The Implementation of Basel III in an Australian Bank: Some Corporate Governance Implications

Victoria Elizabeth Gonzalez
Bachelor of Business (Honours), Economics (Victoria University)
Graduate Certificate, Tertiary Education (Victoria University)
Masters of Business, Economics (Victoria University)

This thesis is submitted in partial fulfilment
of the requirement for the degree of
Doctor of Business Administration

College of Business
Victoria University
Melbourne
April 2016

Declaration

I, Victoria Elizabeth Gonzalez, declare that the DBA thesis entitled *The Implementation of Basel III in an Australian Bank: Some Corporate Governance Implications* is no more than 65,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Signature  Date 14/09/16

Abstract

The uncertainty in financial markets due to the global financial crisis highlights the importance of proper prudential and regulatory practices in commercial banks, and the economic and social costs that can be incurred if risk is not adequately identified and managed. To manage risk, the global community is adopting the third generation of liquidity and capital requirements developed by the Basel Committee on Banking (the Basel III standards). There is no published study focusing on the implementation of Basel III in the Australian banking system. To fill this gap, this study develops a bank asset and liability management model using goal programming for one large Australian bank, to examine the implications of a progressive move to Basel III on key financial variables – net interest income (NII), return on equity (ROE) and return on assets (ROA) – to undertake a preliminary stress testing analysis of the bank after Basel III and to consider some of the governance and policy response issues involved. The `modelling is used to investigate the impact of progressively moving to Basel III from a Basel II base case, assuming that the bank maintains current balance sheet trends, practices and corporate governance settings out to 2019.

The bank asset and liability goal programming model was also used to examine the implications of two stress scenarios: the first involves an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%, and the second involves an increase of 10% in net cash outflow and a decrease in interest income of 10%. Finally, this thesis examines possible policy responses available to the banks, guided by corporate governance, to offset some of the effects of implementing the Basel III requirements.

This study shows that the total capital required increases by 28.8% relative to the base case, taking into account the new Capital Conservation Buffer required by Basel III. Even though the new capital requirements enhance the quality of the balance sheet, they necessitate restructuring ~~of~~ the bank's balance sheet, which causes return on equity to fall by 452 basis points (26%) and return on assets to fall by 4 basis points (4.8%). These results quantify the serious challenges facing the board of directors in managing the impact of the new regulatory requirements. The results of the two stress tests confirm that under both scenarios the bank has sufficient liquidity to cover an increase of net cash outflows of 5% and 10% and still meet the minimum liquidity cover ratio of

100% and sufficient capital to cover a decrease in net interest income of 5% and 10% and only use less than 1% of the capital conservation buffer.

The model has been used to simulate two types of policy responses guided by corporate governance, which aim to offset some of the effects of implementing Basel III requirements. The first response found that each 10 basis points (bsp) increase in mortgage rates can increase return on equity by 36 bsp and increase return on assets by 3 bsp. The second response found that when funds are obtained at 5 bsp lower than the base case, the bank can increase return on equity by an average of 40 bsp and increase return on assets by 3 bsp (given the Basel III regulatory requirements, current practices of holding excess capital and liquidity, and assuming average eight year balance sheet growth trend). While the bank thus has options to attempt to restore profitability, these practices will be constrained by market pressures. Although this study confirms that the introduction of Basel III liquidity and capital requirements leads to a strengthening of the quality of the banks' balance sheet under both normal economic conditions and stress scenarios, it does so at the cost of a significant deterioration in financial performance. However, at the same time it suggests that the above proposed policy responses could help restore bank profitability close to pre-Basel III levels.

Acknowledgements

Firstly, I want to acknowledge that the purpose of life is to learn and that education is a life-long journey – not a destination.

I would like to express my sincere gratitude to my principal supervisor Professor Peter Sheehan, I feel privileged to have his guidance and support, I am forever grateful. Thank you for all the time you dedicated, the knowledge you shared, the interesting conversations and the thought provoking questions you asked, I would walk out of your office inspired and motivated to do better and make a difference in this world.

I would also like to thank my two co-supervisor, Professor Colin Clark, who has been with me in this journey from the beginning and even, given his busy schedule, has always provided me with good advice, guidance and directions. I will always treasure all the advice you have given to me, thank you for always believing in me. I am also grateful to Professor Nada Kulen who shared his knowledge in goal programming methodology, thank you for helping me and motivating me to do my best. I feel privileged to have had such amazing supervisors, who even though were extremely busy, always shared their most treasured asset in life – their time, and always had my best interest at heart and guided me in the right direction.

I thank the Director of the Victoria Institute of Strategic Economic Studies (VISES) Professor Bruce Rasmussen in providing me with all the support I needed to finish my thesis, my sincere gratitude to you. Thank you also to Margarita Kumnick from VISES for her professional advice and always being there for me, I am forever greateful.

Thank you to Dr Petre Santry, who has being with me in this journey sharing her wealth of knowledge and expertise in so many areas. A special thanks to Pete Symons, for proofreading the final version of the thesis.

Last but not least; I would like to thank my amazing family, especially my supportive husband Cristo and my two sons Cristo Junior and Kevin for their unconditional love and support. I would also like to thank Clorinda, Gordon and Lynette for always being there me.

The journey to finish my thesis has been one of the most rewarding journeys I have undertaken; I am grateful for all the lessons I have learned, both academic and personal and the amazing colleagues and friends I have meet along the way, who have supported me directly or indirectly, and even though there are too many to mention here, will never be forgotten.

Table of Contents

List of Tables

List of Figures

Acronyms

ABA	Australian Bankers Association
ABS	Asset-backed security
ABS	Australian Bureau of Statistics
ADI	Authorised deposit-taking institution
AFIC	Australian Financial Institutions Commission
ALM	Asset and liability management
ANZ	Australia and New Zealand Banking Group
APRA	Australian Prudential Regulation Authority
ASIC	Australian Securities and Investments Commission
ASX	Australian Securities Exchange
B2	Basel II Liquidity and Capital Regulatory Requirement
B3	Basel III Liquidity and Capital Regulatory Requirement
BALM	Bank asset and liability management
BCBB	Basel Committee on Banking Supervision
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CACG	Commonwealth Association for Corporate Governance
CCB	Capital conservation buffer
CET1	Common equity capital tier 1
CFPs	Contingency funding plans
CG	Corporate governance
CLERP	Corporate Law Economic Reform Program
CLF	Committed liquidity facility
COSO	Committee of Sponsoring Organizations
FAI	Financial accounting information
FSB	Financial Stability Board

FTP	Funds transfer pricing
GFC	Global financial crisis
GP	Goal programing
HQLA	High quality liquid assets
LCR	Liquidity coverage ratio
LMIS	Liquidity Management Information Systems
LP	Linear programming
LTP	Liquidity transfer pricing
MCEC	Minimum common equity capital
MLH	Minimum liquidity holdings
MIP	Multiple integer programing
NII	Net interest income
NSFR	Net stable funding ratio
OBS	Off-balance sheet
OECD	Organisation for Economic Co-operation and Development
RBA	Reserve Bank of Australia
ROA	Return on assets
ROE	Return on equity
RWA	Risk weighted assets
VaR	Value at risk
WB	World Bank

Chapter 1
Introduction

1.1 Introduction

The 2007-08 global financial crisis (GFC) clearly demonstrated that the prevailing Basel II capital regulatory requirements for banks were inadequate to prevent an international financial meltdown. To avoid further financial crises leading to panic in the financial sector, in 2013 the Basel Committee on Banking Supervision within the Bank for International Settlements (BIS) began to phase in Basel III liquidity and capital requirements (the full implementation will be in 2019) in order to: (i) improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source; (ii) improve risk management and governance; and (iii) strengthen banks' transparency and disclosures (BIS 2016). However, although these requirements will help strengthen the banks' liquidity and capital position, the resulting higher costs may reduce banking performance. Furthermore, banks' restructuring of the balance sheet in order to comply with these new requirements may reduce their ability to extend credit, which in turn could reduce economic activity.

Even though the new Basel III liquidity and capital requirements are expected to enhance bank stability (Littrell 2011a), this new policy raises serious questions for the boards of directors in managing the new regulatory requirements and their impact on the bank risk management framework, structure and quality of the balance sheet, and financial performance in a way that causes minimal impact on all stakeholders. Taking these concerns into account, this thesis presents evidence about the level of impact that Basel III liquidity and capital requirements will have on the forward-looking balance sheet structure and banking performance related to net interest income (NII), return on equity (ROE) and return on assets (ROA). Therefore, in order to analyse the impact of Basel III liquidity and capital regulatory requirements on balance sheet structure and financial performance of a bank (NII, ROE and ROA), this thesis develops a bank ALM (BALM) goal programming model using a case study approach based on an Australian bank. This ALM (ALM) model is used for conducting stress tests under the Basel III framework and for simulating the implementation of possible policy responses guided by governance.

The GFC highlighted the importance of conducting stress tests (Bilston and Rodgers 2013) at both micro and macro levels to assess vulnerabilities facing both banks and the financial system as a whole. However, the results of these tests are usually kept confidential, because they 'allow supervisors to probe vulnerabilities among financial institutions using more severe scenarios without creating unnecessary public concern about unlikely events' (RBA 2011, p. 19). However, after the financial crisis, supervisors in some jurisdictions have published the results of industry-wide stress tests with the aim of reducing uncertainty about the soundness of the banking system at a macro level. While the GFC highlighted the importance of adequate stress testing, it is important to note that such models often use either historical data or unrealistic assumptions to underpin the model. For example, Borio et al. (2013) have emphasised two sets of limitations: the technical aspects of the approach model used to simulate financial distress; and the broader context in which the stress tests are run.

In the same context, this thesis aims to contribute by conducting stress tests in an individual bank using the BALM model (assuming that Basel III has been fully implemented) for two scenarios: (i) an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%; and (ii) an increase of 10% in net cash outflow and a decrease in interest income of 10%.

Following the stress tests, the BALM model (assuming that Basel III has been fully implemented) is used to test possible responses to challenges banks are now facing under the increased liquidity and capital requirements of Basel III. In response to these challenges, corporate governance strategies may include an increase in interest rates, a reduction of interest rate expenses and operational costs, and additional funds obtained from shareholders in order to enhance financial performance. As raising interest rates and reducing interest rate expenses are the most significant variables affecting banking performance in NII, ROE and ROA, this thesis tests the implementation of three corporate governance strategies through: (i) increasing interest in mortgage loans; (ii) essentially reducing interest in obtaining funds; and iii) using a combination of strategies 1 and 2. In order to compare the effectiveness of these three strategies, this thesis then simulates the relative impacts of five possible increases in interest rates for mortgage loans.

Even though the proposed corporate governance strategies may be challenging to implement, at the time of submitting this thesis, banks were already starting to implement the proposed corporate governance strategies. The corporate governance recommended strategies used in this thesis are fully supported by the recent announcements made by all four major banks in Australia. Even though the Reserve Bank of Australia (RBA) has not yet made any announcement on rate changes, the four major banks have independently raised their interest rates on mortgage loans and reduced their base rate on some of its online savings accounts, in order to enhance profitability and cover increases in costs resulting from changes in regulatory requirements.

