE)* ratio, the level of GDP declines up to 0.33%, which is equivalent to the reduction in annual growth rate of GDP of about 0.04%.

Using cointegration and the Vector Error Correction Model (VECM) covering quarterly data over the period from 1994:Q1 – 2008:Q3 in the U.S., Gambacorta (2011) has examined the impact of Basel III on macroeconomic activity. The author has considered the long run relationships amongst the real GDP, short-term real interest rate, spread, loan portfolio, *ROE*, liquidity to deposit ratio, *Tier 1* capital to risk-weighted asset ratio *(TRA)*, tightening indicator, and government spending. The study concludes the tighter capital and liquidity ratios negatively affect the long run steady-state output and seriously affect the profitability of banks; a 1% increase in capital ratio causes around a 0.1% drop in output (GDP) relative to the baseline. Gambacorta (2011), however, did not estimate the benefits of Basel III regulation.

Caggiano and Calice (2011) have used panel data from 22 African countries over the period 2001 to 2008 to explore the impact of higher capital on output through the lending channel. By estimating the impact of lending spread on GDP, Caggiano and Calice (2011) have suggested enhancing capital to asset ratio by 2%, the loss in GDP would increase by around 0.12%. However, a 2% higher capital ratio would increase the gain in GDP by about 0.16%. Hence, the net benefits would increase by roughly 0.05%. The study has measured the crisis probability using a multi-variate logit model and has asserted a 1% increase in capital ratio would reduce the likelihood of a crisis by 0.5%, and this is associated with an increase in output (GDP) of around 0.165%.

Yan et al. (2012) have used Johansen trace statistics (cointegration test) and the Vector Error Correction Model (VECM) to analyse twelve banks' quarterly data from 1997:Q1 to 2010:Q2 to measure the long run costs and benefits of Basel III in the UK. The study has examined the long-term cointegrating relationships amongst the real GDP, real bank lending, short-term interest rate (measured by deducting inflation from 3-month interbank rate), lending spread, return on equity *(ROE), Tier 1* capital to risk-weighted asset ratio *(TRA),* and net stable funding ratio *(NSFR).* The study has revealed a 1% increase in capital requirement increases the associated costs in terms of decline in GDP by 0.08%. However, by raising the same level of capital, the likelihood of crises would be reduced by 1.4% and the associated gain in GDP would increase by 0.49%. Thus, for a 1% increase in capital ratio, the net benefits in terms of gain in output (GDP) would increase by 0.41%.

Similarly, Parcon-Santos and Bernabe (2012) have demonstrated the macroeconomic impact of Basel III by estimating the costs and benefits in the Philippines. The sample of the study comprised 33 banks covering data from 2006 – 2011. In order to estimate the costs, they have used unrestricted *VAR* models. Using the tangible common equity *(TCE),* lending spread, loan portfolio, and real GDP as the endogenous variables, the study suggests for a 1% increase in capital level, GDP would decline (costs of Basel III) by about 0.01% and with the same level of increase in capital (i.e. 1%) would produce an annual benefit of 0.02% of GDP. Hence, the net benefits of implementing Basel III in the Philippines have been 0.01% of steady-state output, which is positive.

Roger and Vitek (2012) have performed a study employing structural macroeconomic panel model with a Bayesian procedure involving 15 major advanced and emerging markets (Canada, the United States, Mexico, Brazil, the United Kingdom, the Netherlands, Germany, France, Spain, Switzerland, Italy, China, Australia, Korea and Japan). The results of the study suggest a 1% increase in the capital requirement of Global Systematically Important Banks *(GSIB)* would adversely affect GDP by around 0.17%.

Bernabe and Jaffar (2013) have investigated the macroeconomic impact of Basel III using panel data from banks in Malaysia. The study has applied a panel least square estimator to measure the benefits of Basel III regulation. The *'Benefit Model'* includes banks' income capacity (net income, return on equity (*ROE*) and return on assets (*ROA*)), risk indicators of banks' balance sheet (risk weighted assets, net loans, loan write offs), and structural indicators representing size (total assets) and capital as the explanatory variables. In order to estimate the costs of Basel III, Bernabe and Jaffar (2013) have used the Vector Autoregressive (VAR) model by including the bank capital, lending wedge, total bank loan, and real GDP in the model. The estimates have suggested a 1% increase in capital yields savings of 0.76% in GDP due to a reduction in the probability of a crisis occurring. However, for a 1% increase in capital, GDP declines by roughly 0.46%. This means the tighter capital regulation produces a net increase (benefit) in GDP of about 0.30%.

Recently, Noss and Toffano (2016) have estimated the impact of enhancing bank capital on lending and growth. Using data from 1986 to 2010 from banks in the UK, Noss and Toffano (2016) have applied VAR models with sign restrictions. They have concluded a 1% increase in the capital requirement is associated with a 4.5% reduction in lending and a 0.85% decline in GDP growth.

3.5 Gaps in Existing Literature

Gaps in the existing literature have been organised according to the objectives of the thesis:

3.5.1 Relevance of Basel III Regulation to Increase Solvency of Banks

Existing literature seems to rely on the *Z-score* model to analyse the robustness of banks' stability (solvency) (Laeven and Levine, 2008; Abdel-Baki, 2012; Chalermchatvichien et al., 2014). The study conducted by Chalermchatvichien et al. (2014) have examined whether the solvency (risk taking) of banks increased or not (higher *Z-score*) by including only the *NSFR*. Abdel-Baki (2012) has included Tier 1 capital ratio, liquidity ratio and leverage ratio in the model. Nevertheless, it is difficult from the study by Abdel-Baki to identify the individual effects of *LCR* and *NSFR* because he combines both the ratios and has referred to it as a liquidity ratio. Hence, none of the present studies have included all three Basel III requirements - capital adequacy ratio *(CAR)*, liquidity coverage ratio *(LCR)* and net stable funding ratio *(NSFR)* in the same model (*Z-score* model) to determine the impact on the solvency of banks. The existing literature uses the capital to asset ratio as a proxy for capital adequacy ratio *(CAR)* in order to calculate the *Z-score*, which is neither risk-based nor a regulatory ratio of Basel III. However, no studies so far have shown the impact of *CAR*, *Tier 1* capital ratio, and leverage ratio in the same study.

Studies testing the solvency of the BRICS banks appear to be scarce. Hence, such a study seems timely given that the BRICS economies represent one-fifth of the total world GDP and have an autonomous multilateral bank established (IMF, 2013; Schuman, 2014; Venu, 2014). The present thesis examines the stability of commercial banks in the BRICS economies by incorporating the *LCR* and *NSFR* in a model together with *CAR*, *Tier 1* ratio, and leverage ratio. Hence, the research question to be addressed is:

Research Question 1: How does Basel III ensure the resilience (solvency) of banks in the BRICS economies?

3.5.2 Impact of Basel III on Loan Price of Banks

The Basel III requires banks to maintain a higher amount of capital. Keeping each unit of additional capital and liquidity, the opportunity cost of holding such capital increases (Osborne et al., 2010; Gambacorta and Marques-Ibanez, 2011). It is assumed those costs may be passed on to borrowers in terms of increased lending rates (BCBS, 2012). Therefore, it is imperative to investigate the impact of Basel III on the loan pricing of banks. The existing literature shows the loan price is a function of the cost of fund, cost operation, and the cost of capital (Elliott 2009; Slovik and Cournède, 2011; Santos and Elliott, 2012). These studies, however, have not individually incorporated the cost of equity, capital adequacy ratio, and *NSFR* in the same model to better understand the impact of those factors on the loan price (interest rate on loans).

Another study by Caggiano and Calice (2011) has used the capital to asset ratio, return on equity *(ROE)* and real interest rate as the determinants of the lending spread. However, Caggiano and Calice (2011) have excluded the ‘costs of operation’ and ‘costs of fund’ from the model. This exclusion may not provide an accurate result to determine the lending rates as it violates the basic loan pricing equation.

Since studies investigating the impact of Basel III on the loan price have neither included all the variables mentioned in the same model nor considered the BRICS economies, this study is novel in that it calibrates all the variables in the loan-pricing model. Therefore, the loan price of the BRICS banks should be a function of funding cost, operating cost, the cost of capital proxied by return on equity *(ROE), Tier 1* capital ratio *(TRA),* and *NSFR*. To this end, the following research question will be answered:

Research Question 2: Does the lending rate of banks increase due to Basel III compliance?

3.5.3 Macroeconomic Costs and Benefits of Basel III

Basel III requires banks to increase their capital in order to protect banks from any unexpected economic shocks (BCBS, 2010a). Any financial regulation has costs as well as benefits. If the benefits outweigh the costs of regulation, there are merits in adopting it. The benefits of higher capital are generated mainly through reducing systemic risks, which would reduce the severity and frequency of financial crises (Barrell et al., 2009; Kato et al., 2010) and would save any accompanying loss to GDP (BCBS, 2012). On the other hand, holding additional capital is costly, which banks load in the loan prices by raising the interest rate on loans (BCBS, 2012). This slows down the activities of borrowers resulting in a lower GDP growth.

Some studies have explored the costs and benefits associated with Basel III regulation such as Schanz (2009), Barrell et al. (2009), BCBS (2010a; 2010b; 2012), MAG (2010a), Kato et al. (2010), Caggiano and Calice (2011), Gambacorta (2011), Schanz et al. (2011), and Yan et al. (2012). However, no such studies have used the calibrated model of loan price as stated above i.e. the cost of fund, administrative cost, the cost of capital, return on equity *(ROE), Tier 1* capital ratio *(TRA),* and *NSFR* in the same equation to determine the costs of holding higher capital.

The existing literature examines the costs and benefits of Basel III in the context of the US, the UK, Europe, Africa and some Asian countries. Since the BRICS have emerged as very important economies (IMF, 2013; Foroohar, 2009), the impact assessment of Basel III is fundamental to the macroeconomic performance of the BRICS. However, there has been no such study, which has estimated the costs and benefits of Basel III in the context of the BRICS. Therefore, this thesis would fill this research gap and determine the costs and benefits of Basel III in the context of the

BRICS markets, and in order to deal with this problem (gap), the following research questions will be addressed.

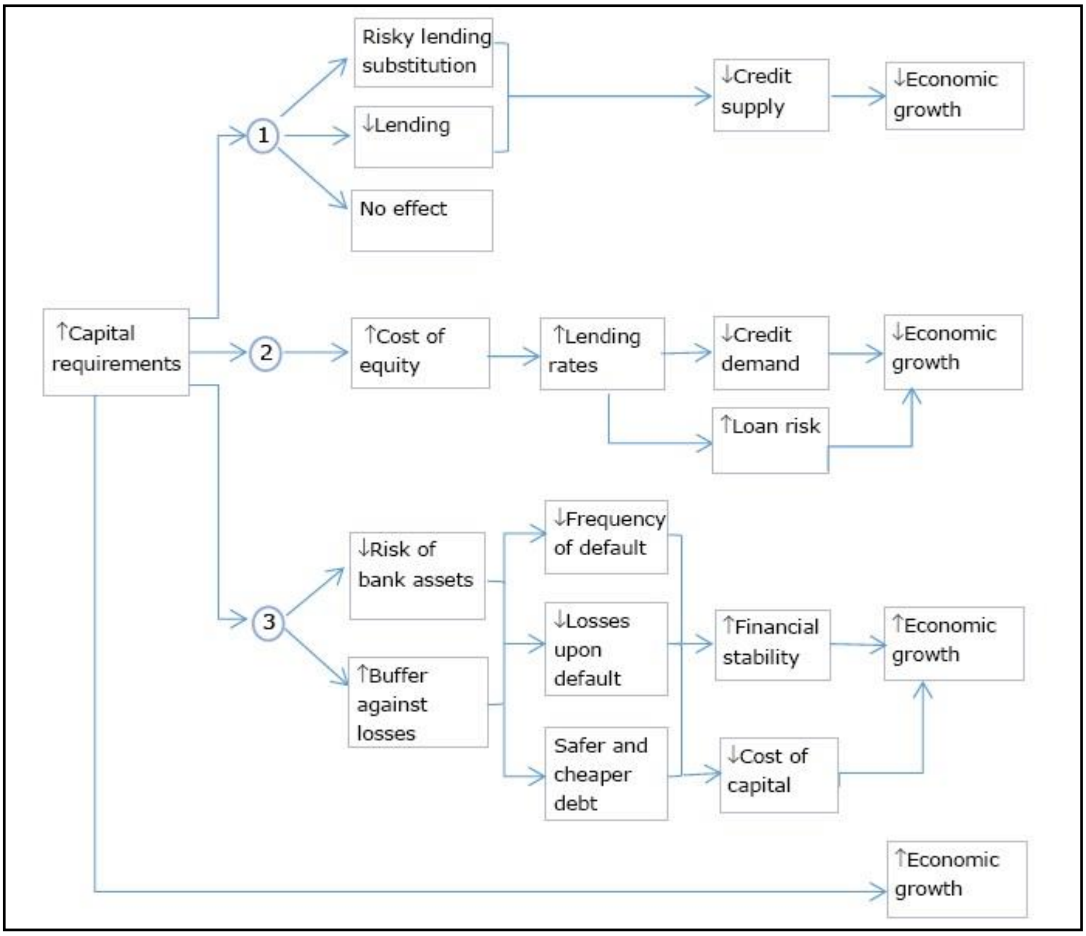
Research Question 3: Will the Basel III regulation increase the macroeconomic costs in the BRICS economies?

Research Questions 4: Will the Basel III regulation bring significant economic benefits to the BRICS economies?

3.6 Conclusion

From the previous literature, it can be concluded that the banks' resilience increases by implementing Basel III norms. This regulation is also critical in increasing the lending rate of banks. However, banks shift those costs to borrowers by increasing the interest rates on loans. As such, credit flows in the economy contract resulting in lower levels of investment and consumption. Therefore, the economy suffers in the short-run, but as banks become more resilient to withstand systematic shocks due to increasing capital levels, the probability of crises occurring in the economy declines. This, in turn, prevents loss of GDP. Thus, the economy will be benefited by implementing the Basel III standards. In fact, the net benefits of implementing the Basel III norms are positive in most economies as indicated by past studies. Figure-3.1 gives a clearer picture of the effects of Basel III on economic growth as summarised from the literature.

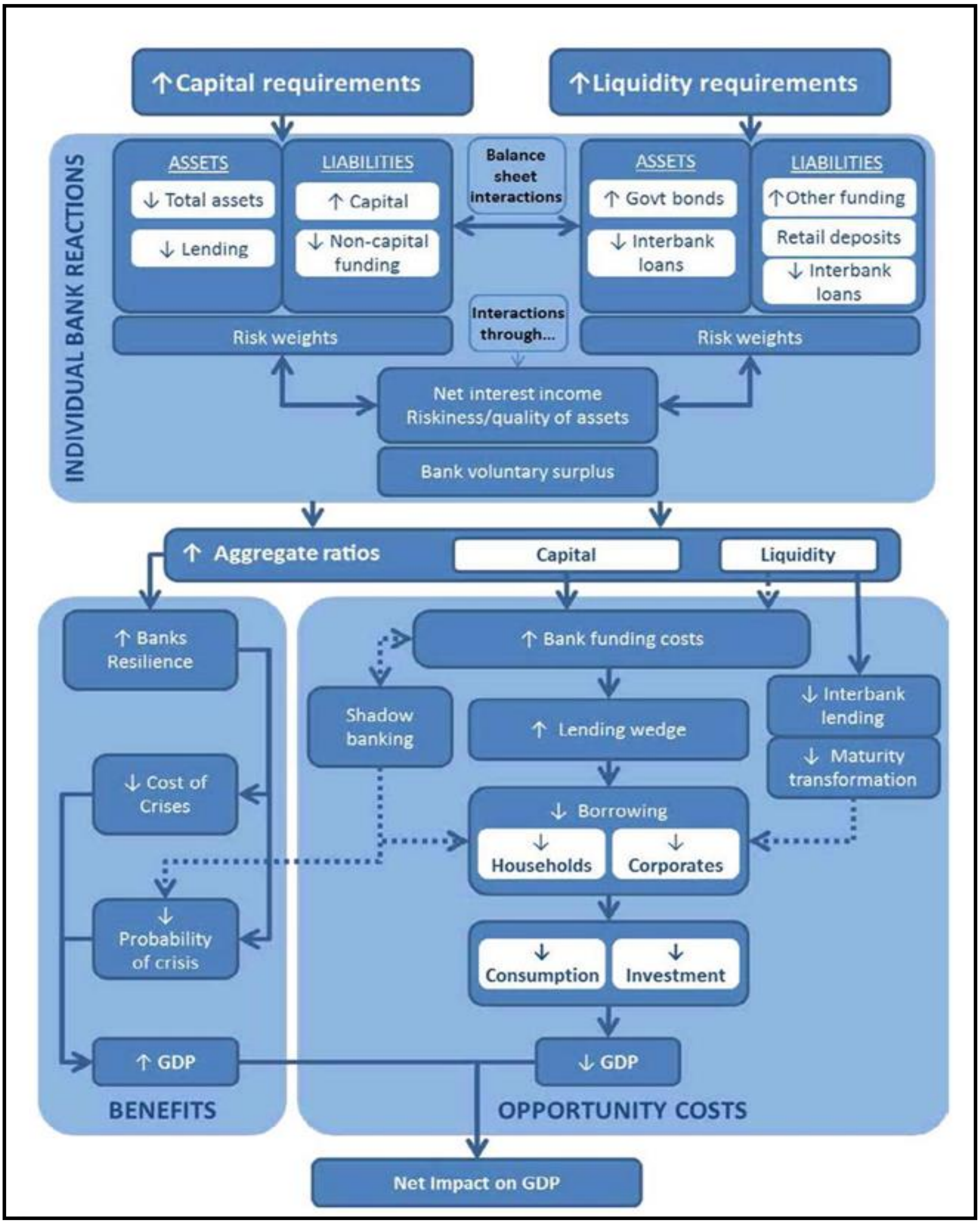
Figure 3.1: Effects of Basel III Requirements on Economic Growth



Source: Based on Martynova (2015) and various literatures

Similarly, a literature review carried out by BCBS (2016) also shows how the regulatory requirements of Basel III are transmitted to economic activity. In their literature review, the BCBS (2016) exhibits individual bank reactions along with the overall macroeconomic impacts of higher capital and liquidity requirements. The transmission mechanism is presented in Figure 3.2.