This chapter provides an overview of the social implications and lessons from the GFC, followed by an overview of the Australian regulatory framework and the Basel I, II and III regulatory requirements. In this chapter, an overview of the role of corporate governance in the context of risk management will also be discussed, including major mechanisms of good corporate governance in order to establish a connection between corporate planning and governance, risk management, financial planning, and ALM. This will assist in identifying the major challenges that banks face in a multidisciplinary environment, and reveal simulation techniques that are optimal for measuring and managing risk uncertainty in banks. Since the literature is vast and crosses several disciplines, every attempt is made to include the major scholarly contributions in these areas.

1.2 Background of the Problem: Implications of the 2008 Financial Crisis

During the 2007-2008 GFC which began in the U.S., financial institutions such as Lehman Brothers failed to allocate capital and manage risk, leading to emergency legislation for government bailouts and purchases of troubled financial firms' assets by the government, costing the U.S. US$1.5 trillion (Yiannaky 2012). Clearly, this challenges the assumption that markets are efficient self-organising systems and are able to achieve allocative efficiency. As Stiglitz (2010) pointed out, this financial crisis has clearly demonstrated that banks' short-term behaviours of excessive risk-taking in the pursuit of high profits result in excessive financial risk being transferred to the government. This, in turn, affects government budget policies and increases risk expenditure at the cost of tax payers, as banks privatise their profits and socialise losses.

The GFC clearly demonstrated that excessively risky behaviour in banks can lead to a contagion of bank failure and economic recession, which results in worldwide economic insecurity. As Stiglitz (2010) predicted – with the U.S. and Europe being in the midst of a significant economic slowdown, the gap between actual and potential outputs increased.

The GFC clearly demonstrated that excessively risky behaviour in banks can lead to a contagion of bank failure and economic recession, and worldwide economic insecurity. As Stiglitz (2010) predicted – with the U.S. and Europe being in the midst of a significant economic slowdown, 'the gap between what output would have been had there not been a crisis, and what is actually produced – will almost surely amount to in excess of several trillion dollars before the economy recovers' (p. 1). In fact, even two years after the financial crisis (2010) many countries had not yet recovered, with unemployment rates at 9.4% in the U.S., 10.1% in France, 7.9% in the United Kingdom, 20.33% in Spain and 11% in Greece (DILC 2010). As a result, consumption further declined, causing many more companies to reduce production or shut down, which had led to an ever-increasing financial stress and deterioration of living standards. Kapp and Vega (2012) found that extreme crisis episodes, occurring with 1% probability, can lead to losses between 2.95% and 4.45% of world GDP. Their findings demonstrate that financial institutions and markets play a vital role in economic prosperity. Thus, the financial crisis described by Stiglitz (2010) not only caused economic problems, but social problems as well.

Other financial collapses, including HIH Insurance, Enron and WorldCom can now be viewed as fairly small compared to the recent spate of U.S. bank failures (including Silver State Bank, Ameribank, Washington Mutual Bank and many others that led to the GFC). This demonstrated the need for improved corporate governance, particularly in the banking sector (FDA 2011). According to Busman and Smith (2001), these collapses were linked to failures in corporate governance, risk management, lack of appropriate financial management, inadequate financial accounting information and inappropriate control systems. Rezaee (2009) further confirmed that the implementation of good corporate governance practices not only reduces risk for investors, but attracts investment capital and improves corporate performance. In the case of Australia, even though it has largely managed to avoid being adversely affected by these crises, the

importance of taking a pro-active approach to managing the financial position and risk of banks is clear. A recent study by Banerjee (2013) quoted Sir Adrian Cadbury (cited in UK Commission Report: Corporate Governance, 1992):

> *Corporate governance is concerned with holding the balance between economic and social goals and between there to encourage the efficient use of resources and equally resources. The aim to align as nearly as possible the interest of individuals, corporation and society.*

These experiences highlighted the importance of taking a proactive approach to managing the financial position of banks; therefore this thesis investigates the role that corporate governance, particularly risk management, plays in minimising the possibility of future failure in Australian banks. Since banks are confronted with risk at many levels, both inside and outside the business, including strategic, financial, operational and legal risk management, systems must be flexible in their ability to cope. Thus, in order to deal with all these threats, this thesis investigates the role of good corporate governance and how, by implementing appropriate risk management strategies to financial management, banks can develop efficient ALM strategies.

1.2.1 Lessons from the 2008 Global Financial Crisis

Stiglitz noted that 'the lessons from the U.S. are relevant in many other parts of the world [as] similar risks are arising elsewhere' (2010, p. 333). In addition, the GFC has resulted in a re-examination of corporate planning and the corporate governance practices of liquidity and capital risk management in banking. The Basel Committee on Banking Supervision (BIS 2012) stated that many banks had failed to conduct adequate stress testing based on the possibility of inter-bank and larger market contraction, as well as put in inadequate contingency funding plans (CFPs) in place. Similarly, the Financial System Inquiry: Final Report (Treasury 2014) found that the financial crisis exposed significant weaknesses in corporate governance specifically in risk management, across the financial services industry.

Numerous studies (Stiglitz 2010; Nilson 2012; Banerjee 2013) have confirmed that the one main factor contributing to the financial crisis was the failure of corporate governance risk management mechanisms. Key issues are: misaligned risk tolerance (Vasudev et al. 2012), low levels of liquidity (Viral 2012), low levels of capital (Viral

2012); excessive leverage and risk taking, excessive bonus payments to executives, complex derivative instruments, (Vasudev et al. 2012); self-interest culture where the concerned players act without any regard for social welfare (Krisnaswami 2011; Iannuzz & Berardi 2010); and inappropriate use of securitization (Iannuzzi & Berardi 2010; Shiller 2008; Minton et al. 2009). These findings suggest that this is a public concern and that paradigm shift from traditional risk management is essential, particularly the role that corporate governance plays in developing risk management policies that minimise the possibility of risk failure in Australian banks by using an analytical framework that integrates corporate planning and corporate governance mechanisms and, at the same time, takes into consideration the stochastic nature of the current economic environment.

1.2.2 Corporate Governance Role

Mullineux (2007b) claims that corporate governance is important as well-governed banks are more likely to allocate capital efficiently and less likely to experience failure. Furthermore, bank success ensures monetary and financial stability, and help to achieve national economic objectives. In addition, the internal corporate governance mechanisms of banks are also subject to external governance mechanisms such as regulation and supervision. Even prior to the GFC, it has been suggested that governance mechanisms have the ability to reduce the expropriation of banks' resources and promote bank efficiency (Bessis 2010).

The financial crisis has called into question many traditional ways of thinking about corporate governance. A study conducted by Banerijee (2013) analysed the evolving issues in corporate governance by reviewing the related literature in the area of principles, policies and practices of corporate governance. The literature shows that the effective corporate governance reduces the ownership and control problems to a large extent, also that the existence of strict corporate governance laws does not ensure complete eradication of corporate failures, and finally that proper implementation together with social policies and high standards of corporate values and ethical behaviour will help minimize corporate governance failure.

1.3 Background: The Financial System and the Banking Sector

Contemporary society relies on banks to obtain funds from surplus units and transfer them into deficit units, in order to function and maintain stability in governments, small and large businesses and households (McGrath & Viney 1997), and hence supports the efficient function of the economy. However, according to Mullineux (2007b), banks are prone to instability due to the combination of information asymmetry that can result in systematic banking crises that are extremely costly to taxpayers, who ultimately fund banking capitalisation.

Uzan (2012) defines a stable financial system as one where financial institutions and market infrastructures facilitate the smooth flow of funds between savers and investors. Therefore, regulators are responsible for maintaining the stability of the financial system by using policies that prevent economic crisis. This implies that the role of regulation is to maintain low inflation, ensure the payment system is safe, maintain an influence on regulatory arrangements, maintain stable developments of financial markets, and build national and international confidence in the domestic financial system. The major aim of the financial system is to facilitate the interaction between savers or providers and users of funds (Johannes 2014).

Other economic functions of financial intermediaries are to minimise the cost of obtaining funds, monitoring borrowers, pooling risk and creating liquidity to allocate the savings to borrowers, as well as contributing to the welfare of individual and society (Valentine 1991). Thereby, the financial system is a critical and essential part of the economy, for efficiency of the financial system serves as a vehicle to achieve the macro and microeconomic objectives of a nation. In addition, a major aim of the financial system is to facilitate the interaction between savers or providers and users of funds. As explained by McGrath and Viney (1997), ‘The financial system’s function is to bring together lenders (suppliers of funds) and borrowers (demanders of funds)’ (p. 6). Banks are an integral part of this complex system. Therefore, a properly designed financial model of a financial institution should incorporate corporate governance models, risk management models, economic valuation model, accounting models and finance models.

The above discussion demonstrates that the financial system is critical to the operation of the overall economy, due to its inter relationship to every other sector (McGrath & Viney 1997). The importance of efficiency in the financial system can also serve as a vehicle to help achieve the macro and microeconomic objectives of a nation. The Australian Prudential Regulation Authority (APRA), Australian Security and Investments Commission (ASIC) and the Reserve Bank of Australia (RBA) are the major regulators responsible for ensuring the stability and efficient operation of the financial system (Lange et al. 2007). This is the current regulatory regime which was implemented following the Wallis Inquiry (Colm 1997) into the efficiency of the financial system in 1997. In addition, in Australia regulation is also the product of international agreements via the Bank for International Settlements (BIS). Prudential regulation and requirements (including Basel II and III liquidity and capital requirements) ensure that management of financial institutions make prudent decisions that minimise institutional failures and protect depositors.

The Australian financial system is a relatively closed oligopolistic structure (McTaggart et al. 2007; Sathye 2005). The Australian banking system is dominated by four main banks: Westpac, Commonwealth, National Australia and ANZ. The government's objectives, during the late 1980s, as explained by the Campbell Inquiry (1981) and Martin Inquiry (1992), was to deregulate the financial system to increase competition, thereby encouraging improvements in allocative efficiency, dynamic efficiency and operational efficiency. The inquiries also concluded that the net effect of these changes has been a transformation in the Australian financial system from a relatively closed, oligopolistic structure in the 1950s and 1960s, based predominantly on traditional bank intermediation, to a more open and competitive system, offering a much wider range of services from an array of different providers (Edey & Gray 1996).

1.3.1 Australian Financial System Inquiries

There have been four major inquiries into the Australian financial system: the Royal Commission (1937), the Campbell Inquiry (1981), the Martin Inquiry (1991) and the Wallis Inquiry (1997). All of these inquiries aimed to learn from the past and provided recommendations targeted at enhancing the efficiency of the financial system. The Royal Commission (1937) came in at the wake of the Great Depression and sought to control credit to stabilise the economy. During the 1980s, the financial system was

deregulated, encouraging Australian banks to compete against each other (Valentine 1991). The Campbell Inquiry (1981) based its recommendations on the assumption that free market forces would determine the best outcome. Based on this assumption, little government interference in the financial sector would produce best results for the community. Furthermore, the promoting of competition in the financial market would allow the 'invisible hand' to promote an efficient allocation of resources and improve operational efficiency, dynamic efficiency and information efficiency. Financial deregulation is driven by government concern for improvements in the operation of the financial systems, and maintains control over real economic activity through the financial system (Valentine 1991). The Wallis Inquiry's recommendations are summarised as follows (Wallis Inquiry 1997, p. 20):

- *financial regulation to be at federal level;*
- *APRA to be separate from the RBA;*
- *RBA retains responsibility for overall system stability;*
- *APRA has responsibility for prudential supervision;*
- *regulation to be proactive not reactive;*
- *regulators are equipped for market volatility;*
- *capital ratios the tool to protect depositors;*
- *harmony with international regulation; and*
- *costs to be low and transparent.*

These recommendations all aim to enhance systemic stability, as when the system fails there are serious consequences. For example, bank depositors can lose their savings or the bank payment system can stall with borrowers being starved of funds. As banks are highly interconnected, the failure of one bank could cause run-ons to other banks. This kind of contagion is unique to financial institutions and usually results from depositors make a 'run' on their banks or (retail) interbank settlements fail (wholesale). Therefore, to maintain system stability regulators need to prevent initial bank failures and prevent one failure spreading to others (Valentine et al. 1991).

1.3.2 The Financial System Inquiry

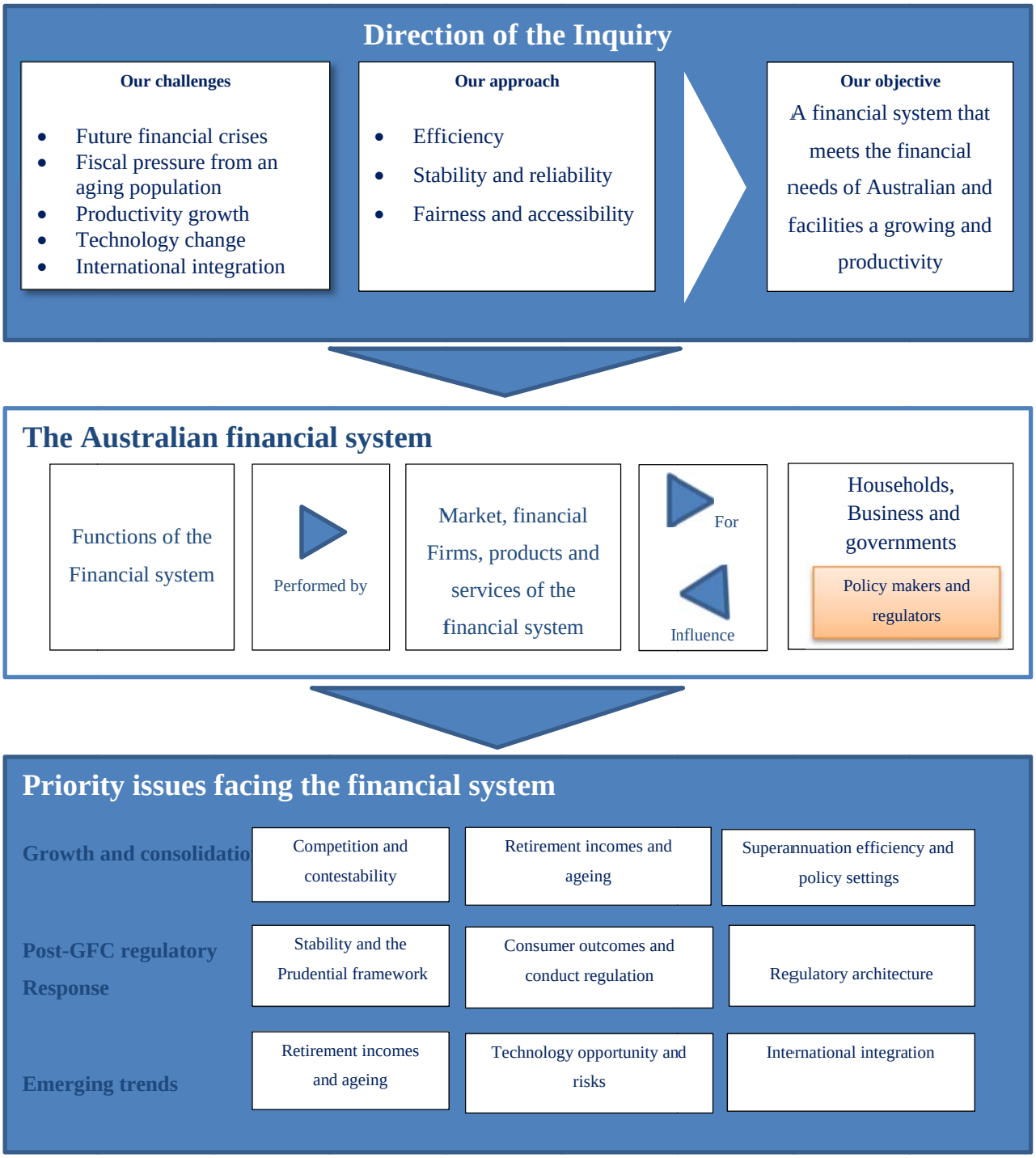
Following the GFC, the Financial System Inquiry was set up by the Australian Government to look at the changes needed for Australia's financial system to provide efficient access to finance while remaining stable, low risk, fair and accessible. The findings of this inquiry aimed to set out a blueprint for the financial system over the next decade. The findings of this inquiry stated that the financial system was operating effectively and did not require substantial change, as 'although tested during the global financial crisis' Australia's financial system performed well in most respects relative to its international counterparts (Treasury 2014, p. 1). Furthermore, the Australian economy is predicted to face a number of opportunities and challenges in the coming decades which may lead to:

- A future fiscal crisis: History has demonstrated that financial crises can and will occur at significant cost to the economy. Although we cannot predict their cause or timing, our financial system framework should reduce the likelihood and impact of such events (Treasury 2014, p. 1).
- International integration: Although Australia's key financial relationship remain with Europe and the U.S., the weight of global economic activity is shifting towards Asia. This trend presents opportunities and risk for Australia (Treasury 2014, p. 1).

The direction of the Financial System Inquiry is shown in Figure 1.1 below, which highlights the challenges facing the Australian financial system including future financial crises, fiscal pressures from an aging population, productivity growth, and technological changes and integration. The approach taken by the inquiry to answer these challenges is to focus on efficiency, stability, reliability, fairness and accessibility, with the objective that the role of the financial system meets the financial needs of Australians and facilitates a growing and productive Australian economy. The top issues facing the Australian financial system are growth and consolidation, competition and contestability, funding Australian economic activities, superannuation efficiency and policy settings. The second issue is the post GFC regulatory response including stability and the prudential framework, consumer outcomes, conduct regulation and regulatory architecture. The third issue is emerging trends including retirement incomes

and the aging population, technology opportunities and risks, and international integration.

Figure 1.1: High Priority Issues Facing the Australian Financial System



Source: Treasury (2014, p. 16).

The Financial System Inquiry (Treasury 2014) pointed out that the GFC has provided many lessons about the global financial system, including the fact that:

> *…complexity and interconnectedness was greater than appreciated; many global financial institutions had too little capital to withstand a large shock; moral hazard was prevalent; liquidity can disappear in a crisis; and there was a lack of focus on system-wide risk. In response, governments and regulators implemented, or will implement, a number of international and domestic policy reforms' (p. 205).*

The Financial Systems Inquiry highlighted that:

- *During the CFC, significant government actions in a number of countries, including Australia, entrenched perceptions that some institutions are too big to fail. These perceptions can be reduced in Australia by making it more credible to resolve these institutions without Government support.*
- *A number of jurisdictions have implemented new macro-prudential toolkits to assist with managing systems risks. The effectiveness of these for a country like Australia is not yet well established, and there are significant, practical difficulties in using such tools.*
- *Australia has implemented some aspects of global prudential framework earlier than a number of jurisdictions. It has also used national discretion in defining capital ratios. When combined with others aspects of the prudential framework and calculated on a consistent basis, Australian banks' capital ratios (common equity tier 1) are around the middle of the range relative to other countries. However, differences such as those in definitions of capital do limit international comparability.*
- *To contribute to the effectiveness of the financial system, sound corporate governance requires clarity of the responsibilities and authority of boards and management. There are differences in the duties and requirements of governing bodies for different types of financial institutions and, within institutions, substantial regulator focus on board has confused the delineation between the role of the board and that of management. (Treasury 2014, p. 205)*

The Financial System Inquiry report supports sound corporate governance as a mechanism to reduce moral hazard and therefore reduce the probability of financial contagion. In the context of this thesis, good corporate governance risk management policies is based on the new Basel III framework, however the regulatory duty of the board of directors is to have adequate risk management policies that ensure the bank's compliance with Basel III minimum liquidity and capital regulatory requirements (Laughlin 2015). Non-regulatory risk management policies in banks are based on industry practices, which include corporate governance policies to: (i) hold excess capital equal to 4.8%, based on industry practice; and (ii) hold more than the minimum of 100% of liquidity cover ratio (APRA 2012b; APRA 2015, p. 16). In the context of this thesis, both regulatory and non-regulatory corporate governance policies are implemented in the bank ALM model. Holding additional capital is important because:

> *…increased capital requirements reduces the likelihood for institutional failure, furthermore that it gives a greater capital buffer to systemically important banks, whose collapse would cause significant damage to financial markets and the economy. Higher capital also helps to ameliorate the effects generated by perceptions of an implicit guarantee (Treasury 2014, p. 217).*

Another important undeclared problem faced by major Australian banks is exposure to derivatives, including the OTC derivatives (Lowe 2015). However, the Financial System Inquiry highlighted that since Australia's 2014 G20 summit addressing the 'too big to fail' issue, the OTC Derivatives Regulators Group has been working to address the cross-border implementation issues identified in its report to the G20 Summit (p. 53).

1.4 Basel Committee on Banking Supervision

As previously discussed, throughout the 1980s and 1990s Australia experimented with banking and financial deregulation. However, the Basel Committee on Banking Supervision (Basel Committee) was formed in 1974, when regulators from the G10 countries began meeting in the offices of the Bank for International Settlements (BIS) to share information about approaches to bank supervision (Chorafas 2007). This Committee provided a forum for regular, ongoing cooperation about banking matters as the primary global standard-setter for the future prudential regulation of banks. Its

mandate is to strengthen the regulation, supervision and practices of banks worldwide, with the purpose of improving and enhancing financial stability. Its objective is to the improve understanding of key supervisory issues and increase the quality of banking worldwide. However, although its committee formulates supervisory standards and guidelines, and recommends statements of best practice in the expectation that individual national authorities will implement them, committee decisions have no legal force. In Australia, the government body responsible for setting Basel standards and monitoring their implementation is APRA.