Figure 3.2: Transmission Mechanism of Basel III Requirements to Economic Activity



Source: BCBS (2016)

However, the existing literature seems to rely on the Z-score model to explore how capital requirement increases the resilience of banks. In order to quantify the lending rates due to increased capital requirements, the present literature has utilised the loan-pricing model and some authors have employed the panel regression models to investigate the impact of loan price on GDP (cost of Basel III). Finally, the existing empirical studies have applied the quantitative impact assessment methodology, as suggested by the BCBS, to assess the benefits of Basel III. In the current literature, however, the following shortcomings are identified:

- The application of all the Basel III norms in a single study is missing;
- In order to calculate the *Z-score*, previous studies use capital to asset ratio *(CAR)* which is neither a regulatory ratio nor risk-based. Hence, studies incorporating the *Z-scores* by considering risk-based ratio such as the capital adequacy ratio *(CAR)* (i.e. regulatory ratio of Basel III) have yet to be done;
- Inclusion of the liquidity ratios (e.g., *NSFR*, *LCR*) in modelling the lending rates is still a new avenue for research;
- In estimating the costs of Basel III, previous studies have not used a comprehensive model of loan price incorporating the cost of fund, administrative costs, the cost of capital, the return on equity *(ROE)*, *Tier 1* capital ratio *(TRA)*, and *NSFR* in the same model;
- Studies on the BRICS economies, so far, in this context are also missing.

Chapter 4

Data and Research Methodology

This chapter has been organised into several parts. Section 4.1 gives an overview of the methodology employed. Section 4.2 provides the data sources and the definition of the variables used in the thesis. The sampling technique and sampling period are described in Section 4.3 and 4.4, respectively whereas the data analysis techniques are portrayed in Section 4.5. The econometric models employed to test the hypotheses are outlined in Section 4.6. Finally, the concluding remarks are provided in Section 4.7.

4.1 An Overview of the Estimation

The objectives of this thesis are to assess the impact of Basel III on the solvency of banks and to measure the macroeconomic costs and benefits in terms of GDP. In order to achieve this goal, first, a *Z-score* model is employed to test the resilience of banks due to an increase in capital requirements using a panel regression model. Next, the impact of higher capital and liquidity requirements on the lending rate of banks is assessed. Previous literature suggests lending rate increases due to additional capital requirements and the resulting effects are a lower credit flow in the economy, which penalises the output (GDP) by contracting economic activity. These effects are examined by applying a panel regression model where the dependent variable is the GDP and the independent variables are the loan price of banks and the real interest rate in the economy. The benefits of higher capital are assessed by following the models of BCBS (2010a) where the reduction of probability of a crisis is multiplied by the savings in GDP. Finally, the net benefits have been calculated by subtracting the costs from the benefits.

In order to estimate the panel regression models, bank-level variables such as capital adequacy ratio *(CAR)*, *Tier 1* capital ratio (*TRA*), leverage ratio (*LEV*), loan-deposit ratio (*LDR*), the cost of fund (*COF*), the cost of operation (*COO*), liquidity coverage ratio (*LCR*), net stable funding ratio *(NSFR)* and loan price (*LP*) have been used.

In addition, with the purpose of assessing the effects of regulatory reforms on the systematic soundness of banks in an economy, a set of country characteristics such as GDP, real interest rate, exchange rate, inflation, real house price growth, the ratio of current account balance to nominal GDP is included in the panel regression model. This is due to the fact that regulators are not only concerned about the risks of individual banks but they are also concerned about the overall systematic risk to the economy (Abdel-Baki, 2012). In fact, many central banks use exchange rate or interest rate as a policy instrument to regulate banks, which affects the banks' resilience and the overall macroeconomic situations of a country.

4.2. Data Sources

The thesis considers secondary sources of information in order to analyse the impact of Basel III on the BRICS economies. In this respect, annual reports of banks, websites, and research articles were utilised for preparing the report. More specifically, bank-level data have been collected from the annual reports of banks whereas the macroeconomic data have been extracted from the *Datastream* – a commercial source of macroeconomic data.

4.2.1 Variable Definition

The variables used in this thesis are described in the following sections. The details of the measurements (variables) used in the existing literature are depicted in Appendix 4.1.

4.2.1.1 Z-Score

Previous literature have employed the *Z-score* differently, for example, Laeven and Levine (2008) and Chalermchatvichien et al. (2014) have used a *Z-score* to measure the solvency of banks where the studies have defined the *Z-score* as a return on assets *(ROA)* plus capital to asset ratio *(TCA)* divided by the standard deviation of return on assets. On the other hand, Abdel-Baki (2012) has described the *Z-score* as the average credit growth/GDP plus recapitalization plus liquidity enhancement/GDP divided by the standard deviation of credit growth/GDP growth. However, in this thesis, the *Z-score* has been defined as the capital adequacy ratio *(CAR)* as defined in

Basel III plus return on assets *(ROA)* divided by the standard deviation of return on assets *[σ(ROA)]*. That is,

$$\frac{CAR + ROA}{\sigma(ROA)} \quad (4.1)$$

The standard deviation of *ROA* is calculated over the sample period of this thesis. Finally, as the *Z-score* series is highly skewed, the natural logarithm of the *Z-score* is taken and for brevity, the level "*Z-score"* is used throughout the thesis in order to measure and indicate the solvency of banks.

4.2.1.2 Capital Adequacy Ratio (*CAR*)

According to the Basel III regulation, capital adequacy ratio *(CAR)* is defined as the regulatory capital (*Tier 1* plus *Tier 2*) divided by the total risk-weighted asset. Using the same definition, banks report those figures in their annual reports. Hence, the data of *CAR* have been extracted from the annual reports of banks.

4.2.1.3 Tier 1 Capital to Risk-Weighted Assets

The *Tier 1* capital comprises tangible common equity *(CET)* plus additional *Tier 1 (AT1)* capital. The ratio is derived by dividing the *Tier 1* capital by the total risk-weighted assets. In Basel III, the minimum requirement of *Tier 1* capital is set at 6%, which was 4% in the previous regulation (i.e. in Basel II). The BCBS believes an increase in the *Tier 1* capital would increase the solvency of banks. This will also cause to increase the costs of capital of banks, as owners of the additional shareholders should be rewarded by giving additional returns. Thus, apart from the *CAR,* this thesis also considers the *Tier 1* capital in order to assess the impact of additional capital requirements on the solvency as well as on the loan pricing of banks.

4.2.1.4 Total Capital to Asset Ratio (TCA)

This ratio considers leverage factors of banks. It is assumed the deleveraging would bring down the probability of crises. Hence, in line with the BCBS (2010a), this ratio is used to measure the probability of a crisis.

4.2.1.5 Leverage Ratio

The leverage ratio is defined as total equity divided by total assets (BCBS, 2011). Previous literature has suggested global banks are exposed to the risk of insolvency and become highly vulnerable because of raising excessive leverage on their balance sheet (Vazquez and Federico, 2015). The BCBS (2011) has proposed to deleverage banks by offering a minimum leverage ratio of 3%. Therefore, banks would be more capitalised and the risk of insolvency would decline.

4.2.1.6 Liquidity Coverage Ratio (*LCR*)

The *LCR* is a new requirement for banks as proposed by the BCBS (2011). Liquidity coverage ratio is defined as the stock of high-quality liquid assets (*HQLA*) divided by the net cash outflow over the next 30 calendar days. However, due to unavailability of required information, year-end values of financial statements are used to measure this ratio. Consequently, this thesis places less emphasis on the *LCR*. In effect, in a monthly horizon, the impact of *LCR* on the solvency of banks might not be visible (Chalermchatvichien et al., 2014).

4.2.1.7 Net Stable Funding Ratio (*NSFR*)

NSFR is the ratio of available funding to required amount of funding and is calculated in a one-year horizon. It is a long-term liquidity requirement for banks. The aim of *NSFR* is to limit reliance on short-term funding sources. In order to calculate the *NSFR*, this thesis relies on the annual reports of banks. Hence, in some cases, the required granular data is missing, so the *NSFR* might differ from the actual ratio as calculated by a bank. However, the difference should be marginal (Gobat et al., 2014). Empirical evidence shows the *NSFR* significantly increases the solvency of banks (Chalermchatvichien et al., 2014; Vazquez and Federico, 2015). Furthermore, the BCBS (2010a) has suggested higher liquidity would likely increase the funding costs of banks. Therefore, in order to assess the impact of liquidity on the solvency and on the loan pricing of the BRICS banks, this thesis relies primarily on the *NSFR*, as defined in Basel III, as a measure of liquidity. The detailed calculation procedures are explained in Appendix 4.2

4.2.1.8 Total Asset

Total assets represent the health of a bank. Hence, it is used as a proxy for the banks' size (Cleary and Hebb, 2016). Since the series is relatively skewed, the natural logarithms of the total assets are taken in this thesis to make the series normally distributed. It is assumed the larger banks are well capitalised, which reduces the risk of insolvency. Moreover, when assets are substantial, banks can diversify the assets in order to minimize risk exposure (Büyüksalvarcı and Abdioğlu, 2011).

4.2.1.9 Loan-Deposit Ratio *(LDR)*

The loan-deposit ratio is the ratio of total loans to deposits. This ratio indicates liquidity of banks. A low ratio implies investable funds on hand whereas a high ratio signifies excessive investments, and hence, are more prone to risks (Brown and Serder, 2011; Almanidis and Sickles, 2012). This measure is expected to exert a negative relationship with the overall financial health of banks (Cleary and Hebb, 2016). However, this ratio also implies the quality of assets of banks (Abdel-Baki, 2012). If banks intend to maintain a higher quality of loans, they would disburse selective loans resulting in a lower loan-deposit ratio making a bank more stable.

4.2.1.10 Loan Price

This is the major earning source for banks. Banks usually load the cost of fund, the cost of operation, and the cost of capital into the lending rate. In line with the works of Elliott (2009), the BCBS (2010a), the MAG (2010a), and Slovik and Cournède (2011), loan price in this thesis, represents the average lending rate of various loans of banks.

4.2.1.11 Cost of Fund

The cost of the fund represents the cost of deposit and borrowing of banks (Elliot, 2009). If the cost of fund increases, banks increase the lending rate in order to recover the extra costs. Hence, there would be a positive association between the cost of fund and the lending rate of banks. This thesis considers the average cost of fund of various deposits and borrowings.

4.2.1.12 Cost of Operation

The cost of operation is the administrative costs of banks (Elliott, 2009). Like the cost of fund, banks increase the lending rate when the cost of operations increases (BCBS, 2010a; Santos and Elliott, 2012). The share of operating cost to total loans and advances has been used in this thesis to represent the cost of operation. It is expected the cost of operation would be positively correlated with the lending rate of banks.

4.2.1.13 Return on Equity

Return on equity is a proxy for the profitability of banks. The return on equity is derived by dividing the net profits by shareholders' equity. If banks earn a higher profit, return on equity would be higher and shareholders would expect a higher return on their capital. Thus, it represents the cost of capital from the bank's point of view. However, if banks' returns decline, they may cut dividend payments resulting in a lower return on capital of shareholders. Hence, the return on equity and the lending rate are expected to have a positive relationship.

4.2.1.14 Real Exchange Rate

Exchange rates, in many economies, are used as excessive regulatory controls (Abdel-Baki, 2012). Hence, exchange rates are used as an explanatory variable to understand their impact on the solvency of banks. Real exchange rate, in this thesis, represents the nominal rate adjusted for inflation. Like in Abdel-Baki (2012), the real exchange rate is taken against the USD and the direct quotation is used to express the BRICS banks' asset and liabilities in terms of US dollars. If domestic currency depreciates, the value of assets and liabilities would fall when expressed in US dollars. Hence, the exchange rate would exert a negative association with the solvency of banks.

4.2.1.15 Inflation

Inflation indicates the average price level of an economy (Abdel-Baki, 2012; Hermes and Meesters, 2015). It affects the economic value of resources (i.e. costs and revenues). A higher inflation confers that an economy is operating above its potential growth level and it is easier for firms to reset higher prices in order to earn additional profits. Consequently, a higher level of inflationary spiral helps the borrowing firms to repay their debts with the additional income. Thus, inflation is expected to have a positive association with the solvency of banks. A number of studies, such as, Shu (2002), Boss (2002), Hoggarth et al. (2005), Baboucek and Jancar (2005), Athanasoglou et al. (2006), Tracey (2007), Akhter and Daly (2009), Roy and Bhattacharya (2011) and Abdel-Baki (2012) have found a strong positive impact of inflation on banks' soundness.

4.2.1.16 Real GDP

In order to assess the costs and benefits of Basel III, the real GDP is considered (BCBS, 2010a; King, 2010; Leaven and Valencia, 2008; 2010; MAG, 2010a; 2010b; Yan et al., 2012). The data on GDP are taken from the *Datastream* - a commercial source for country level data. The natural logarithm of the GDP series is used in order to measure the impact of the lending rate due to the increased capital requirements on GDP.

4.2.1.17 Real Interest Rate

Like the exchange rate, the interest rate is also a policy instrument in many countries (Abdel-Baki, 2012). There is a positive association between the real interest rate and the probability of a banking crisis (Chalermchatvichien et al., 2014). GDP is penalised with an increase in the real interest rate because of increasing the likelihood of crises. Hence, the real interest rate is entered in the cost assessment regression model. However, the real interest rate is proxied by the overall lending rate in economy (Reserve Bank of Australia, 1997) and the rate is obtained after adjustment for inflation *(CPI)*. The data on the real interest rate are also extracted from the *Datastream*.

4.2.1.18 Real House Price Growth

The BCBS (2010a) has suggested the real house price growth is a critical determinant of a crisis. The likelihood of a crisis increases with the increase in the real house price growth (BCBS, 2010a; MAG, 2010a; 2010b). Hence, in order to measure the probability of a crisis, the data on the real house price growth are collected from the *Datastream*.

4.2.1.19 Current Account Balance to GDP

Like in BCBS (2010a), the ratio of current account balance to GDP has been used to determine the probability of a crisis, whose data are also taken from the *Datastream*. It is expected a higher current account balance would reduce the likelihood of a crisis.

4.2.1.20 Liquid Asset Ratio *(LAR)*

Liquid asset ratio is the ratio of the cash and balances with the central bank plus securities over total assets. When liquid assets increase, banks become more solvent. Hence, banking panics declines resulting in lower chances of a crisis in the economy (BCBS, 2010a).

4.3 Sampling Technique

This thesis uses purposive sampling in order to ensure the availability and quality of the data. For this purpose, 50 locally incorporated commercial banks were selected from the BRICS based on the health of the balance sheet (assets size) because not all the banks have an extensive range of activities/operations. Due to the lack of required data such as regulatory ratios and other balance sheet information, at least 6 banks from each country were included in the sample (the sampling distribution of the study by Vallascas and Keasey, (2012) comprises 153 banks where they have considered only 1 bank from Luxembourg, 2 banks from Austria, 3 banks from the Netherlands and so on and Abdel-Baki, (2012) have considered a minimum of 5 banks from a country in the sample of his study). To this end, in order to make the panel balanced, the banks with inconsistent and missing data were removed from the sample, and finally, 43 banks (at least 6 banks from each country) were selected as the sample size of the thesis.

4.4 Sampling Period

In order to measure the impact of Basel III on the BRICS economies, secondary data have been used from 2007 to 2014. The motivation for choosing this time-span is all of the countries in the BRICS except Russia, have implemented Basel II from 2007 (Kruger, 2004; Leeladhar, 2006; BCBS, 2013b). Like in King (2010), Gambacorta (2011), Yan et al. (2012) and Chalermchatvichien et al. (2014), this thesis uses the capital adequacy ratio (*CAR*) and *Tier 1* capital to risk weighted asset ratio, based on the definitions under Basel II as a proxy for the Basel III regulatory ratio. In fact, the principles of Basel III are based on the Basel II regulation (BCBS, 2011).

4.5 Data Analysis Technique

In order to analyse the data, a panel regression model has been employed[23] (see Büyüksalvarcı and Abdioğlu, 2011; Chou and Lin, 2011; Chalermchatvichien et al., 2014). In effect, the empirical testing of this thesis starts with estimating a pooled regression. After that, the random effect model is estimated to check whether the cross-section exerts a common intercept or not. For this purpose, Breusch-Pagan Langrange multiplier test has been applied to compare the suitability of the two models between pooled OLS and random effect model. In effect, if the p-value of the Breusch-Pagan Langrange multiplier test becomes significant, random effect model would be considered appropriate. Finally, this thesis estimates the fixed effect model, which is compared with the random effect model. Because, in a panel study, it is assumed fixed effects model can better handle the time-invariant factors, which is captured in the common intercept term in a panel estimate. Thus, a Hausman test has been applied to determine the better model between the random effects and fixed effects models. Apart from this, different statistical and econometric techniques have also been used to interpret the data.