1.4.1 Basel I and Basel II Requirements

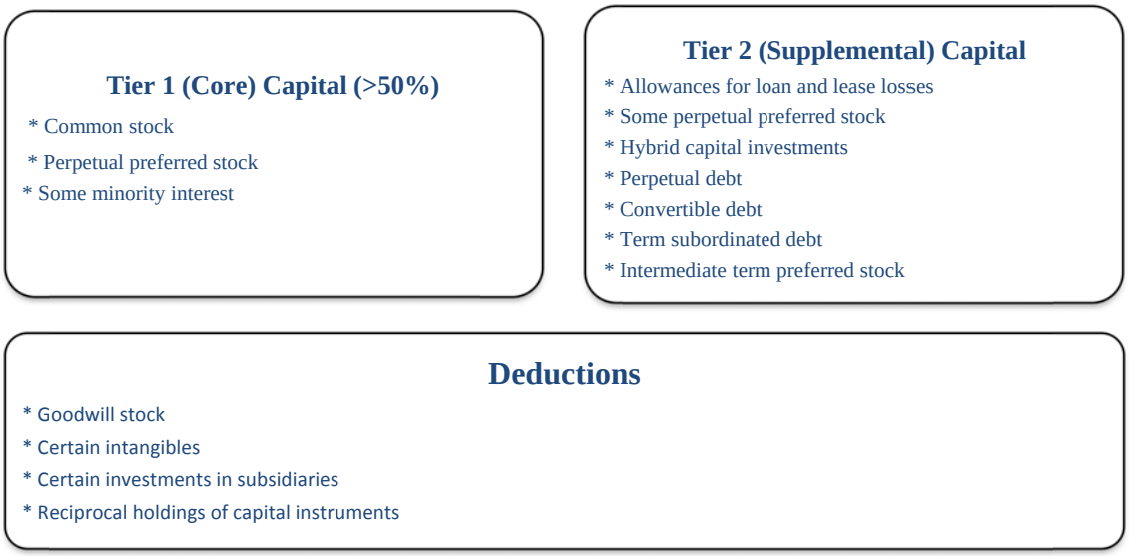
In December 1987, a capital measurement system, referred to as the Basel Capital Accord (Basel I) was approved by the G10 Governors and released to banks in 1988 (see Figure 1.2). The main feature of Basel I was the minimum capital standard set at 8% of risk-weighted assets, calculated on a common basis. Risk weights were differentiated solely by the class of lending – unsecured versus residential real estate secured versus commercial lending (Cortez 2011). However, dissatisfaction with the original Basel Accord led to plans to replace it with an upgraded version – Basel II. In response to the 2007-2008 financial crisis, enhancement of the Basel II framework related to securitisation was realised, and banks were expected to comply with the revised requirements by 31st December 2010. These changes to Pillar 1 included: resecuritisation of risk weights; standard risk weights; use of ratings subject to self-guarantee; operational requirements for credit analysis; liquidity facilities in the standard approach; and general market disruption LFs in the standard and IRB approaches (BIS 2009, p.1).

As pointed out by Edey (2011) in essence, its new focus was to broaden the scope of risk coverage and bring in some flexibility to accommodate the differences between banks' business models and their sophisticated risk management strategies. As Edey (2011, p. 2) explained, Basel II:

> *Introduced the three-pillar structure into the prudential framework, those pillars being the minimum capital standard, supervisory oversight, and disclosure. So the framework was expanded beyond a simple reliance on the minimum capital ratio.*

Introduced a framework of capital requirements to cover operational and other risks. In that way it is recognised that credit quality was not the only source of risk that needed to be backed by capital, and allowed flexibility for sophisticated banks to determine some of their capital requirements using model-based inputs rather than fixed weight.

Figure 1.2: Regulatory Capital Defined



Source: Cortez (2011, p. 194).

As stated by Edey (2011, p. 2), Basel I and Basel II standards did not prevent the GFC, and neither did the existing web of nationally-based regulations adhered to in the major economies. However, he explained that some of the lessons that can be learned from the 2008 financial crisis are that:

Banks need to be made more robust to liquidity risk; loan underwriting standards need to be improved; governance arrangements for banks and financial regulators need to be improved; various forms of conflict of interest need to be eliminated or better managed. Examples of that include the originate-and-distribute lending model that went seriously off-track in some countries, and the role of rating agencies in advising on structured securities. It also include badly structured remuneration practices in the industry; and there needed to be more scope for regulatory regimes to act against the build-up of financial excess (Edey 2011, p. 3).

1.4.2 Basel III Capital and Liquidity Requirements

Many authors have argued that Basel II did not prevent the financial crisis (Stiglits 2010; Edey 2011; Merzaniz 2013). In November 2010, the G20 endorsed Basel III, with the aim to overcome the limitations of Basel I and II. Acknowledging the shortcomings of Basel I and Basel II, in 2013 the Basel Committee on Banking Supervision within the BIS began to phase in Basel III liquidity and capital requirements (full implementation will be in 2019) in order to: (i) improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source; (ii) improve risk management and governance; and (iii) improving banks' transparency and disclosures (BIS 2016). The following sections will discuss the key capital and liquidity requirements (see also Figure 1.3).

The APRA publication *Capital Adequacy: Measurement of Capital* (2012e) outlined the new Basel III regulatory framework, which raises the level and quality of regulatory capital in the global banking system (Basel III), to provide an additional layer of capital requirement based on the state of the credit cycle as set by national regulators. The intention was that regulators adjust the buffer so as to have a countercyclical influence raising capital in good times, and then releasing it to support lending when credit is tight (APRA 2012a). Under the existing prudential framework, there are four categories of capital: fundamental Tier 1 capital, residual Tier 1 capital, upper Tier 2 capital and lower Tier 2 capital (APRA 2012a). Under Basel III, these categories are to be replaced with a Tier 1 capital that consists of common equity, Tier 1 capital, and additional Tier 1 and Tier 2 capital (APRA 2012a).

The APRA publication *Implementing Basel III Liquidity Reforms in Australia* (2013a) presented a new regulatory framework to introduce mandatory requirements for a rise in the level and quality of regulatory liquidity in the global banking system. As liquidity regulations aim to force institutions to hold liquid assets that meet larger-than-normal withdrawals, the new Basel III contains two liquidity requirements. First, the liquidity coverage ratio (LCR) aims to improve short-term resilience of a bank's liquidity risk profile by ensuring that it has sufficient high quality liquid assets (HQLA) to survive a significant stress scenario for a minimum of thirty calendar days. Second, the net stable funding ratio (NSFR) requirement aims to strengthen the long-term resilience of an authorised deposit-taking institution (ADI) by requiring it to maintain a sustainable

maturity structure of assets and liabilities on an ongoing basis. As proposed in the implementation of Basel III liquidity reforms (APRA 2013a), banks are required to demonstrate that they have taken all reasonable steps towards meeting their LCR and NSFR requirements through their own balance sheet, before relying on the RBAs facility.

Figure 1.3: Basel III Phased-in Arrangements

Basel Committee on Banking Supervision

BANK FOR INTERNATIONAL SETTLEMENTS

Basel III phase-in arrangements

(All dates are as of 1 January)

	Phases	2013	2014	2015	2016	2017	2018	2019
Capital	Leverage Ratio		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015				Migration to Pillar 1	
	Minimum Common Equity Capital Ratio	3.5%	4.0%		4.5%			4.5%
	Capital Conservation Buffer				0.625%	1.25%	1.875%	2.5%
	Minimum common equity plus capital conservation buffer	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
	Phase-in of deductions from CET1*		20%	40%	60%	80%	100%	100%
	Minimum Tier 1 Capital	4.5%	5.5%		6.0%			6.0%
	Minimum Total Capital				8.0%			8.0%
	Minimum Total Capital plus conservation buffer		8.0%		8.625%	9.25%	9.875%	10.5%
	Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital		Phased out over 10 year horizon beginning 2013					
Liquidity	Liquidity coverage ratio – minimum requirement			60%	70%	80%	90%	100%
	Net stable funding ratio						Introduce minimum standard	

* Including amounts exceeding the limit for deferred tax assets (DTAs), mortgage servicing rights (MSRs) and financials.

– – transition periods

Source: http://www.bis.org/bcbs/basel3.htm

1.4.3 Possible Limitations of Basel III

Basel III is a direct response to the 2007-2008 financial crisis, and even though it presents a significant milestone in the development of uniform capital requirements, it also assists in the correction of flaws in Basel I and II by including a BCBS regime that incorporates liquidity requirements and a number of macro-prudential tools directed at reducing systematic risk. However, it is important to note that the global financial crisis has reinforced pre-existing beliefs in the weaknesses of the Basel II Accord. For example, Moosa (2011) highlighted that the capital-based regulation and Basel-style capital regulation could not deal with financial crises, and that attention needed to be paid to liquidity and leverage due to a one-size-fits-all approach not being the solution. Hence, Moosa suggested that as it may not be possible to salvage Basel II, the way forward could be to abandon the idea of uniform international capital regulatory requirements (p. 1). Pointing out another limitation of the existing capital adequacy framework, King and Tarbert (2011) emphasised that the assessment of risk arising from on- and off-balance sheet transactions and derivatives-related exposures in banks was particularly apparent, and even though the Basel Committee believed that increased capital and liquidity requirements would strengthen banks across-the-board, these efforts had not yet fully addressed the systematic risk posed by institutional interconnectedness and financial institutions perceived to be too-big-to-fail. Adding to these issues, Hoening (2013) pointed out that:

> *If the Basel risk weight schemes are incorrect, which they often have been, this too could inhibit loan growth, as it encourages investments in other more favourably, but incorrectly, weighted assets. Basel systematically encourages investments in sectors pre-assigned lower weights – for example, mortgages, sovereign debt, and derivatives – and discourages loans to assets assigned higher weights – commercial and industrial loans. We may have inadvertently created a system that discourages the very loan growth we seek, and instead turned our financial system into one that rewards itself more than it supports economic activity. (p. 5)*

While there is no doubt that Basel II did not prevent the GFC and that the new Basel III is currently in the process of being fully implemented with no guarantee of preventing any future financial crises, regulation of any kind cannot be static; it needs to be

dynamic in order to evolve to address any current or future issues that may arise. However, although the effectiveness of Basel III will remain an ongoing debate, this thesis focuses on how the new Basel III liquidity and capital regulatory requirements will impact on the balance sheet structures, financial performance and possible corporate governance responses that banks may undertake to offset any negative impact on profitability.

1.5 Good Corporate Governance Principle: Risk Management

As discussed above, the literature highlights that one of the main causes of the 2008 financial crisis was a failure in corporate governance, particularly with the implementation of risk management in ALM in banks (Bunea 2013). Since the role of corporate governance is to manage the relationships between stakeholders in order to determine a firm's direction (Bushman & Smith 2001), the implementation of good corporate governance principles can reduce the probability of failure.

In the context of this study, corporate governance is applied from a risk management and firm performance perspective due to agency issues. Hirschey (2009) stressed that corporate governance mechanisms and controls are designed to reduce agency problems that arise from different configurations of asymmetric information, adverse selection and moral hazard. Hirschey further explains that:

> *…adverse selection arises before contracting when there is asymmetric information about the contracting agent's type, and moral hazard surfaces when the asymmetric information is about the actions of the manager after contracting. (2009, p. 121)*

Risk is inherit and omnipresent, and 'you cannot get away from it' (Fame 2003, p. 2). The literature has provided many examples where risk is biased towards the negative: 'risk is the chance of injury, damage or loss; a hazard' (Chorafas 2007, p. 9). Conceptual economic idealism differentiates risk as being a separable category from uncertainty. As explained by Knight (1921), it is important to make a distinction between risk and uncertainty: 'uncertainty is where it is not possible to calculate chances, therefore probabilities cannot be assigned to an event, whereas risk should be regarded as a known chance' (Knight 1921, p. 21).

Ultimately, the future is uncertain, in the sense that it cannot be quantified.

> *The purpose of risk management is to improve our understanding of the future, not just to explain the past…The problem with the future, of course, is that no one knows exactly what it will be. (Knight 1921, p. 6)*

Since risk is unavoidable, it is important to consider that:

> *…the goal of risk management is to achieve the best possible balance of opportunity and risk. Sometimes achieving this balance means exposing yourself to new risks in order to take advantage of attractive opportunities. (Knight 1921, p. 69)*

The goal of risk management as described by Blake (2003, p. 58) is that 'risk management is the practice of protecting an organisation from financial harm'. However Fama (2003, p. 29) pointed out that 'if you approach risk management as a discipline…you are concerned with the opportunity for gain as well as loss'.

Managing risk is important for any organisation. The document published by APRA on January 2015, entitled 'Prudential Standard CPS 220 Risk Management' (APRA 2015c), clearly highlights that it is the responsibility of the board of directors of an APRA-regulated institution to have a risk management framework that is appropriate to the size, business mix and complexity of the institution or group it heads. The risk management framework must also be consistent with the institution's strategic objectives and business plan. As outlined by APRA, the institution must:

- *have a risk management framework that is appropriate to its size, business mix and complexity;*
- *maintain a Board-approved risk appetite statement;*
- *maintain a Board-approved risk management strategy that describes the key elements of the risk management framework that give effect to its approach to risk management;*
- *have a Board-approved business plan that sets out its approach for the implementation of its strategic objectives;*
- *maintain adequate resources to ensure compliance with this prudential standard; and*
- *notify APRA when it becomes aware of a significant breach of, or material deviation from, the risk management framework, or that the risk management framework does not adequately address a material risk. (APRA, 2015f, p. 1)*

The importance of an effective risk governance framework was outlined in the 2009 OECD report, 'Corporate Governance Lessons from the Financial Crisis'. Furthermore, the ASX Corporate Governance Recommendation 7: of recognising and management risk, emphasises that companies establish a sound system of risk oversight and manage of internal control. This means that it is the board of director's role to ensure risk is identified, managed and monitored.

While risk management is a fundamental driving force in business and entrepreneurship, the cost of risk management is still often underestimated, both internally and externally (OECD 2014, p. 7). Taking into account that uncertainty is omnipresent, and that it is the board of directors responsibility to develop and implement efficient risk management policies and institutional regulatory framework that guide and direct the organisation's short and long-term behaviour, the Committee of Sponsoring Organisations (COSO) developed an internal control mechanism framework to improve the quality of financial reporting through business ethics, effective internal controls and corporate governance. Choong (2009) defines internal control as an accounting and audit mechanism to ensure that work, resources and people can be monitored to improve efficiency and mitigate loss, either due to honest or dishonest intention.

COSO (2004a) has explained that the internal control processes affected by directors and managers are widely accepted as the international standard (Ballou & Heitger 2005; Spencer 2006; Moeller 2007). COSO (1992) provides an enterprise level framework for corporate governance, focusing on five areas (p. 17):

i. controlled environment;
ii. risk assessment;
iii. control activities;
iv. information and communication; and
v. monitoring.

While these five areas are important in achieving satisfactory control of the entity's control structure (Choong 2009), this thesis chooses to focus on risk assessment and monitoring its impact on financial performance, which is influenced by the balance

structure as the ultimate responsibility of directors. The objectives of this control structure can aid management in ensuring that the control mechanism helps monitor and minimise various business risks, with risks relevant to the business of the company being identified and minimised. The fact that many corporations are run by people with self-interest agendas in an imperfect world calls for the articulation of why and how risk management creates shareholder wealth in the context of banks' stakeholders and society welfare. Therefore, in the context of banks, risk management helps to ensure that firms comply with laws, rules and regulations, and are ethical.

The Australian Stock Exchange (ASX) corporate governance Principle 7 of recognising and managing risk, ensures that companies establish a sound system of risk oversight and management of internal control (ASX 2012, p. 12). This thesis focuses on simulating the implementation of a risk management policy using the Basel III framework to determine its level of effectiveness through output that the BALM model generates, and its level of impact on financial performance. As discussed previously, the corporate governance policy involves both Basel III regulatory compliance and non-regulatory policies, which includes: (i) holding excess capital equal to 4.8%, based on industry practice; and (ii) holding more than the minimum of 100% of liquidity cover ratio (RBA 2015).

1.6 Managing Risk and Uncertainty through Simulation

As discussed above, risk cannot be eliminated – it can only be managed. One method is the use of mathematical techniques (Ragsdale 2012). Levary and Seitz (1990) showed how a simulation technique can be used in linear programming. Integer programming and goal programming are also useful for decision makers who wish to experiment with the model to obtain 'what if?' questions and produce an output that describes the financial management consequences resulting from any change in the independent uncertain variable. In the evaluation of answers to various 'what if?' questions, simulation helps managers make informed decisions in an uncertain capital environment.

The board of directors' role in banks is to ensure that adequate stress testing under Basel III liquidity and capital is conducted as a risk management tool in internal frameworks.

Stress testing is a tool that supplements other risk management approaches and measures including the following:

- providing forward-looking assessments of risk;
- overcoming limitations of models and historical data;
- supporting internal and external communication;
- feeding into capital and liquidity planning procedures;
- informing the setting of a bank's risk tolerance; and
- facilitating the development of risk mitigation or contingency plans across a range of stress conditions (BIS 2009, p. 7).

Collier (2009) discussed the uncertainty associated with the value of the dependent variable in introducing an element of risk to the decision-making problem. Any decisions made on the basis of this value are based on uncertain (or incomplete) information, therefore not all decisions will produce the intended results. As uncertainty increases, so does the probability of failure (Damghani et al. 2009), thus risky environments can affect behaviour. Simon (1947, p. 75) explains that rationality is the 'concern with the selection of preferred behaviour alternatives in terms of some systems of values whereby the consequences of behaviour can be evaluated'. Clearly if risk is not identified, measured and managed, the decision will not be a rational one. Simulation analysis is considered a superior method of analysis because decision makers can experiment (Bilston and Rodgers 2013) with the model and obtain what if?' questions which helps managers make informed decisions in an uncertain environment.

The Australian banking industry risk environment profile is complex. Banks, like other businesses, are faced with a number of risks including: low liquidity, operational, credit, solvency, commodity price, foreign exchange, and interest rate risk (Valentine et al. 1991). Hence, any rational decision will involve a choice selected from a number of options and directed towards organisational objectives to take into account any current risk profiles. Given these constraints, decision makers can find alternatives that give satisfactory profits, rather than maximise profits. By implementing good corporate governance policies that ensure that the bank operates at an optimal level of efficiency, the bank cannot only achieve optimal level of profits, but also be able to manage risk (Bunea 2013). As the role of the board of directors to ensure adequate stress tests are conducted, this thesis simulates stress test scenarios under the Basel III framework in

order to provide assessments of risk by quantifying capital and liquidity needs and quantifying the impact on financial performance.

1.7 Financial Management: ALM Modelling

The GFC highlighted weaknesses in the ALM of banks. As a result, more stringent ALM guidelines have been issued by the Basel Committee. These new regulations require banks to hold higher levels of liquidity and capital, which present challenges to the board of directors in accurately measuring and managing risk and its impact on the balance sheet. This means that incorporating sound corporate governance for risk management of asset and liability in banks is important for both regulatory compliance and long term sustainability. Bunea (2013) recognised that the implementation of good corporate governance practices in this context can not only reduce risk for investors, but also attract investment capital and improve corporate performance. ALM is one of the areas of risk management in banks that has great scope for application of good corporate governance by allowing the formulation of more reliable asset liability management strategies. Hence, this thesis focuses on the impact of the bank balance sheet re-structuring, and consequently the impact on financial performance (NII, ROE and ROA) under the new Basel III framework.

A study conducted by Kosmidou and Zopounidis (2001) and Zoupounidis (1999) developed a multi-criteria optimisation model for assets and liabilities. More recently in a changing financial environment, Kosmidou and Zopounidis (2004) found that the adoption of an ALM model is an important factor in minimising exposure to various risks in banks, while maintaining an appropriate combination of assets and liabilities in financial institutions. ALM is an integral part of the financial management process of any bank. It is concerned with strategic forward-looking balance sheet management and in the context of this thesis, it focuses on the balance sheet structure from a liquidity and capital perspective and the impact this re-structuring will have on financial performance.

1.8 Justification for the Research

The 2007-2008 GFC demonstrated that the traditional approach to managing risk (under Basel II) in identifying or managing the crisis was not successful. Stiglitz (2010, p. 322) explained that although ‘the financial sector is supposed to allocate capital and manage

risk, both with low transaction costs', in reality this was not the case. Instead 'it should be apparent: America's system of governance itself is badly flawed and that the financial sector seemingly had deliberately made things non-transparent' (Stiglitz 2010, p. 330). Since the traditional approach to managing risk under Basel II did not prevent the recent financial crisis, many authors have argued that the stronger Basel III corporate governance mechanisms could be a solution (Hartmann-Wedels et al. 2003). For example, Littrell (2011a) argued that the Basel III would generate the following five benefits: 1) Australian ADIs will be safer in a capital adequacy sense; 2) they will become much safer in a liquidity sense; 3) Australian depositors will be more encouraged to save than was previously the case; 4) the Australian financial sector will become less exposed to whims of short term international money markets; and 5) Australian ADIs will continue to be perceived internationally as subject to sound regulation, which should assist them in accessing international capital markets (2011 p.3); hence leading to the need for this study. While both the banks and the regulatory authorities presumably model these changes in considerable detail at an industry level, there is little work in the public domain measuring the impact of Basel III on individual banks themselves, particularly the impact and measurement on the current and forward looking balance sheet structure.

Even prior to the financial crisis, Gup (2007) argued that it was important for banks to view corporate governance from an integrated and multi-theoretic point of view, because when banks only focus on a single aspect of governance, such as the role of directors, other factors and interactions that may be important within their governance frameworks are omitted. Drawing from the limitation in the literature, this thesis aims to address these issues by implementing good corporate governance principles to an ALM model, thereby enhancing risk management practices through the implementation of corporate governance policies – hence taking an integrated and multi-theoretic point of view.

One of the major justifications for this research is the literature highlighting that the implementation of good corporate governance principles to asset and liability ensures the effectiveness of risk management policies (Banerjee 2013). ALM is one of the areas of risk management in banks which has great scope for the application of good corporate governance, as the composition of a bank's balance sheet of assets and

liabilities is one of the key factors determining the level of risk faced by banks. Here, the structure of the balance sheet should be a conscious decision of the board of directors (Greuning & Bratanovic 2009; APRA 2015c).