The implementation process of Basel III has been started from 2013, and accordingly, banks are expected to fully implement all the norms of Basel III after 2018. Hence, this study is intended to explore the probable impacts of the new regulations on the BRICS economies by augmenting the existing requirements of Basel II with the new rules of Basel III. A similar methodology has been employed by the BCBS (2010c) in the quantitative impact assessment and by Sy (2011) to explore the macroeconomic impact of Basel III, where the Basel III capital ratio has been estimated by applying the new proposals to the present capital ratio under the current regulatory framework.

[23] With a sample size of 37 banks and covering the period from 2001- 2006, Chou and Lin (2011) have estimated a panel regression model with random effects. Chalermchatvichien et al. (2014) also has used a static panel regression model on the data of 68 banks covering the period 2005 – 2009. Following the studies by Chou and Lin (2011) and Chalermchatvichien et al. (2014), this thesis also employs a static panel regression model and in order to decide between fixed effects and random effects models, a Hausman test is undertaken.

4.6 Econometric Models and Hypotheses Development

In this section, according to the research questions, hypotheses have been developed. After which, the econometric models employed are described in order to test the hypotheses.

4.6.1 Relevance of Basel III to Increase the Solvency of Banks

The Basel III claims the implementation of the new standards will increase banks solvency. This suggests a similar observation of increased solvency would be witnessed if the standards were implemented regardless of the characteristics of the country. Therefore, the following hypothesis can be formulated:

H_0: Basel III will not ensure the resilience (solvency) of banks in the BRICS economies

In line with the works of Laeven and Levine (2008), Abdel-Baki (2012), and Chalermchatvichien et al. (2014), where the *Z-score* was built to test the resilience (solvency) of banks due to increased capital and liquidity requirements, equation (4.2) is estimated to examine the resilience of banks.

$$Z_{it} = \alpha_i + \beta_1 BAS_{it} + \beta_2 BNK_{it} + \beta_3 CNT_{it} + \varepsilon_{it} \qquad (4.2)$$

where,

Z (Z-score) = return on assets *(ROA)* plus capital adequacy ratio *(CAR)* divided by the standard deviation of the return on assets, *σ(ROA)* (Laeven and Levine, 2008; Chalermchatvichien et al., 2014; Lou et al., 2016).

BAS = Basel III requirements (capital adequacy ratio (*CAR*), *Tier 1* capital ratio (*TRA*), leverage ratio (*LEV*), liquidity coverage ratio (*LCR*), and net stable funding ratio (*NSFR*));

BNK = bank characteristics (bank size proxied by the logarithm of total assets, and loan-deposit ratio); and

CNT = country characteristics (logarithm of real exchange rate and inflation).

The *Z-score* implies the distance from insolvency (Laeven and Levine, 2008); the higher the calculated *Z-score*, the more stable (solvent) is a bank (Roy, 1952; Laeven and Levine, 2008; Abdel-Baki, 2012; Chalermchatvichien et al., 2014).

4.6.2 Impact of Basel III Compliance on Loan Pricing of BRICS Banks

The Basel III compliant banks are required to keep a higher amount of capital and hold an increased amount of liquidity, which increases the opportunity cost of investable funds of banks (Osborne et al., 2010; Gambacorta and Marques-Ibanez, 2011). This extra cost is likely to pass on to borrowers in the form of increased loan prices (BCBS, 2012). So, the hypothesis is stated as:

H_0: Lending rate will not be increased due to the Basel III compliance by the banks in the BRICS economies

To measure the impact of Basel III on the lending rate based on models provided by Caggiano and Calice (2011) and Santos and Elliott (2012), the following panel regression model (4.3) is estimated.

$$LP_{it} = \alpha_i + \beta_1 TRA_{it} + \beta_2 NSFR_{it} + \beta_3 COF_{it} + \beta_4 COO_{it} + \beta_5 ROE_{it} + \varepsilon_{it} \quad (4.3)$$

where,

LP = loan price (lending rate);

TRA = *Tier 1* capital to risk weighted asset ratio;

NSFR = net stable funding ratio;

COF = cost of fund;

COO = cost of operation; and

ROE = return on equity.

4.6.3 Macroeconomic Costs of Tighter Capital Regulation

Additional capital requirements increase the interest rate on loans. The resultant effect of a higher interest rate is reduced borrowing, and lower consumption and investment activity in the economy (Caggiano and Calice, 2011), which in turn affects output (GDP) (BCBS, 2012). Hence, the hypothesis related to macroeconomic costs can be formulated as:

H_0: There is no macroeconomic costs associated with adopting Basel III in the BRICS economies

Therefore, the costs of Basel III regulation is measured by estimating the impact on GDP (Caggiano and Calice, 2011), using equation (4.4).

$$Y_{it} = \alpha_i + \beta_1 LP_{it} + \beta_2 RIR_{it} + \varepsilon_{it} \qquad (4.4)$$

where,
Y = Logarithm of *GDP*;
LP = loan price (lending rate); and
RIR = real interest rate.
It is expected that the lending rate will have a negative sign.

4.6.4 Macroeconomic Benefits of Tighter Capital Regulation

Increased capital requirements make banks more solvent. Thus, stronger capital base reduces the probability of a banking crisis (Barrell et al., 2009; Kato et al., 2010; MAG, 2010a) and protects loss of GDP. Hence, the hypothesis is presented as follows:

H_0: There are no economic benefits associated with adopting Basel III in the BRICS economies

Empirical studies have postulated the impact assessment of a financial crisis is approximated by calculating the cumulative output (GDP) loss subsequent to a crisis (Laeven and Valencia, 2008; 2010; Cecchetti et al., 2009; Caggiano and Calice, 2011). Hence, the macroeconomic benefits connected with varying levels of capital may be achieved by multiplying "reduction in the probability of crisis" and "crisis output loss" (Caggiano and Calice, 2011; Yan et al., 2012). In other words, the reduction of the probability of a crisis would save *GDP* loss. Thus, the benefits would be measured following the models of Laeven and Valencia (2008; 2010), Caggiano and Calice (2011), and Yan et al. (2012) using equation (4.5).

$$Benefit = \Delta prob\ (crises) \times \Delta GDP \qquad (4.5)$$

It is assumed a crisis lasts for 5 years (Laeven and Valencia 2008; 2010; Caggiano and Calice, 2011). Thus, output losses (expected loss from a financial crisis) are measured as the cumulative gap between the real and trend real GDP. Trend real GDP is measured using the Hodrick–Prescott *(HP)* filter to the GDP series over a 20 years period (Caggiano and Calice, 2011; Yan et al., 2012).

Next, the probability of a crisis reduction is estimated by using equation (4.6) following the model of the BCBS (2010a).

$$P = f(-0.34TCA_{-1} - 0.11LAR_{-1} + 0.08RHPG_{-3} - 0.24CGR_{-2}) \quad (4.6)$$

where,

TCA = ratio of total capital to total assets;

LAR = ratio of cash and balances with the central bank plus securities over total assets;

RHPG = real house price growth; and

CGR = ratio of the current account balance over nominal GDP.

4.6.4.1 Translating Capital to Asset Ratio into Regulatory Ratio

The probability of crisis equation contains a capital to assets ratio (*TCA)* which is not a regulatory ratio; hence, it is to be translated into a regulatory ratio of *Tier 1* capital ratio. Thus, the capital to assets ratio (*TCA)* is estimated for the additional *Tier 1* capital to risk-weighted asset ratio *(TRA)* requirement as prescribed in Basel III. In this way, *TRA* is to be mapped with the probability of a crisis to understand the relationship between *TRA* and the probability of a crisis, and thus any benefits associated with it. Therefore, the mapping is based on a simple pooled *OLS* regression (BCBS, 2010a; Caggiano and Calice, 2011) and is estimated without an intercept[24] using equation (4.7).

$$TCA_i = \beta_1 TRA_i + \varepsilon_i \quad (4.7)$$

where,

TCA = ratio of total capital to total asset ratio; and

TRA = *Tier 1* capital to risk -weighted asset ratio.

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[24] The pooled *OLS* is run without intercept because conceptually if *Tier 1* capital is zero, total capital to asset ratio would also be zero. 'β' represents the estimated proportion between *Tier 1* capital ratio and total capital to total asset ratio.

4.6.4.2 Translating Bank Ratio of Cash Balance over Total Assets into *NSFR*

Similarly, the ratio of cash balance over total assets (*LAR)* in equation (4.6) has been approximated for the additional requirements of *NSFR* as suggested in Basel III. Akin to capital ratio, the *NSFR* is to be mapped with the probability of crises, to understand the relationship between *NSFR* and the probability of a crisis, thus any benefits associated with it. The pooled *OLS* is estimated using the following equation (4.8), which again has no intercept.

$$LAR_i = \beta_1 NSFR_i + \varepsilon_i \qquad (4.8)$$

where,

LAR = ratio of liquid asset to total asset; and

NSFR = net stable funding ratio.

4.7 Conclusion

Several models have been employed to achieve the objectives of this thesis. In order to attain the first objective (i.e. to examine whether the resilience of the BRICS banks would increase or not due to the Basel III regulation), like in Laeven and Levine (2008), Abdel-Baki (2012) and Chalermchatvichien et al. (2014), a *Z-score* model is used. It is expected the *Z-score* model would explore the association between the Basel III regulation and the resilience of banks. Secondly, the loan pricing model would be utilized to explore how the Basel III standards, i.e. capital and liquidity affects the lending rate of banks, where loan pricing is used as the dependent variable whilst the cost of fund, operating cost, the cost of capital, capital adequacy ratio and liquidity ratio are used as the independent variables. With respect to previous studies, the model is unique in the sense that this thesis incorporates the Basel III norms (i.e. *CAR* and *NSFR*) into the same model to prove the Basel Committee's assumption. Finally, employing the BCBS models, this thesis assesses the costs and benefits of Basel III in the BRICS economies, which is of paramount importance for regulators of those economies to formulate common policies for all the economies in the BRICS. It is believed the methodology described in this chapter is sufficient to test the hypotheses, and eventually, to achieve the objectives of the thesis.

Chapter 5

Analysis and Findings

This section of the thesis presents the analysis and findings of the outputs of the models employed. Section 5.1 depicts an introduction of the chapter while Section 5.2 delineates the findings of the measurements of the resilience of banks. The outcome of the estimation of the impacts of capital and liquidity requirements on the loan pricing of banks is described in Section 5.3, and the assessment of costs and benefits of Basel III is provided in Section 5.4. Finally, Section 5.4 contains the conclusion of the chapter.

5.1 Introduction

In an effort to improve the international financial stability, the BCBS provides regulatory guidelines (Basel framework) to control risks, which banks take beyond their risk-taking capacity. The fundamental essence of Basel III is banks must maintain a greater amount of capital and liquidity to absorb any potential losses. If banks hold adequate capital and liquidity, they would be more resilient in a crisis period and are thus better positioned to face extended shocks.

The debate is maintaining a higher amount of capital and liquidity generates macroeconomic costs by impacting the price and availability of credit, and thereby altering the level of investment and output in the economy (BCBS, 2012). In effect, the additional costs of higher capital and liquidity requirements are passed on to borrowers in terms of higher interest rate on loans. Consequently, the demand of credit reduces resulting in a contraction in economic activity, which, in turn, slowdowns GDP growth or, even worse, deepens an economic recession (BCBS, 2016).

In addition, regulators argue an adequate amount of capital would make the financial system more stable and it would reduce the frequency and severity of future banking crises and the accompanying loss of GDP. Hence, higher capital and liquidity requirements could generate social benefits by increasing GDP in the long run. With this background, the hypotheses as stated in Chapter 4 are tested in the following sections to achieve the objectives of this thesis.

5.2 Measuring the Resilience of Banks

In response to the global financial crisis of 2007 – 2008, the innovative approach of the BCBS has been to introduce new capital stability rules aimed at preventing any financial crises in the future. In fact, the increased levels of capital and liquidity requirements are at the heart of Basel III reforms. Specifically, the reforms would help banks raise their resilience in periods of stress by absorbing greater losses (BCBS, 2011). In effect, capital requirements enhance financial stability by reducing banks' incentives to take on excessive risks ex ante, and by making banks more able to absorb losses ex post. This section examines the impacts of the new rules of Basel III on the resilience (solvency) of the BRICS banks by estimating a Z-score model (Hypothesis 1).

It is important to test for multicollinearity before a model is estimated (see descriptive statistics and unit root test results in Appendix 5.1 and Appendix 5.2, respectively). If the independent variables exhibit high collinearity among themselves, the regression results would be biased. Hence, in order to test for multicollinearity, a simple correlation matrix is constructed with the variables of the *Z-score* model. As depicted in Table 5.1, none of the variables has any multicollinearity problem except for the capital adequacy ratio *(CAR), Tier 1* capital to risk-weighted asset ratio *(TRA)* and the leverage ratio *(LEV)*. Therefore, three *Z-score* models have been estimated by accounting for the multicollinearity problem. The first model includes the *CAR*, the second one includes the *TRA*, and the third model considers the *LEV* as the independent variable. Apart from the econometric issue, this kind of modelling helps to distinguish the impact of different Basel III capital norms.

Table 5.1: Correlation Matrix

Variables	Ln(Z)	CAR	TRA	LEV	LCR	NSFR	LDR	LTA	LRE	INF
Ln(Z)	1									
CAR	0.255	1								
TRA	0.187	**0.628**	1							
LEV	0.392	**0.686**	**0.772**	1						
LCR	0.194	0.002	0.050	-0.027	1					
NSFR	0.107	0.062	0.010	0.057	0.316	1				
LDR	0.372	0.264	0.043	0.227	-0.382	-0.461	1			
LTA	0.454	-0.501	-0.448	0.581	-0.286	-0.151	-0.109	1		
LRE	-0.117	0.004	-0.070	0.081	0.273	0.161	0.022	-0.326	1	
INF	-0.243	0.241	0.093	0.189	0.187	0.011	0.197	-0.421	0.620	1

Note:

Ln (Z) = Logarithm of Z-Score, CAR = Capital Adequacy Ratio, TRA=Tier 1 Capital to Risk Weighted Asset Ratio, LEV=Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LDR= Loan Deposit Ratio, LTA=Logarithm of Total Asset, LRE=Logarithm of Real Exchange Rate and INF= Inflation (CPI).

As mentioned earlier, in order to test the first hypothesis of how Basel III increases the resilience of banks, a *Z-score* model is employed. The estimated results of the *Z-score* models (i.e. resiliency test) are exhibited in Table 5.2, where the *Z-score* is the dependent variable whilst the capital adequacy ratio (*CAR*), *Tier 1* capital to risk-weighted asset ratio (*TRA*), leverage ratio *(LEV),* liquidity coverage ratio *(LCR),* net stable funding ratio *(NSFR),* bank attributes and country characteristics are the independent variables. However, as mentioned before, considering the multicollinearity problem and in order to distinguish the impact of various capitals as defined in Basel III, three models (Model 1, Model 2, and Model 3) have been estimated, where Model 1 estimates the *Z-score* model using the *CAR*, *LCR* and *NSFR,* whereas in Model 2 instead of *CAR*, *TRA* and in Model 3, *LEV* have been used. The bank level variables and country characteristics are the same in the three models.

Table 5.2: Estimates of the Resilience of Banks

Dependent Variable: ***Ln(Z)***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Model 1	**Model 2**	**Model 3**
	Fixed Effect Model	**Fixed Effect Model**	**Fixed Effect Model**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
C	2.2783*** (0.0000)	2.9804*** (0.0000)	2.7562*** (0.0000)
CAR	6.2380*** (0.0000)		
TRA		1.8893*** (0.0000)	
LEV			5.2864*** (0.0000)
LCR	0.0151 (0.2240)	0.0198 (0.4630)	0.0307 (0.1847)
NSFR	0.0363** (0.0471)	0.0297 (0.4503)	0.0580* (0.0892)
LTA	0.0313*** (0.0021)	0.0407* (0.0632)	0.0311* (0.0993)
LDR	0.0058 (0.8000)	0.1436*** (0.0036)	0.1399*** (0.0010)
LRE	-0.0484** (0.0361)	-0.1681*** (0.0007)	-0.1272*** (0.0030)
INF	-0.3250* (0.0918)	0.2460 (0.5517)	0.4350 (0.2232)
Adjusted R^2	0.99	0.97	0.98
F-statistic	1053.38 (0.0000)	221.73 (0.0000)	298.62 (0.0000)

This table reports the results of Z-score model:
Model - 1: $Z_{it} = \alpha_i + \beta_1 CAR_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$
Model - 2: $Z_{it} = \alpha_i + \beta_1 TRA_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$
Model - 3: $Z_{it} = \alpha_i + \beta_1 LEV_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$

where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk Weighted Asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:
1. *Figures in parentheses are p-values*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

In effect, the empirical testing of this thesis starts with estimating the pooled OLS and random effects model (results are reported in Appendix 5.2). The Breusch-Pagan Langrange multiplier test (see Appendix 5.3) suggests random effects models are more appropriate than pooled OLS meaning that there are country specific effects in the data. This suggest estimating fixed effects model because it is possible to vary the country specific effects (intercept values) across the countries. Hence, in order to decide which one is an appropriate model in a panel study setting - fixed effects or random effects model, a Hausman test is performed. The purpose is to determine whether there is a significant correlation between the unobserved individual specific random effects (country specific effects) and the regressors. The result of the Hausman test is presented in Table 5.3, which demonstrates the corresponding effects are statistically significant. Therefore, the null hypothesis is rejected (p-value = 0.0001) and the fixed effect model is preferred.

Table 5.3: Correlated Random Effects - Hausman Test (Chi-Sq. Statistic)

	Model 1			Model 2			Model 3		
Test Summary	**Chi-Sq. Statistic**	**Chi-Sq. d.f.**	**Prob.**	**Chi-Sq. Statistic**	**Chi-Sq. d.f**	**Prob.**	**Chi-Sq. Statistic**	**Chi-Sq. d.f**	**Prob.**
Cross-section random	57.36	7	0.0000	46.76	7	0.0000	64.66	7	0.0000

H_o: Random Effect Model is Appropriate

The estimates of the coefficients[25] as reported in Table 5.2 show all the Basel III parameters, i.e. *CAR, TRA* and *LEV,* are statistically significant at the 1% level in the three models (Models 1, 2, 3) with expected signs. Similarly, the net stable funding ratio *(NSFR)* has got the expected sign in all the models and it is significant at the 5% level in Model 1 and at the 10% level in Model 3 but insignificant in Model 2. The *LCR* has the expected sign albeit it is not statistically significant in all the models. The reason might be this ratio was calculated in one-month horizons under the Basel norms. As the annual reports of banks have been used to calculate the *LCR*, year-end values were obtained, which are not suitable to measure the *LCR*. The inclusion of *LCR* in the model might give a better result if monthly data were used. However, the results indicate that a higher value of capital and liquidity signifies a higher degree of bank solvency. Thus, the Basel III regulation is vital to increase the resilience of the BRICS banks.

[25] The coefficients (slope) of fixed effects regression model do not vary across individuals or overtime which helps macro-prudential policy making to be effective.

The common intercept values of the three models are significant at the 1% level, which requires examining whether the differential intercept of each bank varies or not. The intercept of the fixed effects model in Table 5.2 is assumed to vary across banks and is time invariant. This is because each bank is different such as in terms of risk appetite, state of regulatory compliance, and ownership structure, which may remain unobserved. Hence, the compliance of Basel III regulation will have varying degrees of impact on the resilience due to the unobserved heterogeneity. In order to understand the role of individual banks to promote the resilience, Model 1 (the model with *CAR*) is re-estimated by including cross sections *id* in the model and the results are reported in Appendix 5.3. It is found the differential intercepts of all banks (except one) are statistically significant, meaning perhaps 43 banks are heterogeneous, and therefore, they might have divergent impacts on the resilience due to unobservables. Hence, the estimated parameters in Model 1, Model 2, and Model 3 may be suspected, which calls for performing diagnostic tests.

5.2.1 Endogeneity Diagnostic Test

It is indispensable to test the endogeneity problem in the estimated regression models. When the estimates are obtained with an endogeneity problem, the regression results would be biased. It is possible to have two types of endogeneity problem. First, the association between resilience and capital may be affected by a third unobservable bank characteristic. Second, results might be obtained due to the reverse causality. Apart from this, the results might be biased due to the possibility of omitted variables. Hence, three tests (i.e. the test of unobservables, the reverse causality test, and the omitted variable test) have been undertaken to check whether there is any bias in the estimated regression models. The details of these tests are described in the following sections.

5.2.1.1 Test of Unobservables (Control Regression)

It is possible the relationship between the resilience of banks *(Z-score)* and capital requirement is endogenously attained. That is, the resilience may be affected by a third unobservable bank characteristic. For example, the solvency of banks also depends on the banks’ attitude toward risk or the risk profile of banks. Hence, if this were the case, the measurement of the relationship between the banks' resilience and capital requirement would be biased. Thus, the possibility of biasedness would be addressed by following the methodology of Altonji et al. (2005), which also used by Chalermchatvichien et al. (2014). Both studies have recommended using the observed parameters to estimate bias produced by the unobservable in order to judge the strength of unobservables compared to the observables.

The calculation methodology of testing this kind of problem starts with the assumption of two regressions; one is with a full set of variables and the other regression is with a restricted set of variables (restricted regression). The estimated coefficient for the full set of variables is referred as C_F (where *'F'* denotes full), whereas the coefficient with the restricted regression is conferred as C_R (where '*R'* denotes restricted). A ratio would then be computed using the coefficients of the restricted and unrestricted regressions. More specifically, the formula for calculating this ratio is $C_F/(C_R - C_F)$. When the value of $(C_R - C_F)$ is small, the observables would be much stronger relative to the unobservables and the selection of unobservables is less likely to influence the effect away, and if C_F were larger, the section of observables would be stronger compared to unobservables to take the effect away. Hence, the higher the ratio[26], the less likely the model would be explained by unobservables.

Applying this notion, the estimated parameters of control regression are reported in Table 5.4. The regressions have been estimated considering the three different definitions of capitals (*CAR, TRA,* and *LEV)* as the independent variables in the three models whereas the *Z-score* is the dependent variable. The ratio is calculated by taking the coefficients in Table 5.2 and Table 5.4. For example, the coefficient of *CAR* of Model 1 in Table 5.2 is 6.2380 and the same coefficient of the control regression in Table 5.4 is 6.3853. Hence, the ratio turns out to be 43.35 [6.2380/(6.3853-6.2380)]. Likewise, the ratios of Model 2 and Model 3 are 17.82 and 27.96, respectively, which are much higher than the benchmark ratio of 2. Thus, the unobservables in Model 1, Model 2 and Model 3 have to be 43.35 times, 17.82 times and 27.96 times stronger, respectively than the observables to explain the effect away, which is unlikely. Therefore, it seems very implausible the estimated

[26] The benchmark ratio in order to compare as suggested by Altonji et al. (2005) is at least 2.

association between the resilience and capital adequacy is affected by the unobservable variables.

Table 5.4: Control Regression Results

Dependent Variable: Ln(Z)
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Model 1	**Model 2**	**Model 3**
	Fixed Effect Model	**Fixed Effect Model**	**Fixed Effect Model**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
C	2.7061*** (0.0000)	3.4390*** (0.0000)	3.2067*** (0.0000)
CAR	6.3852*** (0.0000)		
TRA		1.9953*** (0.0000)	
LEV			5.4755*** (0.0000)
Ratio of Unbiasedness	**43.35**	**17.82**	**27.96**

This table reports the results of Z-score model with control variables

Model -1: $Z_{it} = \alpha_i + \beta_1 CAR_{it} + \varepsilon_{it}$ *; Model -2:* $Z_{it} = \alpha_i + \beta_1 TRA_{it} + \varepsilon_{it}$ *; Model -3:* $Z_{it} = \alpha_i + \beta_1 LEV_{it} + \varepsilon_{it}$

where

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk Weighted Asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:

1. *Values in parentheses are p-values*
2. **** denotes 1% level of significance.*

5.2.1.2 Reverse Causality Test

The results might be obtained due to reverse causality. For instance, the resilience may lead to capital stability of banks. In this case, the causality would be reversed. In order to address the issue, the *Z-score* is re-assessed by considering the previous year's capital adequacy ratio. If the association is found significant, the direction of causality is running from the capital stability to resiliency, not vice versa (Chalermchatvichien et al., 2014). The results of the estimates are shown in Table 5.5. The results of all the models indicate the coefficients of capital stability are significant. Therefore, the results signify the models are not affected by the reverse causality; causality is running from the capital stability to the resilience (solvency) of banks.

Table 5.5: Reverse Causality Test

Dependent Variable: ***Ln(Z)***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Model 1	Model 2	Model 3
	Fixed Effect Model	**Fixed Effect Model**	**Fixed Effect Model**
Variables	**Coefficient**	**Coefficient**	**Coefficient**
C	3.8463*** (0.0000)	3.7082*** (0.0000)	3.8532*** (0.0000)
CAR(-1)	0.9436** (0.0147)		
TRA(-1)		0.8003*** (0.0025)	
LEV(-1)			1.8019*** (0.0006)
LCR	0.0496* (0.0887)	0.0457 (0.1137)	0.0447 (0.1201)
NSFR	0.0023 (0.9587)	-0.0027 (0.9518)	0.0029 (0.9468)
LTA	0.0032 (0.9086)	0.0159 (0.5659)	0.0029 (0.9161)
LDR	0.1206** (0.0263)	0.1071** (0.0486)	0.1148** (0.0323)
LRE	-0.1983*** (0.0005)	-0.2060*** (0.0003)	-0.2052*** (0.0003)
INF	-0.1934 (0.6658)	0.2239 (0.6149)	0.3610 (0.4174)
Adjusted R^2	0.97	0.97	0.97
F-statistic	203.38 (0.0000)	206.10 (0.0000)	208.39 (0.0000)

This table reports the results of Z-score model:

Model -1: $Z_{it} = \alpha_i + \beta_1 CAR(-1)_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$

Model -2: $Z_{it} = \alpha_i + \beta_1 TRA(-1)_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$

Model -3: $Z_{it} = \alpha_i + \beta_1 LEV(-1)_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$

where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk Weighted Asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:

1. *Values in parentheses are p-values*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

5.2.1.3 Testing the Possibility of Omitted Variables

Although the results of the regression models are not influenced by the unobservables (not spurious and no endogeneity problem) yet, a test has also been performed to understand whether the results are biased by any probably omitted variables.

Table 5.6: Analysis of Changes in Liquidity and Capital Stability

	Model 1	**Model 2**	**Model 3**
Dependent Variable	**OLS** **Δ Ln(Z)**	**OLS** **Δ Ln(Z)**	**OLS** **Δ Ln(Z)**
Constant	0.0094 (0.2970)	0.0734*** (0.0002)	0.0129 (0.4296)
ΔCAR	6.2544*** (0.0000)		
ΔTRA		2.0327*** (0.0000)	
ΔLEV			5.7815*** (0.0000)
ΔLCR	0.0133 (0.3278)	0.005186 (0.8463)	0.0232 (0.3360)
ΔNSFR	0.0728*** (0.0003)	0.0715* (0.0725)	0.0691* (0.0538)
ΔLTA	-0.0243 (0.5352)	-0.3957*** (0.0000)	-0.0522 (0.4668)
ΔLDR	-0.0213 (0.4987)	0.1729*** (0.0054)	0.1042* (0.0597)
ΔLRE	-0.0697 (0.2056)	-0.4925*** (0.0000)	-0.1477 (0.1404)
ΔINF	-0.0767 (0.7502)	0.4861 (0.3067)	-0.0011 (0.9980)
Adjusted R^2	0.80	0.16	0.36
F-statistic (P-value)	173.20 (0.0000)	2.19 (0.0000)	25.15 (0.0000)

This table reports the test of omitted variables. The values of this table have been calculated by taking the first difference of the variables as reported in Table-5.2.

Model – 1: $Z_{it} = \alpha_i + \beta_1 \Delta CAR_{it} + \beta_2 \Delta LCR_{it} + \beta_3 \Delta NSFR_{it} + \beta_4 \Delta LTA_{it} + \beta_5 \Delta LDR_{it} + \beta_6 \Delta LER_{it} + \beta_7 \Delta INF_{it} + e_{it}$

Model – 2: $Z_{it} = \alpha_i + \beta_1 \Delta TRA_{it} + \beta_2 \Delta LCR_{it} + \beta_3 \Delta NSFR_{it} + \beta_4 \Delta LTA_{it} + \beta_5 \Delta LDR_{it} + \beta_6 \Delta LER_{it} + \beta_7 \Delta INF_{it} + e_{it}$

Model – 3: $Z_{it} = \alpha_i + \beta_1 \Delta LEV_{it} + \beta_2 \Delta LCR_{it} + \beta_3 \Delta NSFR_{it} + \beta_4 \Delta LTA_{it} + \beta_5 \Delta LDR_{it} + \beta_6 \Delta LER_{it} + \beta_7 \Delta INF_{it} + e_{it}$

where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk weighted Asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:

1. *Δ denotes first difference*
2. *Values in parentheses are p-values*
3. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

Chalermchatvichien et al. (2014) have suggested the problem of omitted variables can be eliminated by examining differences in variables rather than levels, which removes the influence of omitted bank characteristics. The results of the three *Z-score* models of this notion are reported in Table 5.6, where the variables are differences rather than levels. The differences in the *Z-score* and other variables are made from one year to another. The coefficient of differences in the *CAR* and *NSFR* is positive and statistically significant, meaning that, an increase in capital and liquidity reduces the risk of default. In other words, an increase in capital and liquidity increases the solvency of banks. Similar findings have been reported by Chalermchatvichien et al. (2014).

5.2.2 Impact of Basel III Requirements

As the estimated models are robust, the coefficients of the models can now be used to examine the impact of Basel III. The following section describes the impact of higher capital and liquidity requirements on the resilience of banks in the BRICS economies.

5.2.2.1 Impact of Higher Capital (Sensitivity Analysis)

In order to understand to what extent the Basel III regulation, (i.e. *CAR*, *TRA,* and *LEV)* increases the solvency of banks, Table 5.7 is constructed, where the value of the *Z-score* has been calculated on the estimated parameters of the *Z-score* models (Models 1, 2, 3). Like in BCBS (2010a), the impact[27] on the resilience of banks in terms of increasing the *Z-score* is tested by increasing the capital and leverage ratios by 10% and keeping the other parameters constant (see Table 5.7).

[27]BCBS (2010a) has increased the ratio by 6% initially then extend it up to 15%. This thesis increases the requirement by 10%, which is the mid-value of 6% and 15%.

Table 5.7: Impact of Higher Capital Requirements on the Resilience of Banks (Sensitivity Analysis)

	Improvement in Z-score (%) for a 10% increase in ***CAR***	Improvement in Z-score (%) for a 10% increase in ***TRA***	Improvement in Z-score (%) for a 10% increase in ***LEV***
Brazil	2.56	0.56	1.00
China	2.18	0.48	0.91
India	2.56	0.65	1.27
Russia	2.42	0.53	1.24
South Africa	2.87	0.86	1.58
Overall	**2.51**	**0.61**	**1.20**

The values of this table have been calculated using the parameters estimated in equation (4.2) of Chapter 4 as reported in Table 5.2

Z_{it}= 2.2783+6.2380*CAR+0.0151*LCR+0.0363*NSFR+0.0313*TA+0.0058*LD-0.0484*RER-0.3250*INF
Z_{it}= 2.9804+1.8893*TRA+0.0198*LCR+0.0297*NSFR+0.0407*TA+0.1436*LD-0.1681*RER+0.2460*INF
Z_{it} = 2.7563+5.2864*LEV+0.0307*LCR+0.0581*NSFR+0.0311*TA+0.1399*LD-0.1273*RER+0.4351*INF

where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 capital to Risk weighted asset, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

It is found from Table 5.7 a 10% increase in *CAR*, *TRA*, and *LEV* increases the solvency of banks in terms of increasing the *Z-score* by 2.51%, 0.61% and 1.2%, respectively. Hence, the *CAR* is robust to increase the resilience of banks. Therefore, compared to the *TRA* and *LEV*, the *CAR*[28] significantly increases the resilience of banks. This finding is consistent with the findings by Abdel-Baki (2012).

5.2.2.2 Impact of Liquidity Requirements (Sensitivity Analysis)

The impact of holding additional liquidity on the solvency of banks is shown in Table 5.8. For a 10% increase in the *NSFR* in the three models (i.e., *CAR*, *TRA*, and *LEV* models), the *Z-score* of banks (solvency) varies from 0.09% to 0.18%. The impact of increased liquidity in increasing the resilience (solvency) of the BRICS

[28] The capital adequacy ratio (*CAR*) includes both the *Tier 1* and *Tier 2* capitals. *"Tier 1 capital is a going concern capital whereas Tier 2 is expected to bear losses in case of insolvency"* (Abdel-Baki, 2012, p. 5).

banks is better in leverage ratio model *(Model 3).* That means, if the *NSFR* is implemented simultaneously with the *LEV* rather than with *CAR* and *TRA*, the resilience of banks would be expected to be greater. Therefore, the imposition of liquidity and leverage ratios would be an appropriate control in the regulatory regime of Basel III in response to the recent financial crisis.

Table 5.8: Impact of Enhanced Liquidity Requirements on the Resilience of Banks (Sensitivity Analysis)

	Improvement in *Z-score* (%) for a 10% increase in *NSFR* (Model-1: *CAR*)	**Improvement in *Z-score* (%) for a 10% increase in *NSFR* (Model-2: *TRA*)**	**Improvement in *Z-score* (%) for a 10% increase in *NSFR* (Model-3: *LEV*)**
Brazil	0.08	0.06	0.13
China	0.14	0.11	0.22
India	0.13	0.11	0.21
Russia	0.11	0.09	0.17
South Africa	0.11	0.09	0.18
Overall	**0.11**	**0.09**	**0.18**

The values of this table have been calculated using parameters estimated in equation (4.2) of Chapter 4 as reported in Table 5.2

Z_{it}= 2.2783+6.2380*CAR+0.0151*LCR+0.0363*NSFR+0.0313*TA+0.0058*LD-0.0484*RER-0.3250*INF

Z_{it}= 2.9804+1.8893*TRA+0.0198*LCR+0.0297*NSFR+0.0407*TA+0.1436*LD-0.1681*RER+0.2460*INF

Z_{it} = 2.7563+5.2864*LEV+0.0307*LCR+0.0581*NSFR+0.0311*TA+0.1399*LD-0.1273*RER+0.4351*INF

where,
Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk weighted asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

5.3 Measuring the Impact of Capital and Liquidity Requirements on Loan Pricing of Banks

After the global financial crisis, there was a broad consensus amongst the regulators with others on the need to increase the level of capital and liquidity requirements for banks. There is no doubt this would make the banking sector safer by providing a better cushion against severe financial and economic shocks. However, banks might also respond to higher capital and liquidity requirements by increasing the lending rate or reducing credit (Elliott, 2009; BCBS, 2016). The analysis of previous literature suggests banks can opt for a combination of policies to adjust this expected rate of return on loans. In this regard, they can lower the cost of fund or increase efficiency by lowering operating costs or even reducing the return on equity (Elliott, 2009; BCBS, 2010a).