The main motivation for this study is that previous models have failed to link the cross-disciplinary aspects needed to formulate an appropriate ALM model for use in the banking sector. Therefore, drawing from related research investigating the relationship between two variables, financial accounting information and corporate governance (Buhsman 2001; Murphy, 1999b; Aboody & Kasznik 1999), an integrated good corporate governance asset and liability model is developed to ensure the effectiveness of risk management policies that aim to enhance economic performance in the context of an Australian bank. The research is drawn from related literature in two academic fields: financial accounting and corporate governance (Negakis 2005; Cotter & Zimmer 1999; Lang & Lundholm 1996; Sloan 1996); and financial accounting information and firm performance (Tangen 2004).

Another motivation for this study is that the literature highlights that there is positive relationship between good corporate governance and risk management (Bushman & Smith 2001; Bessis 2010). Therefore the thesis argues that implementing good corporate governance can lead to improvements in the implementation of risk management (see Chapter 6) and financial performance (see Chapter 9). In the context of this study, this concept is essential in improving and enhancing ALM models that achieve corporate governance objectives.

Since no studies have addressed either the role of corporate governance mechanisms from a risk management perspective under the new Basel III framework nor how these mechanisms can be used to simulate the implementation of financial management strategies that enhance banks' financial performance and eliminate problems including agency cost, inefficient decision making, unnecessary loss, and even future corporate collapse (Bushman & Smith 2001; Brown et al. 2011), the current study aims to fill the gap by applying corporate governance risk management policies in an ALM model under Basel III framework for use in an Australian bank.

Adrian and Shin (2008) highlighted that even though it is in the best interest of banks to hold higher levels of capital in order to avoid bankruptcy and ensure their continued

existence, due to limited liability they may neglect the consequences of their insolvency and hold too little capital relative to the socially optimal amount that takes these cost into account. When a bank fails, it causes negative externalities and costs to third parties. Negative externalities in banking failures include: possible contagious runs-ons to other banks, disruptions to the payment systems, loss of confidence in the banking system, and the reduction of credit due to a banking crisis which can slow economic growth and lead to costs by reducing GDP (Boyd et al. 2005).

In the above context, regulatory changes in the liquidity and capital requirements (Basel III) are an important area to research due to the uncertain impact that they will have on individual banks and the system as a whole. To date no research has attempted to address this issue, and none have researched the implementation of Basel III capital and liquidity requirements and the impact they will have on the ALM strategies of a bank. Therefore, in the context of this thesis, ALM is useful for simulating the implementation of good corporate governance policies in banks in order to manage risk management under Basel III framework.

1.9 Research Aims of the Study

The new Basel III regulatory requirements aim to strengthen the liquidity and capital position of banks, however changes in the regulatory environments have raised many questions for banks, regulators and investors. The regulatory reform represented by Basel III needs to be examined in light of the impact it will have balance sheet re-structuring, financial and banking performance. The research aims of the thesis are as follow.

Research Aim 1

To measure the impact of Basel III liquidity and capital regulatory requirement on:

a. Financial performance return on equity (ROE) and return on assets (ROA).

b. Banking performance interest income (II), interest expense (IE) and net interest income (NII).

c. Balance sheet structure.

Research Aim 2

To conduct two stress tests in terms of crisis scenarios for increases in net cash outflows (NCO) and decline in interest income (II) to analyse and quantify the financial position of the bank by:

a. Meeting and measuring the Basel III Liquidity and capital requirements.

b. Measuring the impact of financial performance return on equity (ROE) and return on assets ROA).

c. Measuring the impact of banking performance interest income (II), interest expense (IE) and net interest income (NII).

d. Measuring the impact on balance sheet structure.

Research Aim 3

To develop, analyse and quantify possible strategic responses to the new challenges faced by banks in terms of holding higher liquidity and capital requirements in order to take a pro-active approach to avoid corporate failure or collapse.

1.10 Contribution to Knowledge

The motivation for this thesis comes from the failures of the past and present research to fully address the multi-dimensional nature of corporate governance from a risk management perspective under Basel II framework; and although many disciplines have been interested in financial performance, research in this area has mostly been myopic. Furthermore, an integrated discipline approach has been sparse, and holistic integrative approaches uncommon. Hence, this thesis aims to contribute a new multi-dimensional ALM model under the Basel III framework that assists in explaining the emerging issue of good corporate governance using risk management polices to achieve the goals of all stakeholders.

This study addresses limitations in the multi-dimensional nature of corporate governance from a risk management and ALM perspective. It presents a new multi-dimensional BALM model that progressively implements Basel III liquidity and capital

requirements under corporate governance risk management policy constraints using the ALM Goal Programming Model of Kosmidou and Zopounidis (2005) as a foundation. The new BALM model measures and quantifies the impacts that APRA Basel III liquidity and capital regulatory requirements have on: financial performance, return on equity (ROE) and return on assets (ROA); banking performance, NII, interest expense and net income; and a forward-looking balance sheet structure. The outcomes provide the boards of directors (BoDs) with useful information that can enhance transparency in a forward looking balance sheet that helps provide resilience to the bank under the new regulatory environments.

Further simulations of stress tests were conducted to examine the stress scenarios. Increases in net cash outflow and decreases in interest income scenarios were used to measure and quantify impacts on financial and banking performance. The BALM model was also used to analyse and quantify three simulated possible strategic responses to the new challenges faced by banks when holding higher liquidity and capital requirements. As this is the first attempt undertaken in an Australian context using the ANZ bank as a case study, this thesis makes a particularly significant contribution towards an integrative approach for ALM under the new APRA Basel III framework.

1.11 Methodology

Relying heavily on quantitative research methodologies, this thesis is carried out through the construction of a positive empirical model that uses simulation optimisation methodologies derived from examining the key stochastic and static models of: corporate governance (Bushman and Smith 2001; Dechow et al. 1996; Beasley 1996; Smith & Warner 1979; Francis et al. 1994; Skinner 1994; DeFond & Subramanyam 1998; Cheng et al. 2007), risk management (Bario et al. 2001; Brockmejer 2007; Chong 2010; Levary & Seitz 1990; Collier 2009), and ALM (Chambers & Charnes 1961; Cohen & Hammer 1967; Komar 1971; Roberson 1972; Lifson & Blackman 1973; Fielitz & Loeffler 1979; Seshadri et al. 1999; Carino et al. 1994; Kosmidou & Zopounidis 2004). The thesis incorporates a quantitative financial simulation optimization method that is specific to the task of an ALM model for banks. Here, an optimization algorithm available through linear goal programing is used on empirical data accessed from a major Australian bank – ANZ.

In implementing the concepts found in related disciplines, the proposed framework is structured to enable a mathematical model that incorporates the conflicting objectives of corporate governance, risk management and performance enhancement. Since banks need to manage conflicting goals, a profit maximization and risk minimization goal programming technique has been considered as useful due to its flexibility in allowing the decision maker to incorporate various goals and constraints (Kosmidou & Zopounidis 2004).

As discussed above, uncertainty plays an important role in the development of financial management strategies. In this study, simulation optimization is used to generate sound financial management strategies based on good corporate governance principles to manage risk and achieve a sustainable financial performance that takes uncertainty into account. Furthermore, in order to get an overview of the strategic direction of the ANZ Bank, apart from using data from its financial statements, this study also uses an average of interest rates on deposits, loans and bonds over 5 years. As these rates fluctuate, simulation analysis is used to reduce the uncertainty encountered in decision making.

1.11.1 Case Study Approach

In this study, the goal programming model will be developed to cover a 9-year time span using data from financial statements, including the ANZ balance sheets, and profit and loss statements from 2006 to 2015. This period was chosen in order to analyse performance before and after the financial crisis. The model includes 39 structural variables, of which 10 correspond to assets, 6 to liabilities, 5 to equity, 5 capital ratios, 4 liquidity variables, 1 liquidity ratio, 3 financial performance variables, 3 profit variables and 2 financial performance ratios. This data is operationalised within an ALM methodology in a stochastic interest rate environment in order to quantify the impact of Basel III on the key variables discussed previously, conduct stress tests and test three simulated corporate governance strategic policies.

1.11.2 Steps in Model Development

The methodology adopted in this research is a uniquely applied routine optimization technique. In order to formulate an integrated ALM model that simulates Basel III implementation together with good corporate governance principles, the thesis firstly

defines the problem, selects decision variables and parameters, and justifies the choice of mathematical techniques. This is followed by data collection and model execution to obtain the optimal solution. Some of the steps are iterative as new information becomes evident and adjustments are required

As the role of corporate governance is to develop and implement policies that ensure that banks comply with current regulatory requirements to manage liquidity risk as a priority (Greuning & Bratanovic 2009), this model differentiates from previous models (Kosmidou & Zopounidis 2001) by implementing policy constraints that ensure banks have a counter-cyclical buffer adjusted to GDP trends. This liquidity cushion not only takes into account balance sheet exposures, but also off-balance sheet exposures, such as credit instruments that include letters of credit and guarantee commitments, foreign exchange, interest rate derivatives, swaps, options and futures. In managing solvency risk, the current model incorporates the new Basel III capital requirements.

1.12 Structure of the Thesis

Chapter 2, discusses the relevant literature, starting with the role of corporate governance, including: theories used in corporate governance; good corporate governance principles from a Basel III risk management perspective; meaning of managerial risk accounting; mechanisms that influence financial accounting regime; relationship between financial accounting information and financial performance; and inter-relationship between corporate governance, agency theory and economic performance. The next section in the literature review will introduce risk and uncertainty in banking and the role of risk management under Basel III, ALM for banks. Finally, the regulatory requirements that have caused a paradigm shift in ALM and risk management in banking are presented, including the relationship between corporate governance, risk management and ALM.

Chapter 3, discusses the literature validating the conceptual framework, including the theories used in the proposed framework and how corporate governance, risk management, ALM are integrated to develop a bank ALM goal programing model used to the research aims.

Chapter 4 discusses the methodology used and Chapter 5 presents the integrated bank asset and liability management goal model adopted for use in this thesis. A detailed

analysis of the type of data used within this model, how it is to be collected and the reasons for using it will be discussed. The construction of model analysis for the Basel III simulated implementation are discussed in Chapter 6, and in Chapter 7 the impact of moving progressively to Basel III will be discussed. This is followed by Chapter 8, where the results of the stress test simulations under Basel III are discussed. Finally, Chapter 9 presents possible policy responses to the implementation of Basel III regulatory requirements, including the implications of the proposed simulated strategies, contribution to knowledge, limitations of the study and implications for further research.

Chapter 2
Literature Review

2.1 Introduction

The GFC resulted in the largest wave of banking crises seen since the Great Depression, bringing to light highly inadequate banking regulations (Admary & Hellwin 2013), corporate governance and risk management. These resulted in banks taking on high levels of risk, failing to address the financial cycle, managing risk poorly and implementing low credit controls. Furthermore, the credit rating agencies around the world failed to appropriately evaluate risk. In order to correct these issues, new Basel III liquidity and capital regulatory requirements are currently being implemented by banks with the expectation of strengthening the financial system. However, even though government and central banks are responsible for upholding stability in their domestic financial systems, from the banks' perspective it is the responsibility of boards of directors to comply with regulatory requirements and ensure that risk is identified and managed in order to avoid financial distress.