This section attempts to address the second objective of the thesis; to what extent is the loan pricing of banks affected by the additional capital and liquidity requirements imposed by the Basel III (Hypothesis 2). To this end, in assessing the loan price of banks, this thesis employs the Tier 1 capital ratio *(TRA)*, net stable funding ratio *(NSFR)*, the cost of fund *(COF)*, the cost of operation *(COO)* and return on equity *(ROE)* as the independent variables whereas the loan price is the dependent variable.

Table 5.9 depicts how the additional capital and liquidity requirements of Basel III affect the loan pricing of banks. The estimated parameters as reported in Table 5.9 are the results of the cross-section fixed effects[29] panel regression model since the Hausman test results (Table 5.10) reject the random effect model. As the autocorrelation and heteroskedasticity tests results suggest the loan pricing model is biased by the autocorrelation and heteroskedasticity problems (see Table 5.12 and Table 5.13), the parameters of the loan-pricing model are estimated after rectifying the autocorrelation and heteroskedasticity problems (standard errors are adjusted to account for clustering at the bank level) to make it robust.

[29] To start with, this thesis employs a pooled regression model (see appendix 5.5). The F-value of the pooled regression suggests data can be pooled. Next, in order to choose between pooled OLS and random effect model, the Breusch-Pagan Langrange multiplier test is carried out. The p-value of the Breusch-Pagan Langrange multiplier test (reported in appendix 5.6) shows random effect model is better than pooled OLS. However, it is crucial to check whether the intercept value (country specific effect) in a random effect model varies or not. Hence, fixed effect model is required to estimate and if the p-value of the Hausman test is significant, random effect model is no longer appropriate over the fixed effect model.

Table 5.9: Impact of Higher Capital and Liquidity Requirements of Basel III on Loan Pricing of Banks

Dependent Variable: ***Loan Price***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Fixed Effect Model (Cluster Adjusted by Banks)
Variables	**Coefficient**
C	0.0358*** (0.0000)
TRA	0.0975 *** (0.0008)
NSFR	0.0099** (0.0210)
COF	0.5866*** (0.0000)
COO	0.3079*** (0.0000)
ROE	0.0025 (0.9027)
Adjusted R^2	0.90
F-statistic (P-value)	69.41 (0.0000)

This table reports the results of Loan Pricing equation:

$$LP_{it} = \alpha_i + \beta_1 TRA_{it} + \beta_2 NSFR_{it} + \beta_3 COF_{it} + \beta_4 COO_{it} + \beta_5 ROE_{it} + \varepsilon_{it}$$

where,

LP=Loan Price (lending rate), TRA=Tier 1 Capital to Risk-Weighted Assets Ratio, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

Notes:

1. *Values in parentheses are p-values*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*
3. *Robust standard errors are used in order to correct the possible presence of heteroskedasticity.*

Table 5.10: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	31.3943	4	0.0000

H_o: Random Effect Model is Appropriate

It can be seen from Table 5.9 all the variables have expected signs. The Tier 1 capital ratio (*TRA)*, cost of fund (*COF)* and cost of operation (*COO)* are highly significant at the 1% level, whereas the net stable funding ratio (*NSFR)* is significant at the 5% level. Thus, the capital ratio, liquidity ratio, the cost of fund, and the costs of operation significantly affect the loan pricing of banks. In particular, for a 1% increase in capital and liquidity, the loan price of banks increases by about 0.10% and 0.01%, respectively. The positive signs of *COF* and *COO* indicate the BRICS banks can adjust the increased cost by lowering the cost of fund (i.e. reducing deposit rate) and by increasing operating efficiency. The empirical evidence shows the reduction in *COF* of around 0.59% is sufficient to offset each percentage point increase in loan price, and for operating cost, it is about 0.31%. Although the return on equity (*ROE)* shows the correct sign, it has no impact on the loan pricing of the BRICS banks. Possibly, banks in the BRICS economies prefer to adjust the additional cost of Basel III requirements by adjusting the COF and COO while keeping shareholders return (ROE) unchanged.

5.3.1 Diagnostic Tests

In the previous section (i.e. Section 5.2.1), endogeneity diagnostic tests were performed to explore the robustness (*Z-score* model) of the impact of capital and liquidity on the resilience of the BRICS banks. In particular, the milticollinearity test, the test of unobservable variables, omitted variables, and reverse causality were employed to detect the endogeneity problem. In the loan-pricing model, apart from the multicollinearity and reverse causality test, other diagnostic tests such as autocorrelation and the heteroskedasticity test have been employed to check the endogeneity problem in the estimation.

5.3.1.1 Multicollinearity Test

In a regression equation, the regressors are required to be independent and identical. If the coefficients are inflated by other regressors due to collinearity, the regression results would be biased. Hence, in order to understand the degree of collinearity among the regressors in the loan-pricing model, variance inflation factors (VIF) have been employed and the outcomes of the estimates are reported in Table 5.11. The estimates show the mean value of VIF is 1.44, which is less than the benchmark value of 10. Thus, it can be concluded there is no milticollinearity problem in the loan-pricing model.

Table 5.11: Variance Inflation Factors (VIF)

Variable	VIF	1/VIF
TRA	1.84	0.543518
NSFR	1.20	0.831485
COF	1.19	0.841541
COO	1.91	0.523895
ROE	1.05	0.949505
Mean VIF	**1.44**	

Note:

TRA= Tier 1 capital to risk weighted assets, NSFR= Net stable funding ratio, COF= Cost of fund, COO= Cost of operation, ROE= Return on equity.

5.3.1.2 Autocorrelation Test

It is assumed in regression models the residuals would be independent and identically distributed (i.i.d). If errors were serially correlated, the regression estimates would be biased due to the influence of confounding variables (unobservables). Thus, it is indispensable to perform the autocorrelation test. In this thesis, the Wooldridge test for autocorrelation is undertaken and the F-test statistic has been reported in Table 5.12. The probability value (p-value = 0.000) of the test indicates there is an autocorrelation problem in the first order errors of the model.

Table 5.12: Wooldridge Test for Autocorrelation in Panel Data

Test Summary	F. Statistic	Prob.
Wooldridge Autocorrelation Test	33.2320	0.0000

H_o: no first-order autocorrelation

5.3.1.3 Heteroskedasticity Test

In a panel regression analysis, heteroskedasticity is a major concern amongst the researchers. It is assumed modelling errors would be uncorrelated and uniform, because if the true variance varies with the estimated effects, the results would be biased. Hence, the variances are expected to remain fixed (do not vary) with the effects being modelled. In order to detect the heteroskedasticity problem, this thesis employs the Modified Wald test for group wise heteroskedasticity in a fixed effect regression model. The result of the Chi^2 test statistic is shown in Table 5.13. The probability value of the test statistic suggests there is a heteroskedasticity problem in the model.

Table 5.13: Heteroskedasticity Test Statistic

Test Summary	Chi-Sq. Statistic	Prob.> Chi2
Modified Wald Test	16000.99	0.0000

H_0: no heteroskedasticity problem

5.3.1.4 Reverse Causality Test

The estimated relationship between the loan price and capital adequacy might be obtained due to reverse causality. For instance, it is possible the lending rate would also affect the capital requirements of banks. If this were the case, the causality would be reversed. Hence, in order to address the problem, the capital adequacy of the earliest year is replaced with the loan price of the subsequent year. The idea is the loan price in the earliest year would not have resulted from the loan price in the subsequent year. If the relationship were found significant, the direction of causality would be running from the capital adequacy to loan price rather than vice versa. The results of the causality test are depicted in Table 5.14. The coefficients of capital adequacy and liquidity are statistically significant at the 1% and 5% level, respectively, which indicate reverse causality is unlikely.

Table 5.14: Reverse Causality Test Results

Dependent Variable	**Loan Price (LP)** **(Cluster Adjusted by Banks)**
Constant	0.0062 (0.5785)
TRA(-1)	0.1372*** (0.0003)
NSFR(-1)	0.0110** (0.0372)
COF	0.8167*** (0.0000)
COO	0.7173*** (0.0000)
ROE	-0.0402 (0.1619)
Adjusted R^2	0.6694

This table reports the results of Loan Pricing equation:

$LP_{it} = \alpha_i + \beta_1 TRA(-1)_{it} + \beta_2 NSFR(-1)_{it} + \beta_3 COF_{it} + \beta_4 COO_{it} + \beta_5 ROE_{it} + \varepsilon_{it}$

where,

LP=Loan Price (lending rate), TRA(-1)=Lag Tier 1 Capital to Risk-Weighted Assets Ratio, NSFR(-1)=Lag Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

Notes:

1. *Values in parentheses are p-values*
2. *****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

5.3.2 Impact of Higher Capital Requirements on Loan Price (Sensitivity Analysis)

The previous diagnostic tests suggest the loan-pricing model is not biased by multicollinearity, misspecification bias, and reverse causality. However, the autocorrelation and the heteroskedasticity test statistics indicate the loan-pricing model is biased by the autocorrelation and the heteroskedasticity problems. Therefore, the loan pricing equation is estimated after rectifying the autocorrelation and the heteroskedasticity problems (see Table 5.9, Table 5.12 and Table 5.13). In an effort to assess the impact of an increase in bank capital as required by the Basel III on the loan price, the estimated parameters in the loan-pricing model (Table 5.9) are used. Like in BCBS (2010a), the current level of *TRA* is raised by 6% at the starting point and goes up to 15%. While measuring the impact of increased capital requirements, other parameters of the loan-pricing model are kept constant. The results as shown in Table 5.15 suggest as the capital ratio increases, the loan price of banks also increases gradually. In fact, when the capital ratio increases by 6%, the lending rate increases by about 0.66% and for a 15% increase in capital ratio, the lending rate rises by about 1.65%. Hence, the higher capital ratio increases the loan pricing of banks.

Table 5.15: Impact of Increases in Capital Ratio (TRA) on Lending Rate (Sensitivity Analysis)

Increase in TRA (%)	Change in lending rate (%)
6	0.658
7	0.768
8	0.878
9	0.989
10	1.098
11	1.207
12	1.317
13	1.427
14	1.537
15	1.646

The values of this table have been calculated by using parameters estimated in equation (4.3) as reported in Table 5.9

*LP = 0.0358 + 0.0975*TRA + 0.0099*NSFR + 0.5866*COF + 0.3079*COO + 0.0025*ROE*

where,

LP = Loan Price, TRA=Tier 1 Capital to Risk-Weighted Assets Ratio, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

5.3.3 Impact of Increased Liquidity *(NSFR)* Requirements on Loan Pricing (Sensitivity Analysis)

Likewise, the impact of increases in the *NSFR* on the lending rate is measured using the parameters estimated in the loan-pricing model (see Table 5.9). The current level of *NSFR* is increased by 5%, 10% and so on up to 25% (BCBS, 2010a). Here again, other variables of the loan pricing model are kept constant and only the *NSFR* is increased by the indicative percentages to assess the resulting impact on the loan price. The results of the estimation are shown in Table 5.16. As shown in the table, for a 5% increase in *NSFR,* the associated change in the lending rate is about 0.59% and the lending rate increases to 2.94% when the liquidity ratio *(NSFR)* is raised by 25%. Therefore, holding a higher amount of liquidity positively influences the loan price of banks in the BRICS economies.

Table 5.16: Impact of Increases in NSFR on Lending Rate (Sensitivity Analysis)

Increase in NFSR (%)	Change in lending rate (%)
5	0.588
10	1.176
15	1.764
20	2.352
25	2.940

The values of this table have been calculated by using the parameters estimated in equation (2) of Chapter 4 as reported in Table 5.9

*LP = 0.0358 + 0.0975*TRA + 0.0099*NSFR + 0.5866*COF + 0.3079*COO + 0.0025*ROE*

where,

LP = Loan Price, TRA=Tier 1 Capital to Risk-Weighted Assets Ratio, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

5.4 Measuring the Costs and Benefits of Basel III

Previous literature suggests the regulatory reform package of Basel III has macroeconomic costs because it would adversely affect the GDP by reducing credit supply in the economy (Barrell et al., 2009; Bank of Canada, 2010; BCBS, 2010a; MAG, 2010a; 2010b; Wong et al., 2010; Caggiano and Calice, 2011; Elliott et al., 2012, Parcon-Santos and Bernabe, 2012; and Yan et al., 2012). Researchers also argue the higher capital and liquidity would carry economic benefits by bringing down the probability of a crisis (Caggiano and Calice, 2011; Yan et al., 2012). Therefore, in order to attain the third objective (i.e. to test Hypothesis 3 and Hypothesis 4) of the thesis, this section attempts to assess the potential macroeconomic costs and benefits of the Basel III regulation.

5.4.1 Costs of Basel III Regulation

In order to assess the macroeconomic costs, a panel regression model (Equation 4.4; i.e.$Y_{it} = \alpha_i + \beta_1 LP_{it} + \beta_2 RIR_{it} + \varepsilon_{it}$) is employed. The outputs of the panel regression model of the impacts of loan price on GDP are depicted in Table 5.17. The model is estimated after removing the autocorrelation and heteroskedasticity problems (see Table 5.20 and Table 5.21) and the results are reported under the cross section fixed effects model[30] since the Hausman test (Table 5.19) rejects the random effects model (p-value = 0.000). The dependent variable of the model is the natural logarithm of GDP whereas the independent variables are the loan price of banks and the real interest rate in the BRICS economies.

Table 5.17: Estimation of the Impact of Loan Price on GDP

Dependent Variable: *LGDP*
Method: Panel Least Squares
Sample: 2007 - 2014
Periods included: 8
Cross-sections included: 43
Total panel (balanced) observations: 344

	Fixed Effect Model **(Cluster Adjusted by Banks)**
Variables	**Coefficient**
C	14.6486*** (0.0000)
LP	-1.4582** (0.0325)
RIR	-1.9136*** (0.0000)
Adjusted R^2	0.93
F-statistic	106.89 (0.0000)

This table reports the results of the impact of loan price on GDP:
$Y_{it} = \alpha_i + \beta_1 LP_{it} + \beta_2 RIR_{it} + \varepsilon_{it}$
where,
Y= log real GDP, LP=Loan Price, RIR= Real Interest Rate
Notes:
1. *Values in parentheses are P-values*
2. **** and ** denote 1% and 5% level of significance, respectively.*
3. *Cross-section clusters (banks) are adjusted to remove the potential autocorrelation and heteroskedasticity.*

[30] To start with, this thesis employs a pooled regression model (see appendix 5.5). The F-value of the pooled regression suggests data can be pooled. Next, in order to choose between pooled OLS and random effect model, the Breusch-Pagan Langrange multiplier test is carried out. The p-value of the Breusch-Pagan Langrange multiplier test (reported in appendix 5.6) shows random effect model is better than pooled OLS. However, it is crucial to check whether the intercept value (country specific effect) in a random model varies or not. Hence, fixed effect model is required to estimate and if the p-value of the Hausman test is significant, random effect model is no longer appropriate over the fixed effect model.

Table 5.18: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	14.9887	7	0.006

H_o: Random Effect Model is Appropriate

It is found from Table 5.17 the loan price *(LP)* of banks and the real interest rate *(RIR)* are significant at the 5% and 1% level, respectively. The signs of both the variables are negative indicting the loan price and the real interest rate *(RIR)* both are negatively associated with GDP. In fact, for a 1% increase in loan price, GDP declines about 1.45% and for each percentage point increase in the real interest rate, GDP declines by 1.91%.

5.4.1.1 Diagnostic Tests

Akin to the previous sections (Section 5.2.1 and 5.3.1), in order to understand the robustness of the GDP model in a panel study setting, a multicollinearity test, autocorrelation test and a Heteroskedasticity test have been carried out.

5.4.1.1.1 Multicollinearity Test

As mentioned earlier, variance inflation factors (VIF) is a measure of the degree of collinearity amongst the regressors. VIFs explain how much of the variance of the estimated coefficients of the regressors are inflated due to the collinearity with the other regressors. It is assumed if the *mean* VIF is greater than 10 then collinearity exists among the independent variables. The results of the test are given in Table 5.19. The mean value of VIFs shows there is no problem of multicollinearity in the GDP model.

Table 5.19: Variance Inflation Factors (VIF)

Variable	VIF	1/VIF
LP	1.07	0.9379
RIR	1.07	0.9379
Mean VIF	**1.07**	

LP= Loan Price (Lending Rate), RIR= Real Interest Rate.

5.4.1.1.2 Autocorrelation Test

One of the assumptions of regression models suggests the residuals would be independent and identically distributed (i.i.d). It is argued when errors are serially correlated then regression estimates would be biased due to the power of confounding variables (unobservables). Thus, it is crucial to remove the autocorrelation from the model. Hence, in order to detect whether the GDP model contains autocorrelation or not, the Wooldridge test of autocorrelation in panel data is carried out and the test statistic is given in Table 5.20. The probability value of the test statistic suggests there is an autocorrelation problem in the model.

Table 5.20: Wooldridge Test for Autocorrelation in Panel Data

Test Summary	**F. Statistic**	Prob.
Wooldridge Autocorrelation Test	88.670	0.000

H_o: no first-order autocorrelation

5.4.1.1.3 Heteroskedasticity Test

Another assumption in regression estimation is that the variances of the estimates would not vary with the effects being modelled. If the true variance varies with the estimated effects, the results would be biased. Hence, in order to verify whether the variances in the GDP model varies with the effects or not, the heteroskedasticity test has been performed and the results are shown in Table 5.21. The test statistic suggests heteroskedasticity is a concern in the GDP model.