The financial crisis triggered renewed interest in the causes and effects of banking crises, and optimal policy response to them. This resulted in the introduction of Basel III liquidity and capital requirement changes within riskier market environments, meaning that banks' boards of directors now face the dilemma of managing risk while attempting to achieve profitability. Therefore, in order to measure the impact of Basel III on financial performance in banks and address the research aim outlined in Chapter 1, in this chapter a review of relevant literature is undertaken.

This chapter is divided into 9 sections, beginning with a review of the literature on corporate governance including corporate governance mechanisms; efficiency in corporate governance and corporate governance mechanisms. Section 2.3 provides an overview of risk and uncertainty in banking, including the recommendations of the Committee of Sponsoring Organisations mission (COSO) on risk management strategies and their implementation procedures, and risk management under Basel III framework. Section 2.4 reviews the studies conducted in ALM for banks. Section 2.5 comments on the integration of financial accounting information and financial

performance, corporate governance, agency theory, and the integration of corporate governance mechanisms, risk management and ALM. Section 2.6 overviews goal programming models for banks, while in Section 2.7 the research conducted on managing the stochastic environment using simulation is discussed. Finally, Section 2.8 points out the limitations in the existing literature.

2.2 Corporate Governance

There is a large body of literature on corporate governance, but only some focuses on its internal mechanisms; including principal agency theory (Holmstrom 1979), and managerial incentive plans and director monitoring (Dechow et al. 1996; Beasley 1996). Other studies include the role of accounting information in the operation of other governance mechanisms with regards to takeovers (Palepu 1986), shareholder litigation (Kellogg 1984; Francis et al. 1994; Skinner 1994), debt contract (Smith & Warner 1979; Leftwich 1981; Press & Weintrop 1990; Sweeney 1994), audit function (Feltham et al. 1991; DeFond & Subramanyam 1998), and board size (Cheng et al. 2007). These corporate governance mechanisms and controls are designed to reduce the inefficiencies that arise from moral hazard and adverse selection (Hirschey 2009). In this chapter, the literature review will focus on corporate governance in relation to theories used in corporate governance, risk management and financial accounting information in relation to measuring financial performance and decision making.

Corporate governance (CG) refers to the relationship among stakeholders that is used to determine a firm's direction and control its performance (Bushman and Smith 2001). The ASX Corporate Council Government has presented the ten core principles that help facilitate good corporate governance (see Appendix 1). Although these recommendations are not mandatory, and cannot in themselves prevent corporate failure or mistakes in corporate decision making, they can provide a reference point for improving governance structures that minimise problems and optimise performance and accountability.

The finance literature on corporate governance is often described as the set of rules, structures and procedures that help investors get a return on their investment and ensure that managers do not misuse the investors' funds to pursue their own interests (Shleifer & Vishny 1997). According to Greunning et al. (2009) corporate governance provides a

disciplined structure through which a bank sets its objectives and means of attainment, while monitoring the process of achieving those objectives. The central components of risk management are the identification, quantification and monitoring of the risk profile of the bank, by implementing good corporate governance mechanisms through risk management strategies. Banks are encouraged to operate in a safe and sound manner by using their resources more efficiently.

Various theories and philosophies have provided the foundation for corporate governance systems, including agency theory, stewardship theory, stakeholder theory, resource dependency theory, social contract theory and legitimacy theory. This thesis mainly focuses on the theoretical perspective of corporate governance from agency theory and stakeholder theory.

Based on the literature review, it is clear that corporate governance is important to the company operations and has become increasingly important in determining the cost of capital in a global capital market (ASX 2012). The purpose of good corporate governance is to increase shareholder value, lower the cost of capital, reduce operational risk, and ensure capital management addresses reasonable shareholder concerns. Australian banks need to be governed properly in order to compete globally, and maintain and promote investor confidence both locally and overseas. A study by Mullineux (2007a) found that while bank managers have a fiduciary duty to both depositors and shareholders, focusing only on maximising shareholder value is inappropriate because it can lead to undue risk taking.

Corporate governance mechanisms are the means by which managers are disciplined in order for them to act in the interest of all stakeholders. Bushman and Smith (2001) outlined both the internal mechanisms: managerial incentive plans, director monitoring and internal labour market; and the external mechanisms: the managerial labour market, competition in the market, market for corporate control, shareholder monitoring and security laws, that protect outside investors. In the next section, the theories used in corporate governance will be discussed.

2.2.1 Theories Used in Corporate Governance

Corporate governance has become an important factor in managing organisations in the current global and complex environment (Abdullah & Valentine 2009). However,

although there are many ways to describe corporate governance, it can be broadly defined as the responsibility and accountability for the overall operation of an organisation (Bohen 1995). More recently, corporate governance has been defined as the system of controls that helps a corporation effectively manage, administer and direct economic resources (Hirschey 2009). The fundamental theories in corporate governance began with agency theory, expanded into stewardship theory and stakeholder theory, and evolved into resource dependency theory, transaction cost theory, legitimate theory and social contract theory. Hence 'it is suggested that a combination of various theories is best to describe an effective and good governance practice rather than theorizing corporate governance based on a single theory' (Abdullah 2009, p. 1). The following sections will discuss the main theories that apply to this thesis, including agency theory and stakeholder theory.

First, Jensen and Meckling (1976) define agency theory as the relationship between the principals (shareholders) and agents (company executives and managers) in a corporation. If both parties to the relationship are utility maximisers, there is good reason to believe that the agent will not always behave in the best interest of the principal, meaning that managers have incentives to pursue their own interest at the expense of shareholders. Based on this premise, in order to protect shareholders and managers from conflicts of interests, organisations need adequate monitoring and control mechanisms (Fama & Jensen 1983). These corporate control mechanisms ensure that firms eliminate the potential divergence of interest between managers and stakeholders (Bushman and Smith 2001) in order to alleviate the agency problem and achieve corporate governance goals. As there is ample evidence that agency problems were one of the main contributors to the 2008 financial crisis (Stiglitz 2010), agency theory has become one of the major concerns in corporate governance literature, and a fundamental premise in this thesis.

Second, stakeholder interests have been defined as accountability to more than just shareholders, but to include all those who can be affected by the achievement of the firm's objectives. Stakeholder theory was originally embedded in the management discipline in 1970 (Abdullah & Valentine 2009), and gradually developed by Freeman (1984), who described organisations as having networks of relationships to serve, including suppliers, employees and business partners. In the context of banks,

stakeholders also include society as a whole, due to the important role banks play in our society. As Ogden and Watson (1999) explained, an economically successful firm is one in which managers implement corporate governance strategies and policies that facilitate the maintenance of an appropriate balance between the interests of all stakeholders. Clarke (2004) also confirmed that if a corporate manager's job is to maximize the total wealth of the organisation, they have a responsibility to take into account the effects of their decisions on all stakeholders. Furthermore, from a theoretical welfare economics view, Beckerman (2011) asked the very important question: What is the society whose welfare we are trying to maximize? For the real world many policies decisions depend on the way we draw the boundaries around the society in question. In the context of banks, due to the important role banks play in our society, it is difficult to draw boundaries, therefore stakeholders go beyond those individuals that have a direct relation to the bank, and it is for this reason the thesis argues that corporate governance policies need to manage risk and enhance performance so society benefits from the positive externalities.

Third, there are attempts to view the firm as an organisation comprising people with different views and objectives, which in many circumstances are conflicting. Cyert and March (1963) initiated the transaction cost theory. Abdullah (2009) pointed out that the underlying assumption of transaction theory is that some firms have become so large they in effect are substitutes for the market when determining the allocation of resources. They maintained that the organisational structure of a firm can determine price and production. Hirschey (2009) explained that the ability of the firm depends upon its ability to minimize the transaction cost of coordinating productivity activity. These costs include information costs, decision costs and enforcement costs. In the context of this thesis, it is argued that the structure of the balance sheet 'ALM' determines the risk appetite and profitability of the bank.

2.2.2 Good Corporate Governance Principles: Risk Management

Bushman and Smith (2001) concluded that corporate control mechanisms can assist in reducing any inefficiencies that arise from moral hazard and adverse selection, thus minimising the probability of financial failure and providing the means by which managers can be disciplined to act in shareholders' interests. Since banks operate under a unique system of public oversight in the form of bank supervisors and a

comprehensive body of banking laws and regulations, they also need to fulfil their fiduciary duties to all stakeholders. Thus, corporate governance can enhance the relationships between stakeholders by determining the firm's direction and controlling its performance (Bushman and Smith 2001). In addition, several studies have found a relationship between corporate governance and financial accounting information (Bushman and Smith 2001; Cho & Lee 2003; Choi & Hasan 2005), with corporate governance managers being influential in the generation of financial accounting information. As a result, the objective of bank managers should be to provide financial accounting information that is useful, qualitative, understandable, relevant, reliable, dependable, complete and transparent.

Good corporate governance practices include good financial accounting reporting practices (Banks 2003) with accurate and reliable financial accounting information (FAI) allowing both internal and external users to make knowledgeable efficient decisions that result in allocative, operational, dynamic and information efficiency. However, it might be hard to distinguish between accurate and inaccurate information. This is a problem as, fraud or failure is difficult to detect, especially when companies appear to be acting responsibly and following the rules. This was clearly demonstrated by financial failures such as Enron and WorldCom, resulting in an increased demand for reliable and accurate FAI becoming a major issue.

2.2.3 Managerial Risk Accounting

A study by Collier (2009) stated that managerial risk accounting is concerned with the generation, dissemination and use of risk-related accounting information to managers within organisations to enable them to judge and shape the risk situation of the organisation according to their objectives, and that the two main functions of managerial risk accounting include decision making and decision-influencing or stewardship. Colliers's research provided the relevant information needed to improve the ability and willingness of bank employees to achieve the goals and objectives of corporate governance in any organisation. Chorafas (2007, p. 11) described risk and uncertainty as formally characterised by a range of possible values connected to an object as detailed below:

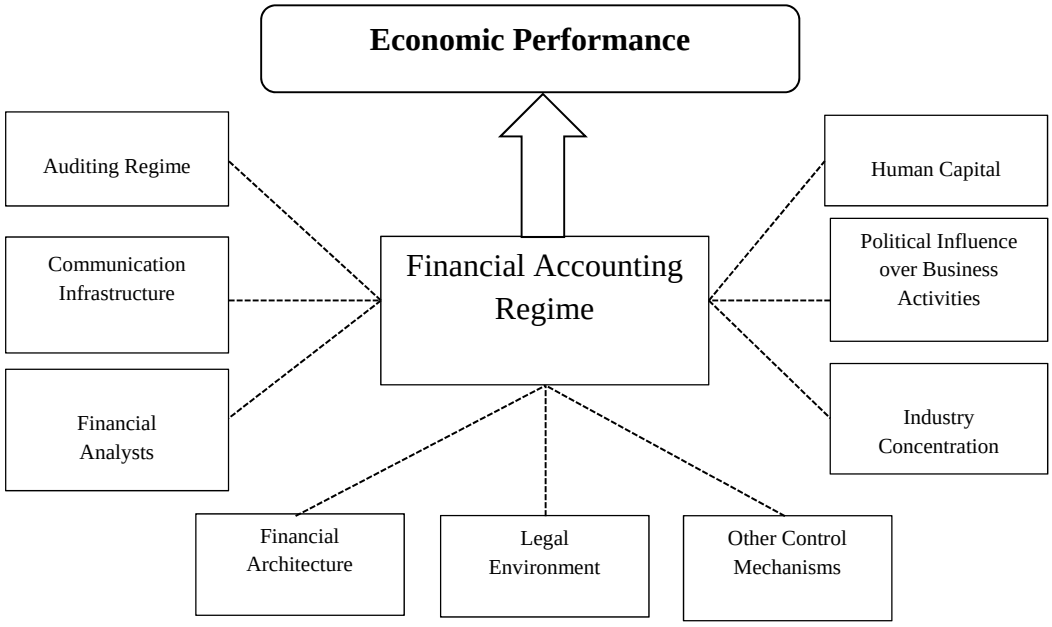
1. Financial accounting: Risks are mainly represented by the recognition of Provision (accounting) or Contingent liability. Fair value measurement partially includes considerations of risk. Hedge accounting allows for limited aggregation of mutually offsetting risks.
2. Cost accounting: Risks in the sense of unexpected resource consumption are accounted for by using normalised costs for those events (expected value).
3. Capital budgeting: Risk representation ranges from flat adjustments to cash flows and duration via risk adjusted discount rates to decision tree analyes, stochastic simulation and real options.
4. Performance measurement: Risk is usually represented in form of risk adjusted discount rates or hurdle rates.