Table 5.21: Heteroskedasticity Test Statistic

Test Summary	**Chi-Sq. Statistic**	Prob.> Chi2
Modified Wald Test	1465.07	0.0000

H_0: no heteroskedasticity problem

5.4.1.2 Impact of Capital on GDP (Sensitivity Analysis)

In order to understand how much additional capital would lead to how much of an increase in the loan price and the associated impact on GDP, Table 5.22 is constructed, where change in lending rate is calculated on the basis of the parameters estimated in equation (4.3) as reported in Table 5.9, i.e. *LP = 0.0358 + 0.0975*TRA + 0.0099*NSFR + 0.5866*COF + 0.3079*COO + 0.0025*ROE.* Hence, change in capital level *(TRA)* is mapped with the loan price. Subsequently, for each level of capital (i.e. from 6% to 15%), the associated change in lending rate is made to observe the impact of lending rates on GDP based on the parameters estimated in Table 5.17 (autocorrelation and heteroskedasticity are rectified in the model)

Table 5.22: Impact of Increases in TRA on Lending Rate and GDP (Sensitivity Analysis)

Increase in TRA (%)	Change in lending rate (%)	Change in GDP (%)
6	0.658	-0.068
7	0.768	-0.146
8	0.878	-0.235
9	0.989	-0.335
10	1.098	-0.446
11	1.207	-0.569
12	1.317	-0.702
13	1.427	-0.847
14	1.537	-1.003
15	1.646	-1.170

Note:
The values of this table has been calculated by using the estimated parameters in equations (4.3) and (4.4) of Chapter 4 as reported in Table 5.9 and 5.17.

*LP = 0.0358 + 0.0975*TRA + 0.0099*NSFR + 0.5866*COF + 0.3079*COO + 0.0025*ROE*

where,
LP is Loan Price, TRA=Tier 1 Capital to Risk-Weighted Assets, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

and,

*Y = 14.6486 - 1.4582*LP - 1.9136*RIR*

where,
Y= log real GDP, LP=Loan Price, RIR= Real Interest Rate

It is found from Table 5.22 the lending rate (loan price) changes about 0.66% when the capital ratio is increased by 6%, and it is associated with a 0.07% decline in GDP. When the capital ratio increases by 15%, the positive impact on the lending rate is about 1.65%, which results in a 1.17% decline in GDP. Hence, the association between the capital regulation and lending rate is positive. The relationship, however, is negative with GDP; meaning that capital ratio leads to an increase in the lending rate, which consequently, reduces the GDP.

5.4.1.3 Impact of Liquidity on GDP (Sensitivity Analysis)

Similarly, the impact of liquidity as measured by the *NSFR* is reported in Table 5.23. The table shows a 5% increase in *NSFR* increases the lending rate by 0.59% and the associated decline in GDP is 0.06%. When the capital ratio is raised from 10% to 20%, the lending rate has increased from 1.18% to 2.35%, which leads to a decline in GDP from 0.18% to 0.60%. Thus, akin to the capital ratio, the relationship between liquidity ratio and lending rate is positive, but with GDP, the association is negative. The analysis indicates a higher liquidity does increase the lending rate resulting in a decline in the GDP.

Table 5.23: Impact of Increases in NSFR on Lending Rate and GDP (Sensitivity Analysis)

Increase in NFSR (%)	Change in lending rate (%)	Change in GDP (%)
5	0.588	-0.060
10	1.176	-0.180
15	1.764	-0.359
20	2.352	-0.597
25	2.940	-0.896

Note:
The values of this table has been calculated using the parameters estimated in equations (4.3) and (4.4) of Chapter 4 as reported in Table 5.9 and 5.17.

*LP = 0.0358 + 0.0975*TRA + 0.0099*NSFR + 0.5866*COF + 0.3079*COO + 0.0025*ROE*
where,
LP is Loan Price, TRA=Tier 1 Capital to Risk-Weighted Assets, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

*Y = 14.6486 - 1.4582*LP - 1.9136*RIR*
where,
Y= log real GDP, LP=Loan Price, RIR= Real Interest Rate

5.4.2 Benefits of Basel III Regulation

In order to estimate the benefits of higher capital and liquidity requirements the following formula - *reduction in annual probability of crisis* times *the cumulative output (GDP) loss*, where cumulative output loss is measured by *HP* filtering over the 20-year period, is considered (Eq. 4.5). When the frequency of crises declines, output, which would have been lost, can be saved. This is treated as the benefit of reducing systemic risk (crises). The trend real GDP as measured by applying the *HP* filter yields an output loss of 30.67% for the BRICS economies.

Like in BCBS (2010a), the probability of a crisis is calculated using equation (4.6) i.e. $P = f(-0.34TCA_{-1} - 0.11LAR_{-1} + 0.08RHPG_{-3} - 0.24CGR_{-2})$, where, P is the probability of a crisis, *TCA* is the ratio of total capital over total assets, *LAR* is the ratio of cash and balances with the central bank plus securities over total assets, *RHPG* is the real house price growth, and *CGR* is the ratio of the current account balance over nominal GDP. It is important to mention the ratio of capital to total asset *(TCA)* is the 'capital ratio' in the probability of crisis equation, which is not a regulatory ratio imposed by Basel III. Thus, the ratio *TCA* needs to be mapped with the Tier 1 capital to risk-weighted asset ratio (*TRA)*, which is a regulatory ratio of Basel III and of interest to the thesis. Therefore, in order to map *TCA* with the *TRA*, like in BCBS (2010a), equation (4.7) has been applied, which is; $TCA_i = \beta_1 TRA_i + \varepsilon_i$, where, *TCA* is the ratio of total capital to total asset ratio and *TRA* is *Tier 1* capital to risk-weighted asset ratio. The equation is a simple pooled *OLS* and is estimated without intercept[31]. The results of the mapping show a *TRA* of 10% is approximately equivalent to a *TCA* of 8% and the associated reduction in the probability of a crisis is about 5.025%.

The calculation of probability crises in Table 5.24 shows as the capital ratio increases, the reduction in the probability of crises becomes larger. For example, when the capital ratio increases from 6% to 10%, the reduction in probability of a crisis ranges from 3.015% to 5.025%. A further increase in the capital ratio to 15% reduces the probability of a crisis by 7.537%. Hence, the enhancement of capital base of banks ensures the economic stability by reducing crises in the economy.

5.4.2.1 Impact of Capital on GDP (Sensitivity Analysis)

After the mapping of capital ratio, it is possible to quantify the impact of an increase in regulatory capital ratio on the probability of crises and consequently, on output. For example, in order to estimate the impact of a 10% increase in *TRA* on output, the

[31] The rationale is if *Tier 1* capital is zero then total capital would also be zero.

equation of "Benefit" would be employed. The calculation shows the benefit would be: *0.0525*0.3067 = 0.01541 = 1.541%*. Likewise, the results of these impacts are depicted in Table 5.24. For a 6% increase in capital ratio, the probability of a crisis declines by 3.015% resulting in a 0.925% gain in the GDP. If the capital ratio is increased by 10%, the reduction in the probability of a crisis is 5.025% and the associated benefit in terms of an increase in GDP is 1.541%. Hence, the evidence shows the higher capital is associated with a reduction in crises and an increase in the GDP.

Table 5.24: Impact of Increases in Capital Ratio (TRA) on Probability of Crisis and GDP (Sensitivity Analysis)

Increase in TRA (%)	Reduction in probability of crisis (%)	Output gain (%GDP)
6	3.015	0.925
7	3.517	1.079
8	4.020	1.233
9	4.522	1.389
10	5.025	1.541
11	5.527	1.695
12	6.030	1.849
13	6.532	2.003
14	7.034	2.157
15	7.537	2.312

Note:
The values of this table have been calculated by using the following equations:
$P = f(-0.34TCA_{-1} - 0.11LAR_{-1} + 0.08RHPG_{-3} - 0.24CGR_{-2})$
where,
P is the probability of crisis, TCA is the ratio of total capital over total assets, LAR is the ratio of cash and balances with the central bank plus securities over total assets, RHPG is real house price growth, and CGR is the ratio of the current account balance over nominal GDP.
and,
Benefit = Output Gain = Δprob (crises) ×ΔGDP
where,
prob denotes probability and Δ signifies change

5.4.2.2 Impact of Liquidity on GDP (Sensitivity Analysis)

It is also assumed similar to capital; higher liquidity reduces the probability of crises and protects loss of GDP. Hence, in order to understand the impact of liquidity on the probability of a crisis *(P)* again equation (4.6) i.e. $P = f(-0.34TCA_{-1} - 0.11LAR_{-1} + 0.08RHPG_{-3} - 0.24CGR_{-2})$, is employed. The only liquidity term in this probability of crisis equation is LAR, which is the ratio of cash and balances with the central bank plus securities over total assets and is not a regulatory ratio. Therefore, it is important to map *LAR* with the regulatory ratio of Basel III. Accordingly, the *LAR* is mapped with the *NSFR* using equation (4.8) as suggested by the BCBS (2010a), i.e. $LAR_i = \beta_1 NSFR_i + \varepsilon_i$, where *LAR* is the ratio of liquid asset to total asset and *NSFR* is the net stable funding ratio. The mapping is again based on the ordinary pooled *OLS* and is run without intercept.

Table 5.25: Impact of Increases in *NSFR* on Probability of Crisis and GDP (Sensitivity Analysis)

Increase in NFSR (%)	Reduction in probability of crisis (%)	Output gain (%GDP)
5	0.687	0.211
10	1.374	0.421
15	2.062	0.632
20	2.749	0.843
25	3.436	1.054

Note:
The values of this table have been calculated by using the following equations:
$P = f(-0.34TCA_{-1} - 0.11LAR_{-1} + 0.08RHPG_{-3} - 0.24CGR_{-2})$
where,
P is the probability of crisis, TCA is the ratio of total capital over total assets, LAR is the ratio of cash and balances with the central bank plus securities over total assets, RHPG is real house price growth, and CGR is the ratio of the current account balance over nominal GDP.
Benefit = Output Gain = Δprob (crises) ×ΔGDP
where,
prob denotes probability and Δ signifies change

The estimates show a *NSFR* of 20% is roughly equivalent to a *LAR* of 5% and the associated reduction in the probability of a crisis is about 2.749%. Likewise, the reduction in the probability of crises associated with the increases in the *NSFR* from 5% to 25% is calculated. Similar to the estimates of the impact of increases in capital levels on output, the impact of *NSFR* is measured. For example, a 20% increase in the *NSFR* is associated with a reduction in the probability of a crisis of 2.749%, which yields benefit of about 0.843% (0.0274*0.3067). Likewise, the outcomes of the estimates are reported in Table 5.25. It is found as the *NSFR* increase from 5% to 25%, the reduction in the probability of a crisis rises from 0.687% to 3.436% and the associated benefit increases from 0.211% to 1.054%. Akin to the capital ratios, the relationships amongst the liquidity, reduction in the crises, and gain in GDP are positive.

5.4.3 Costs and Benefits of Basel III Compared

Comparing the costs and benefits would reveal the long-term macroeconomic impact of capital and liquidity requirements of Basel III. Like in the BCBS (2010a), Table 5.26 shows the summary of the costs and benefits of the enhanced capital requirements. In effect, Table 5.26 depicts the benefits and costs for each rise in capital levels from 6% to 15% and the corresponding net benefits associated with it. As shown in Table 5.19, the net benefits increases from 0.857% to 1.156% when the capital ratio increases from 6% to 13%. However, the marginal net benefits are negative beyond the 13% capital level, i.e. if the capital is increased further to 15%, the net benefit reaches 1.142% (lower than 1.156%). Therefore, it can be concluded that the long-term net benefit of higher capital is positive for the BRICS economies up to a certain level; beyond that level, no benefits are achieved. These findings are consistent with the findings of BCBS (2010a; 2011), MAG (2010a; 2010b), and Caggiano and Calice (2011).

Table 5.26: Expected Annual Benefits and Costs of Tighter Capital Ratios (in Terms of GDP Level)

Increase in TRA (%)	Expected Benefit (%)	Expected Cost (%)	Net Benefit (%)
6	0.925	-0.068	0.857
7	1.079	-0.146	0.933
8	1.233	-0.235	0.998
9	1.389	-0.335	1.054
10	1.541	-0.446	1.095
11	1.695	-0.569	1.126
12	1.849	-0.702	1.147
13	2.003	-0.847	1.156
14	2.157	-1.003	1.154
15	2.312	-1.170	1.142

Notes:

1. *Expected benefits are reported from the Table 5.24*
2. *Expected costs are extracted from the Table 5.22*

Similarly, in order to assess the macroeconomic impact of *NSFR*, the cost and benefits are compared. The results are reported in Table 5.27. It can be seen from the table as the *NSFR* increases, the net benefits increase. In effect, when the *NSFR* is increased from 5% to 15%, the net benefits increase from 0.151% to 0.273%. A further increase in the *NSFR* to 20% produces a net benefit of 0.246%, which is lower than the benefits (0.273%) produced by 15% level of *NSFR*. Therefore, similar to the capital ratios, the net benefits of higher liquidity are also positive and are achieved if the liquidity is increased to a certain threshold level. This finding is also consistent with the findings of BCBS (2010a; 2011), MAG (2010a; 2010b), and Caggiano and Calice (2011). This is due to the fact that when banks increase additional funding from the owners, debt holders and depositors for the purpose of taking excessive risks, the costs of fund increase faster beyond a certain level as argued by Modigliani and Miller (MM) in the capital structure theory. Because due to taking excess risks, the marginal returns investors require are much higher than the initial required rare of returns. Therefore, higher costs as incurred by banks beyond the optimum capital level cause to decline the marginal benefits. Besides, the contribution of capital and liquidity to reduce the probability of crisis gradually becomes lower, which yields lower marginal benefits after certain level of capital and liquidity enhancement.

Table 5.27: Expected Annual Benefits and Costs of Higher Liquidity Requirement (in Terms of GDP Level)

Increase in NFSR (%)	Expected Benefit (%)	Expected Cost (%)	Net Benefits (%)
5	0.211	-0.060	0.151
10	0.421	-0.180	0.241
15	0.632	-0.359	0.273
20	0.843	-0.597	0.246
25	1.054	-0.896	0.158

Notes:

1. *Expected benefits are reported from the Table 5.25*
2. *Expected costs are extracted from the Table 5.23*

5.5 Conclusion

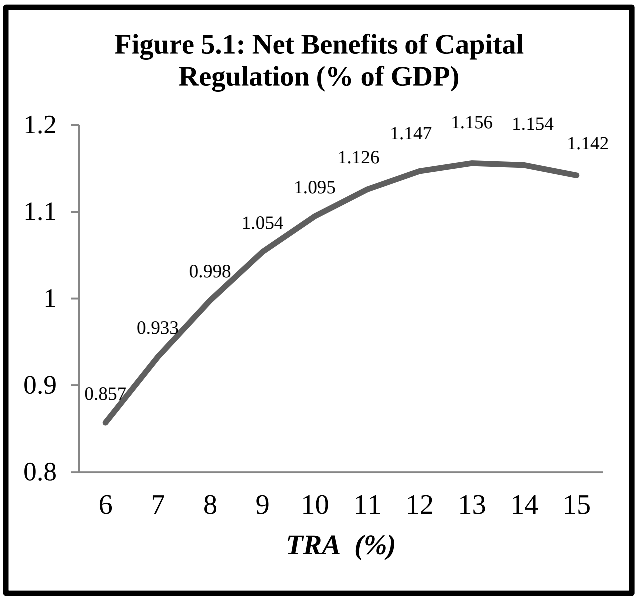
The empirical evidence of the *Z-score* model shows the capital and liquidity requirements are effective to increase the resilience of banks. As the higher amount of capital and liquidity is kept by banks, the solvency increases in the long run. Most importantly, the solvency of banks improves even more if banks concentrate on increasing the total capital; i.e. *CAR*. However, the role of *NSFR* to increase the solvency of banks is better with the *LEV* compared to the *CAR* and *TRA*.

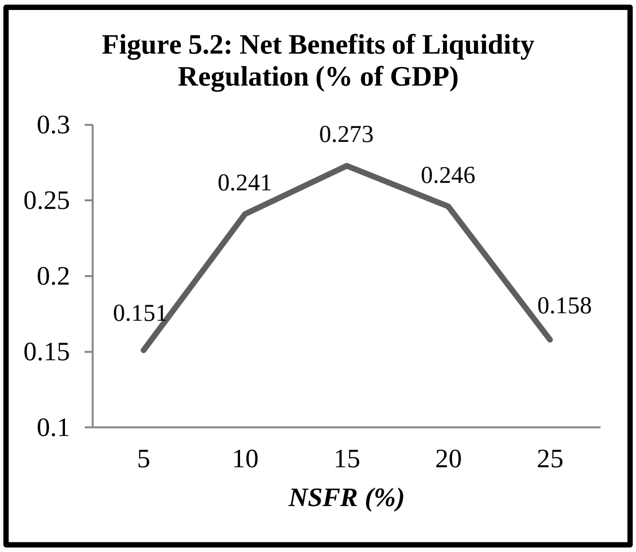
It is found from the loan-pricing model that the capital requirements significantly explain the loan pricing of banks. As stock of capital and liquidity increase, the loan price of banks also increases. However, banks in the BRICS economies can adjust the increased cost in several ways in order to keep the loan price unchanged. For example, for a 1% potential increase in the loan price, banks can reduce the cost of fund by about 0.59% and the cost of operation by 0.31%.

The empirical evidence of the assessment of costs shows the association between capital/liquidity requirement and GDP is negative. As the holdings of capital and liquidity increase, GDP in the economy declines. In effect, for a 1% increase in the levels of capital from 6% to 7%, GDP declines by about 0.078% and with an increase of liquidity (*NSFR*) from 5% to 10%, GDP declines to -0.18% from -0.068%.

However, additional capital also yields benefits in the economy by reducing the probability of a crisis and hence, protecting the GDP from declining. For a 1% increase in capital, the reduction in the probability of a crisis is about 0.502% and the accompanying benefits are 0.159%. For a 5% increase in liquidity, the reduction in crises increases by about 0.687% and the associated benefits increase to 0.211%.

Eventually, the net benefits of higher capital and liquidity requirements are positive for the BRICS economies. Figure 5.1 highlights the net benefits increase from 0.857% to 1.156% when the capital ratio is increased from 6% to 13%. However, when the capital requirement is raised to 14%, the net benefits are 1.154%, which is lower than the benefits (1.156%) produced by 13% capital level. If the capital ratio is raised further, the net benefits continue to decrease. Thus, the marginal net benefits of the capital regulation are negative beyond the 13% capital levels.





Similarly, when the *NSFR* is raised from 5% to 15%, the net benefits increase from 0.151% to 0.273% as depicted in Figure 5.2. However, a further increase in *NSFR* to 20% produces a decline in net benefits to 0.246%. Hence, the net benefits are achieved up to a certain level of the increase in liquidity. After that point, the marginal net benefits of increasing liquidity are negative. Hence, there is an optimum level of *NSFR*, which maximises the net benefits in terms of GDP.

In summary, the capital and liquidity requirements are effective to increase the resilience of banks. Although the Basel III implementing countries would incur macroeconomic costs, the regulations would produce macroeconomic benefits by reducing systematic crises in the economy resulting in an increase in GDP. The findings of this thesis are of particular interest to researchers, policy makers, regulators and practitioners.

Chapter 6

Conclusion

6.1 Overview

The global financial crisis of 2007-2008 has highlighted the importance of effective banking regulations due to the fact many banks have collapsed during the recent financial crisis even though those banks have been Basel II compliant. The major causes of bank failure as revealed by the existing literature are inadequate capital stocks, a high degree of leverage, and poor liquidity buffers (Cannata and Quagliariello, 2009). Thus, taking the lessons from the global financial crisis, the flaws of Basel II have been rectified by the BCBS. Consequently, a new regulation, popularly known as the Basel III, has been introduced in 2010 by increasing the capital and liquidity standards for banks. Besides, the new Basel III framework contains a non-risk-based leverage ratio, which would act as a supplement to the risk-based capital requirements of banks. However, banks around the world are required to implement the Basel III regulation from 2013 (BCBS, 2011).

The BCBS believes capital and liquidity requirements increase financial stability by reducing banks' incentives to take on excessive risks ex ante, and by making banks more able to absorb losses ex post. Indeed, the Basel III norms would improve the resilience of banks by increasing the quality and quantity of capital and liquidity (BCBS, 2011). The regulation is likely to bring down the probability of banking crises, and thus, it would save GDP (MAG, 2010a; 2010b; BCBS, 2010a). However, the higher capital and liquidity requirements would increase the overall cost of bank. Thus, it is likely the increased costs would be transferred to borrowers by increasing the lending rate, which would penalise the investment flows in the economy resulting in an adverse impact on GDP (Barrell et al., 2009; Elliot, 2009; BCBS 2010a; 2010b; Kato et al., 2010; MAG, 2010a; 2010b; Caggiano and Calice, 2011; Gambacorta, 2011; Yan et al., 2012). Hence, it is critical to investigate whether the benefits of Basel III regulation are higher than the costs. Besides, the Basel III regulation is likely to *"ensure a level playing field"* (BIS, 2014, p. 1) in all banking operations across countries. The question arises as to what extent this universally binding regulation is appropriate for the already highly regulated emerging market economies, particularly the BRICS economies (Abdel-Baki, 2012; AfDB, 2012).

Researchers argue most empirical investigations on the Basel III regulation focus on the needs of the advanced economics (Suttle et al., 2010). Hence, the circumstances of the BRICS and emerging market economies have been overlooked (Suttle et al., 2010) though the BRICS economies have also suffered from the consequences of the global financial crisis in 2007-08 (Banerjee and Vashisth, 2010). Hence, it is crucial to examine the effectiveness of Basel III regulation to increase the resilience of banks. It is equally important to assess the macroeconomic impacts of Basel III regulation to formulate common policies for the BRICS economies.

The broad objective of the thesis was to investigate the impending effects of Basel III on the BRICS economies. More specifically, the first objective was to examine the resilience of banks due to the enhanced capital and liquidity requirements. The second objective was to assess the impacts of the higher standards of capital and liquidity on the lending rate of banks, and finally, the thesis attempted to measure the economic costs and benefits of additional capital and liquidity requirements in the BRICS economies.

The thesis used secondary bank level and macroeconomic data from 2007 to 2014 in order to perform the analysis. The bank level data were collected from the annual reports of 43 banks in the BRICS countries while the macroeconomic data were gathered from the *Datastream* – a commercial source of macroeconomic data. Panel regression models were employed to test the hypotheses, and hence, to achieve the objectives of the thesis.

6.2 Main Findings of the Thesis

The analysis of the *Z-score* model reveals the higher capital and liquidity requirements of Basel III increase the resilience (solvency) of banks in the BRICS. Specifically, it is found the capital adequacy ratio *(CAR)*, *Tier 1* capital ratio, leverage ratio (*LEV*) and net stable funding ratio (*NSFR)* are statistically significant to increase the solvency of banks. That is, as the higher amounts of capital and liquidity are kept by banks, the solvency increases in the long run. These findings are very similar to the findings of Laeven and Levine (2008), Angora and Roulet (2011), Abdel-Baki (2012), Chalermchatvichien et al., (2014). Apart from this, the thesis puts forward a new finding; compared to Tier 1 capital and leverage ratio, the solvency increases the most when banks focus on increasing the capital adequacy ratio. This is very relevant because during the economic woes the Tier 2 capital (component of the *CAR*) acts as an additional safeguard with the Tier 1 capital. As a result, banks become more solvent and shock resilient. This finding is consistent with the study by Abdel-Baki (2012). In his study, it is stated *"Tier 2 capital is expected to bear losses in case of insolvency"* (Abdel-Baki, 2012, p. 5). Further, empirical evidence of this thesis shows the impact of *NSFR* to increase the resilience is higher with the leverage ratio than the impact comes from the capital adequacy ratio and Tier 1 capital ratio. This thesis is unique in the sense it uses a regulatory and risk-based measure of capital (i.e. *CAR*) while calculating the *Z-score*, and incorporates all the Basel III norms in the study, which were missing in the previous studies.

The findings of the loan-pricing model discover capital and liquidity requirements significantly increase the lending rate of banks. Banks in the BRICS economies increase the lending rate in order to cover the costs of holding additional capital and liquidity. For a 1% increase in capital and liquidity, the lending rate increases by about 0.10% and 0.01%, respectively. It is found, however, banks can adjust those additional costs by reducing the cost of fund and operating cost. For example, for a 1% potential increase in loan price, banks can reduce the cost of fund by about 0.59% and cost of operation by 0.31%. The results are consistent with the findings of Elliott (2009), the MAG (2010a), the BCBS (2010a) and King (2010). The novelty of this thesis, in this case, is the methodological contribution to the loan pricing equation, which establishes the argument of the BCBS (2010a) by incorporating the liquidity component in the model.

The results of costs and benefits analysis indicate the implementation of Basel III has been costly for the BRICS economies. For instance, when capital ratio is raised from 6% to 7%, GDP of those economies declines by about 0.078% and increasing the liquidity ratio from 5% to 10%, the GDP declines from -0.068% to -0.18%.

Furthermore, it is found that higher levels of capital also generate economic benefits in the form of reducing the probability of a crisis, and hence, safeguards GDP loss. Specifically, for a 1% increase in capital from 6% to 7%, the reduction in the probability of a crisis reaches 3.517% from 3.015% and the associated benefits increase from 0.92% to 1.079%. Similarly, an increase of the liquidity from 5% to 10%, the reduction in the probability a crisis increases from 0.687% to 1.374% and the accompanying benefits increase from 0.211% to 0.421%.

The comparison between the costs and benefits reveals the net benefits of Basel III are positive for the BRICS economies. The net benefits increase from 0.857% to 1.156% when the capital ratio is raised from 6% to 13%. However, the marginal net benefits of capital standards are negative beyond the 13% capital levels. Similarly, when the *NSFR* is raised from 5% to 15%, the net benefits increase from 0.151% to 0.273% and a further increase in *NSFR* to 20% produces a decline in the net benefits of 0.246%. Hence, the net benefits of Basel III would be obtained when capital and liquidity standards are raised up to a certain level because after that level, the marginal net benefits of increasing the capital and liquidity are negative. It is important to mention that these findings are similar to the findings of the BCBS (2010a), the MAG (2010a), Angelini et al., (2011), Caggiano and Calice (2011), Gambacorta (2011), Locarno (2011), Parcon-Santos and Bernabe (2012), and Yan et al., (2012). This thesis provides new evidences to policy makers of the BRICS economies and fills the gap in the previous literature.

6.3 Policy Recommendations for Banks

After scrutinizing the results, the following recommendations for banks have been enumerated.

- Banks should focus on increasing the capital adequacy ratio rather than focusing only on the Tier 1 capital. The empirical evidence of this thesis shows compared to Tier 1 capital and leverage ratio, the capital adequacy ratio significantly improves the resilience of banks. This is very crucial because the two components of the capital adequacy ratio, i.e. Tier 1 capital is a *'going concern capital'* whereas Tier 2 capital tolerates losses in the event of insolvency.

- The findings of this thesis indicate the lending rate of banks increases with the increase in addition capital and liquidity. Hence, if banks aspire to gain competitive advantage, they might achieve operating efficiency by reducing the operating costs. Eventually, this would reduce the lending rate and offset the increased costs of Basel III regulation. Another avenue to offset the additional costs of capital and liquidity is to reduce the costs of fund. In this case, banks might focus on mobilizing low-cost deposits such as current account and short notice deposits.

- Banks should be cautious about their investment and lending activities during the implementation phase of Basel III. Because, the empirical evidence shows GDP reduces due to implementing the Basel III regulation, which may negatively affect the business environments of banks, causing an adverse impact on their profitability.

6.4 Policy Recommendations for Regulators

Based on the analysis and findings, the thesis offers the following policy recommendations for regulators:

- In order to increase the solvency of banks in the BRICS economies, regulators may impose the capital, liquidity and leverage standards of the Basel III regulation because the empirical evidence shows those standards significantly increase the solvency/resilience of banks. However, regulators might also formulate pragmatic policies to increase the capital adequacy ratio, particularly Tier 2 capital, not emphasizing only to raise the Tier 1 capital. In this case, the specific guidelines of the Basel III can be consulted.

- It is found the impact of *NSFR* on increasing the resilience of banks is more effective combined with the leverage ratio than the impact with capital adequacy ratio and Tier 1 capital ratio. Hence, regulators might concurrently impose the *NSFR* and leverage requirements on banks.

- It is revealed the higher capital and liquidity requirements increase the lending rate of banks. Hence, in order to keep the lending rate unchanged, the regulators of the BRICS economies might devise specific policies to regulate the costs of fund and costs of operation. If these costs are managed, banks can adjust or offset the costs of holding additional capital and liquidity.

- The analysis of costs and benefits suggests the benefits of higher standards of capital and liquidity are achieved up to a certain level of increments in capital and liquidity, for this reason, regulators should be vigilant in setting the standards of capital and liquidity. Hence, during the implementation period of Basel III, the capital and liquidity requirements should be increased gradually.

6.5 Limitation of the Study

This thesis has shed light on the impending impacts of Basel III norms, which is scheduled to be phased in from 2013 to 2018. The actual results could not be known due to the paucity of secondary data. Thus, the results of the thesis should be read as the perceived impacts of Basel III regulation. This thesis does not cover the non-banking financial institutions and shadow banking, which constitute a major part in any financial system, hence, the policy implications of this thesis should be considered only in a banking context.

6.6 Future Research

This thesis is based on secondary sources of information obtained from websites of respective banks. Qualitative information, such as experts', regulators' and practitioners' opinions would certainly supplement the findings of the thesis. Apart from this, the inclusion of non-bank financial institutions or shadow banking to represent the entire financial system could have improved the reliability of the results. This thesis could not address these limitations due to the time constraints. However, this thesis leaves these areas for future research.

As the thesis relies on the annual reports of banks, only year-end information is available. This kind of information is not suitable for calculating the *LCR* because it requires data that are more granular. Hence, future research could be undertaken by more accurately incorporating the *LCR*.

Further, volatility in GDP is a very common phenomenon in many economies. This thesis does not consider volatility in the GDP series. Thus, the assessment of costs and benefits of Basel III might be conducted in the future by considering the volatility of GDP in the BRICS economies. Finally, future research might investigate and explore how the Basel III affects the banks' solvency and macroeconomic conditions when it is already in effect in 2018 and latter.

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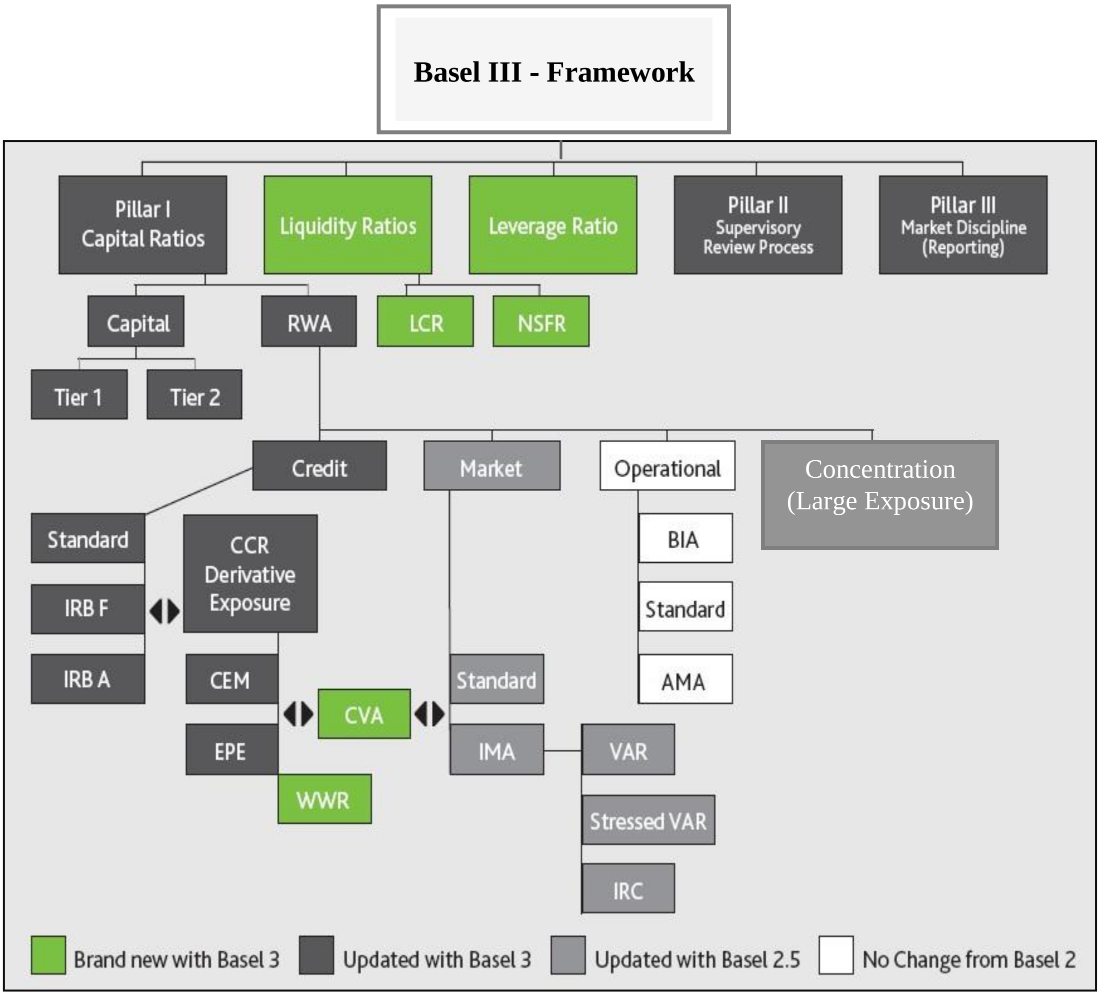
Appendixes

Appendix to Chapter 2

Appendix 2.1: Proposed Basel III Framework



Source: Irwin (2011)

Appendix to Chapter 4

Appendix 4.1: Measurement (variables) Used in Previous Literature

Author(s) Name	**Measurement (Variable) Used**
Laeven and Levine (2008); Abdel-Baki (2012); Chalermchatvichien et al. (2014); Vazquez and Federico (2015).	*Z-Score* (Measured by *CAR* plus *ROA* divided by the standard deviation of assets returns)
BCBS (2010a); King (2010); Angora and Roulet (2011); BCBS (2011); Vallascas and Keasey (2012); Noss and Toffano (2016).	Capital adequacy ratio (*CAR*)
BCBS (2010a); MAG (2010a); Gambacorta (2011); Locarno (2011); Yan et al. (2012).	Tier 1 capital ratio (*TRA*)
Laeven and Levine (2008); Angelini et al. (2011); Caggiano and Calice (2011); Abdel-Baki (2012); Cummings and Wright (2015).	Total capital to asset ratio (*TCA*)
BCBS (2010a); MAG (2010a); Abdel-Baki (2012).	Leverage ratio (*LEV*)
BCBS (2010a); MAG (2010a); BCBS (2011); Abdel-Baki (2012); Gobat et al. (2014); Chalermchatvichien et al. (2014); Vazquez and Federico (2015).	Liquidity coverage ratio (*LCR*)
BCBS (2010a); MAG (2010a); King (2010); BCBS (2011); Angora and Roulet (2011); Abdel-Baki (2012); Yan et al. (2012); Gobat et al. (2014); Chalermchatvichien et al. (2014); Vazquez and Federico (2015).	Net stable funding ratio (*NSFR*)
Laeven and Levine (2008); Angora and Roulet (2011); Abdel-Baki (2012); Vallascas and Keasey (2012); Chalermchatvichien et al. (2014).	Total asset
Abdel-Baki (2012).	Loan deposit ratio (*LDR*)

This appendix is continued on the next page

Appendix 4.1: (Continued)

Author(s) Name	Measurement (Variable) Used
Elliott (2009); BCBS (2010a); MAG (2010a); King (2010); Caggiano and Calice (2011); Gambacorta (2011); Slovik and Cournède (2011); Parcon-Santos and Bernabe (2012); Santos and Elliott (2012); Yan et al. (2012); Cummings and Wright (2015).	Loan price (*LP*)
Elliott (2009); BCBS (2010a); MAG (2010a); Santos and Elliott (2012).	Cost of fund (*COF*)
Elliott (2009); BCBS (2010a); MAG (2010a).	Cost of operation (*COO*)
Elliott (2009); BCBS (2010a); MAG (2010a); King (2010); Kashyap et al. (2010); Caggiano and Calice (2011); Gambacorta (2011); Yan et al. (2012); Bernabe and Jaffar (2013).	Return on equity (*ROE*)
Abdel-Baki (2012).	Real exchange rate
Akhter and Daly (2009); Roy and Bhattacharya (2011); Abdel-Baki (2012).	Inflation (*INF*)
BCBS (2010a); MAG (2010a); Angelini et al. (2011); Caggiano and Calice (2011); Gambacorta (2011); Locarno (2011); Parcon-Santos and Bernabe (2012); Roger and Vitek (2012); Yan et al. (2012); Bernabe and Jaffar (2013); Chalermchatvichien et al. (2014).	Real GDP
Caggiano and Calice (2011); Gambacorta (2011); Yan et al., (2012).	Real interest rate
BCBS (2010a).	Real house price growth
BCBS (2010a).	Current account balance to GDP
BCBS (2010a).	Liquid asset ratio (*LAR*)

Appendix 4.2: Components of Net Stable Funding Ratio *(NSFR)*

Available stable funding (sources)	Factor	Required stable funding (uses)	Factor
Items		**Items**	
Capital instruments	100%	Cash, banknotes, central bank reserves and unencumbered loans to banks < 6m.	0%
Stable deposits of retail customers (non-maturity or residual maturity <1 year)	95%		
Less stable deposits of retail customers (non-maturity or residual maturity <1 yr)	90%	Unencumbered HQLA securities < 1 year: Debt issued or guaranteed by sovereigns, central banks, BIS, IMF, EC, multilateral development banks, non-central government, with a 0% risk weight under Basel II standardized approach	5%
Other Deposit & Short Term Borrowing: wholesale funding provided by non-financial corporate customers, sovereign central banks, multilateral development banks and PSEs (non-maturity or residual maturity 6 months to 1 year)	50%	Unencumbered Level 2a and 2b securities: unencumbered non-financial senior unsecured corporate bonds and covered bonds rated at least AA-, and debt that is issued by sovereigns, central banks, and PSEs with a risk weighting of 20% (maturity 6 month to 1 year) and listed equity securities or non-financial senior unsecured corporate bonds (or covered bonds) rated from A+ to A−, maturity ≥1 year.	50%
Long term borrowing (funding) effective maturity of 1 year or greater	100%	Loans	85%
		Net derivative: If receivables > payables	100%
All other liabilities and equity not included above	0%	Other assets	100%
		Off-balance sheet	5%

Source: BCBS, (2014)

Appendix to Chapter 5

Appendix 5.1: Descriptive Statistics

variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Observations
Ln(Z)	3.67	3.67	5.29	0	0.87	-0.56	3.36	20.2	344
CAR	0.15	0.14	0.28	0.07	0.03	1.15	4.58	112	344
TRA	0.12	0.1	0.27	0	0.06	3.88	3.53	125	344
LEV	0.08	0.07	0.24	0.02	0.04	1.56	5.63	239	344
LCR	0.87	0.7	2.89	0.04	0.57	0.92	3.38	50.7	344
NSFR	1.22	1.23	2.99	0.26	0.36	0.96	6.69	248.1	344
LD	0.96	0.88	2.15	0.17	0.33	0.93	3.96	63.08	344
LTA	17.55	17.62	21.92	11.48	2.21	-0.23	2.77	388	344
RER	2.69	2.49	4.2	0.54	1.15	-0.29	1.8	25.38	344
INF	0.06	0.06	0.14	0	0.03	0.12	3.05	89	344
LP	0.10	0.09	0.38	0.03	0.05	2.3	9.39	888	344
COF	0.04	0.04	0.25	0	0.03	6.86	91.06	1138	344
COO	0.04	0.03	0.24	0	0.04	3.59	19.97	4871	344
ROE	0.14	0.15	0.32	0	0.06	-0.21	2.85	282	344
RIR	0.06	0.03	0.39	-0.03	0.10	2.12	6.1	396	344

Ln(Z) = Natural Logarithm of Z-score; CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital Ratio; LEV = Leverage Ratio, LCR = Liquidity Coverage Ratio; NSFR = Net Stable Funding Ratio; LD = Loan Deposit Ratio; LTA = Logarithm of Total Assets; RER = Real Exchange Rate; INF = Inflation Rate (CPI); LP = Loan Price; COF = Cost of Fund; COO = Cost of Operation; ROE = Return on Equity; RIR = Real Interest Rate.

Appendix 5.2: Panel Unit Root Test: Summary

Variables	Methods							
	Levin, Lin & Chu t		Im, Pesaran and Shin W-stat		ADF - Fisher Chi-square		PP - Fisher Chi-square	
	Statistic	P-value	Statistic	P-value	Statistic	P-value	Statistic	P-value
Z-score	-8.10***	0.000	-0.688	0.245	109.15**	0.047	214.06***	0.000
CAR	-8.20***	0.000	-2.729**	0.003	123.68***	0.005	218.98***	0.000
TRA	-29.10***	0.000	-7.579***	0.000	203.22***	0.000	265.01***	0.000
LTA	-16.80***	0.000	-6.075***	0.000	201.25***	0.000	200.93***	0.000
LDR	-4.41***	0.000	-2.072**	0.019	131.76***	0.001	104.76*	0.083
LLP	-14.19***	0.000	-6.256***	0.000	185.12***	0.000	178.43***	0.000
INF	-41.89***	0.000	-11.031***	0.000	266.62***	0.000	154.65***	0.000
LCR	-12.33***	0.000	-2.084**	0.019	124.13***	0.005	149.59***	0.000
LEV	-5.30***	0.000	-0.420	0.337	102.63	0.107	156.07***	0.000
NSFR	-20.65***	0.000	-3.192***	0.001	144.22***	0.000	171.13***	0.000
LRE	-9.95***	0.000	1.028	0.848	71.65	0.867	130.30***	0.002

Notes:

1. *CAR = Capital Adequacy Ratio, TRA = Tier 1 capital to risk weighted assets, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LLP=logarithm of Loan Loss Provision, INF= Inflation (CPI), LCR=Liquidity Coverage Ratio, LEV=Leverage Ratio, NSFR=Net Stable Funding Ratio, LRE=Logarithm of Real Exchange Rate.*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

H_o = Panel has unit root

Appendix 5.3: Estimation of Resilience of Banks (Pooled OLS and Random Effect Model)

Dependent Variable: ***Ln(Z)***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Pooled OLS			Random Effects Model		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Variables	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**
Cons	2.291*** (0.000)	2.578*** (0.000)	3.364*** (0.000)	2.099*** (0.000)	2.392*** (0.000)	2.241*** (0.000)
CAR	1.324 (0.270)	-	-	6.207*** (0.000)	-	-
TRA	-	0.212 (0.753)	-	-	1.850*** (0.000)	
LEV	-	-	-2.627** (0.025)	-	-	4.964*** (0.000)
LCR	0.175** (0.016)	0.181** (0.013)	0.171** (0.018)	0.017 (0.203)	0.031 (0.279)	0.039 (0.117)
NSFR	-0.634*** (0.000)	-0.635*** (0.000)	-0.618*** (0.000)	0.035* (0.073)	0.028 (0.502)	0.052 (0.157)
LTA	0.159*** (0.000)	0.151 (0.000)	0.119*** (0.000)	0.042*** (0.000)	0.071*** (0.001)	0.063*** (0.001)
LDR	-1.053*** (0.000)	-1.021*** (0.000)	-0.959*** (0.000)	-0.001 (0.974)	0.113** (0.028)	0.114** (0.013)
RER	0.064 (0.136)	0.056 (0.194)	0.048 (0.249)	-0.052** (0.028)	-0.139*** (0.002)	-0.128*** (0.002)
INF	-2.033 (0.218)	-1.816 (0.268)	-2.001 (0.219)	-0.279 (0.173)	0.352 (0.415)	0.537 (0.161)
Adjusted R^2	0.3682	0.3661	0.3753	0.8360	0.2313	0.4251
F-statistic	29.21 (0.000)	29.21 (0.000)	30.35 (0.000)	1292.37 (0.0000)	81.97 (0.000)	176.46 (0.000)

This table reports the results of Z-score model:

Model - 1: $Z_{it} = \alpha_i + \beta_1 CAR_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$
Model - 2: $Z_{it} = \alpha_i + \beta_1 TRA_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$
Model - 3: $Z_{it} = \alpha_i + \beta_1 LEV_{it} + \beta_2 LCR_{it} + \beta_3 NSFR_{it} + \beta_4 LTA_{it} + \beta_5 LDR_{it} + \beta_6 LER_{it} + \beta_7 INF_{it} + \varepsilon_{it}$

where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, TRA = Tier 1 Capital to Risk Weighted Asset Ratio, LEV = Leverage Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:

1. *Figures in parentheses are p-values*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

Appendix 5.4: Estimation of Resilience of Banks - Breusch and Pagan Lagrangian Multiplier Test for Random Effects

	Model 1		Model 2		Model 3	
Test Summary	**Chi-Sq. Statistic**	**Prob.**	**Chi-Sq. Statistic**	**Prob.**	**Chi-Sq. Statistic**	**Prob.**
Cross-section random	779.61	0.0000	751.85	0.0000	713.76	0.0000

H_o: Pooled OLS model is appropriate

Appendix 5.5: Estimation of the Impact of Capital and Liquidity on Loan Pricing of Banks (Pooled OLS and Random Effect Model)

Dependent Variable: ***Loan Pricing (LP)***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Pooled OLS	**Random Effects Model**
Variables	**Coefficient**	**Coefficient**
Cons	-0.0019 (0.851)	0.0282*** (0.001)
TRA	0.2075*** (0.000)	0.1255*** (0.000)
NSFR	0.0143*** (0.004)	0.0093** (0.028)
COF	0.7655*** (0.000)	0.6098*** (0.000)
COO	0.6508*** (0.000)	0.4005*** (0.000)
ROE	-0.0374 (0.157)	-0.0008 (0.970)
Adjusted R^2	0.6880	0.6854
F-statistic	151.81 (0.000)	239.59 (0.000)

This table reports the results of Loan Pricing equation:

$$LP_{it} = \alpha_i + \beta_1 TRA_{it} + \beta_2 NSFR_{it} + \beta_3 COF_{it} + \beta_4 COO_{it} + \beta_5 ROE_{it} + \varepsilon_{it}$$

where,

LP=Loan Price (lending rate), TRA=Tier 1 Capital to Risk-Weighted Assets Ratio, NSFR=Net Stable Funding Ratio, COF= Cost of Fund, COO=Cost of Operation, ROE=Return on Equity.

Notes:

1. *Values in parentheses are p-values*
2. ****, ** and * denote 1%, 5% and 10% level of significance, respectively.*

Appendix 5.6: Estimation of the Impact of Capital and Liquidity on Loan Pricing of Banks - Breusch and Pagan Lagrangian Multiplier Test for Random Effects

Test Summary	Chi-Sq. Statistic	Prob.
Cross-section random	415.65	0.0000

H_o: Pooled OLS model is appropriate

Appendix 5.7: Estimation of the Impact of Loan Price on GDP (Pooled OLS and Random Effect Model)

Dependent Variable: *LGDP*
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

	Pooled OLS	**Random Effects Model**
Variables	**Coefficient**	**Coefficient**
Cons	15.160*** (0.000)	14.676*** (0.000)
LP	-8.456*** (0.000)	-1.888*** (0.004)
RIR	1.242*** (0.003)	-1.674*** (0.000)
Adjusted R^2	0.2286	0.0356
F-statistic	51.67 (0.000)	24.52 (0.000)

This table reports the results of the impact of loan price on GDP:

$Y_{it} = \alpha_i + \beta_1 LP_{it} + \beta_2 RIR_{it} + \varepsilon_{it}$

where,

Y= log real GDP, LP=Loan Price, RIR= Real Interest Rate

Notes:

1. *Values in parentheses are P-values*
2. **** and ** denote 1% and 5% level of significance, respectively.*

Appendix 5.8: Estimation of the Impact of Loan Price on GDP - Breusch and Pagan Lagrangian Multiplier Test for Random Effects

Test Summary	Chi-Sq. Statistic	Prob.
Cross-section random	889.80	0.0000

H_o: Pooled OLS model is appropriate

Appendix 5.9: Estimation of Individual (Bank) Effects (Differential Intercept)

Dependent Variable: ***Ln(Z)***
Method: Panel Least Squares
Sample: 2007 - 2014
Cross-sections included: 43
Total panel (balanced) observations: 344

Variables	Individual (Bank) Effects Coefficients
Cons	1.9293***
	(0.000)
CAR	6.2473***
	(0.000)
LCR	0.0151
	(0.223)
NSFR	0.0366**
	(0.045)
TA	0.0321***
	(0.001)
LD	0.0058
	(0.801)
RER	-0.0470**
	(0.041)
INF	-0.3132
	(0.102)
Banrisul	-0.6636***
	(0.000)
Bndes	-0.5916***
	(0.000)
Bradesco	0.5814***
	(0.000)
Safra	1.2649***
	(0.000)
Votorantim	-0.7017***
	(0.000)
Agricultural Bank	1.0180 ***
	(0.000)
Bank of China	1.8381***
	(0.000)
Construction Bank	1.3715***
	(0.000)
Development Bank China	1.0131 ***
	(0.000)
Merchants Bank	1.4444***
	(0.000)
Hua Xia Bank	0.6396***
	(0.000)
Minsheng Bank	0.6019 ***
	(0.000)

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Appendix 5.9: (Continued)

Variables	Individual (Bank) Effects Coefficients
HuiShang Bank	0.9674 *** (0.000)
Industrial and Commercial Bank	1.1295*** (0.000)
Axis Bank	0.9072*** (0.000)
Bank of India	0.5498*** (0.000)
City Union Bank	2.0289*** (0.000)
HDFC Bank	1.0658*** (0.000)
ICICI Bank	0.7327*** (0.000)
IndusInd Bank	0.0415 (0.665)
Kotak Mahindra	0.3333*** (0.001)
Panjab Bank	0.4280*** (0.000)
State Bank of India	1.4632*** (0.000)
Yes Bank	1.1709*** (0.000)
Bank ZENIT	0.3323*** (0.000)
Bank of Moscow	-0.7516*** (0.000)
Gazprombank	-1.4659*** (0.000)
Nomos Bank	0.1988** (0.017)
Promsvyazbank	0.2042** (0.014)
Raiffeisenbank	-0.2385*** (0.005)
Rosbank	-1.0132*** (0.000)
Sberbank	-0.3581*** (0.000)
Unicredit	0.3310*** (0.000)
Globex	-1.4245*** (0.000)

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Appendix 5.9: (Continued)

Variables	Individual (Bank) Effects Coefficients
MDM Bank	-1.0828*** (0.000)
Bidvest Bank	-0.7803*** (0.000)
Capitec Bank	-0.5502*** (0.000)
FirstRand Bank	0.7436*** (0.000)
Nedbank	0.9127*** (0.000)
Standard Bank	1.3976*** (0.000)
Teba (Ubank)	-0.8704*** (0.000)
Mercantile Bank	-0.2378*** (0.006)

This table reports the results of Z-score model:

$$Z_{it} = a_0 + \alpha_1 Bank_1 + \alpha_2 Bank_2 \ldots\ldots\ldots + \alpha_{43} Bank_{43} + b_1 CAR_{it} + b_2 LCR_{it} + b_3 NSFR_{it} + b_4 LTA_{it} + b_5 LDR_{it} + b_6 LER_{it} + b_7 INF_{it} + e_{it}$$

Where,

Z= Logarithm of Z-score, CAR = Capital Adequacy Ratio, LCR=Liquidity Coverage Ratio, NSFR=Net Stable Funding Ratio, LTA=Logarithm of Total Asset, LDR= Loan Deposit Ratio, LRE=Logarithm of Real Exchange Rate, INF= Inflation (CPI).

Notes:

1. *Values in parentheses are p-values*
2. ****and ** denote 1%, and 5% level of significance, respectively.*