Research conducted by Chorafas (2007) emphasised that it is important to identify risk and uncertainty in accounting to allow banks to develop corporate governance policies that minimise risk and maximise economic performance. Central to this is the configuration of adequate risk measures that capture the risk situation and measure the capability of the organisation to bear liquidity, solvency and operational risk. These measures need to take into account behavioural and cognitive aspects of judgement and decision making under both risk and uncertainty (Damghani et al. 2009).

2.2.4 Mechanism that Influence the Financial Accounting Regime

Bushman and Smith (2001) describe the main factors influencing economic performance as: institutional characteristics, auditing regime, communication infrastructure, financial analyst community, financial system architecture, legal environment, corporate control mechanisms, industry concentration, political influence over business activities and human capital. Many of these institutional characteristics are likely to influence the economic effects of financial accounting information generated through all channels (see Figure 2.1).

Figure 2.1: Factors Influencing the Effects of Financial Accounting Information on Economic Performance



Source: Bushman and Smith (2001).

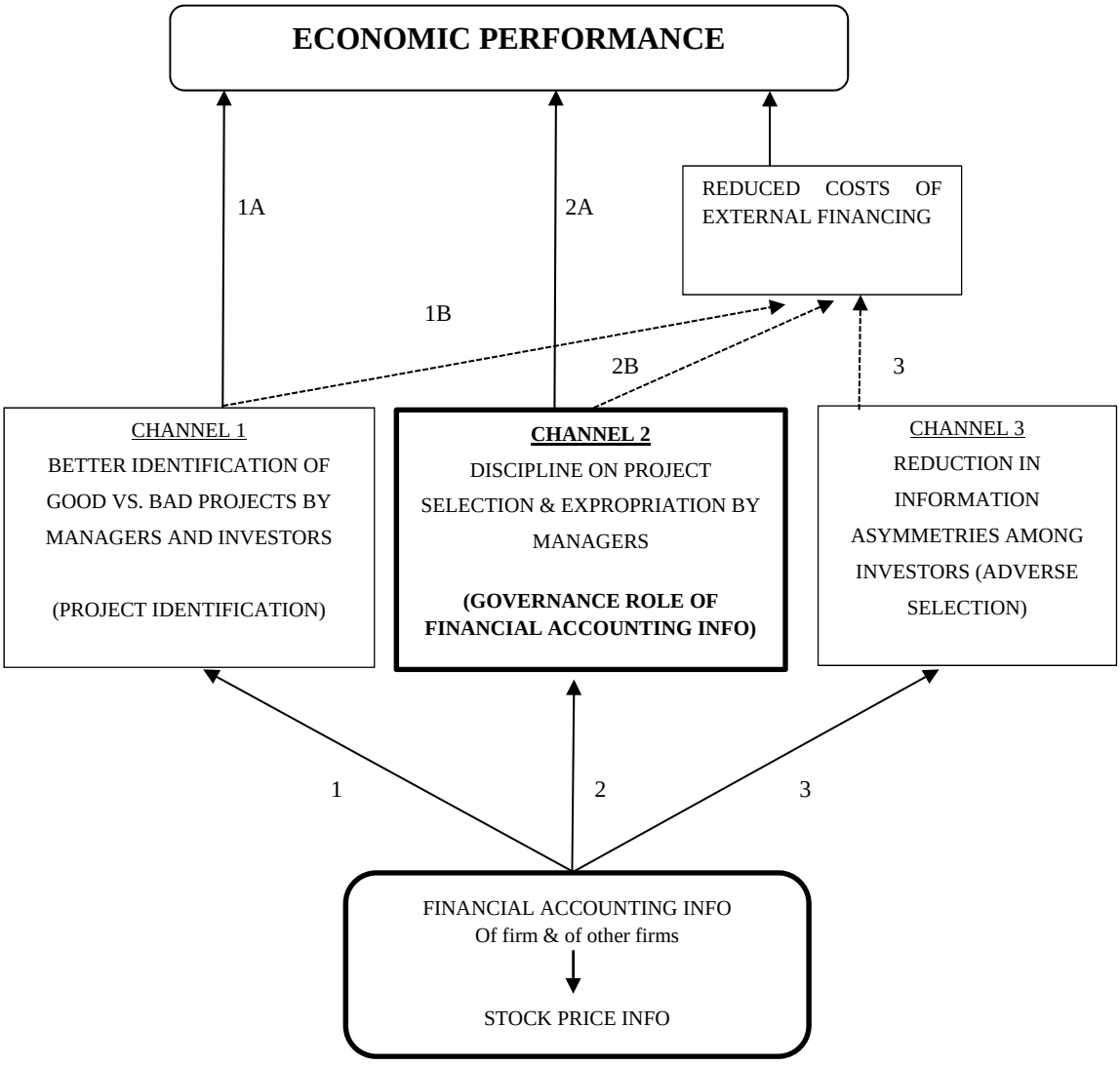
Costs of collecting and processing audited, standardised accounting information signals from the accounting system are in many cases low relative to those of alternative measures. As a result, it is likely that firms will only use the more costly performance measures when the accounting information and stock price taken together do a poor job in capturing the precise contribution of important elements in managerial action towards firm value. In the context of this thesis, the focus is on financial performance, particularly in aspects of financial analysis, ALM, risk management in relation to bank's legal regulatory environment and prudential regulation. The following chapter on the conceptual framework used in this thesis outlines the financial analysis and the legal environment that is aligned with the development of a new bank ALM model.

2.2.5 Relationship between Financial Accounting Information and Financial Performance

Figure 2.2 outlines Bushman and Smith's (2001) research on the channels through which financial accounting information affects economic performance. However, it does not isolate the effects of the governance role of financial accounting information on economic performance. Channel 1 looks at better identification of good and bad projects by managers and investors, Channel 2 looks at discipline on project selection and expropriation by managers, Channel 3 looks at reduction in information

asymmetries amongst investors, hence allowing for a reduction in external financing which in turn increases economic performance.

Figure 2.2: Three Channels Through Which Financial Accounting Information May Affect Economic Performance. Governance Role of Financial Accounting Information Operates Through Channel 2



Source: Bushman and Smith (2001).

Bushman and Smith's channels clearly highlight that the role of financial accounting information operates through these channels, emphasizing the usefulness of financial accounting information in corporate governance mechanisms. Bushman and Smith's findings are relevant to the current research, as the new asset and liability model uses financial accounting information to identify the allocation of assets and management of capital and liabilities.

2.2.6 Inter-relationships between Corporate Governance, Agency Theory and Economic Performance

A study by Collins (1990) concentrated on the dynamic efficiency of the U.S. banking industry by using measures derived from agency theory to access the effects of the innovation process resulting from technological advances, changing regulations, increasing competition and the interest rate regime. According to this theory, some of the criteria used to maximise performances based on microeconomic measures include increased asset growth and high dividend payouts to facilitate equity raisings that meet both regulatory and growth needs, levels of total executive compensation, firm-based measures of financing and incidence of long term incentive compensations for Chief Executive Officers. However, as objectives of the principal and the agent may be in conflict, Watts and Zimmerman (1978, p. 5) developed the concept of managerial self-interest. This was part of a principal-agent relationship aiming to form what they termed as 'a nexus of contracts' between managers and shareholders, and between managers and subordinates. As a result, this type of agency theory model helped to improve the understanding of managers' interest in financial reporting and the role of executive compensation plans in motivating and controlling management's operation of the firm and ways in which the plans use accounting information. It also leads to an improved understanding of managers' interests in accounting policy choice and reveals any bias or otherwise manipulated reports of net income. At the very least, this model can help manage and hence improve sound economic performance. This type of research enables us to understand the boundaries of management's legitimate role in financial reporting and why accountants are frequently caught between the interests of the investors and managers. Although the agency problem is not new, literature reveals that when good corporate governance practices are implemented, managers can allocate capital more efficiently and banks are less likely to fail (Gup 2007). In this way these practices can then create positive externalities of financial stability, efficient investment and economic growth.

2.3 Risk and Uncertainty in Banking

Given that a major objective of bank managers is to increase profitability, this often comes, however, at the cost of an increased risk which comes from an uncertainty of outcome. This is often quantified in terms of probabilities of chance including damage

or loss occurring when a particular action is taken (Chorafas 2007 p. 9). In the context of risk management, the Committee of Sponsoring Organisations of the Treadway Commission (COSO 2004b, p. 16) further defines risk as 'the possibility that an event will occur and adversely affect the achievement of objectives'. Conceptual economic idealism separates risk as a separable category from uncertainty. Knight (1921, p. 2) explains that 'risk is quantifiable, uncertainty is not'. Risk should be regarded as a known chance and uncertainty, on the other hand, it means probabilities cannot be assigned to an event. This distinction has shaped and influenced operational strategies for management and regulation of risk in an organisation. In addition, a key characteristic of both risk and uncertainty as emphasized by Frame (2003, p.2) is 'you cannot get away from it'.

The financial crisis led to a significant re-assessment of risk, with the risk manager's mantra today being to identify, measure, monitor and control (Black et al. 2003). In this thesis, the focus is on identifying, measuring and managing liquidity, solvency and interest rate risk though simulation analysis in order to reduce uncertainty. This provides managers with various scenarios, hence leading to a more efficient allocation of resources. However, even though uncertainty and therefore risk cannot be eliminated, risk can be identified, monitored and managed to reduce uncertainty. Therefore, financial managers need to devote significant time in understanding and managing the kinds of risks to which their banks are exposed.

Therefore, any financial decision will always involve some level of risk. Thus, although one of the main objectives of corporate governance is to maximise return for all stakeholders, no return can be gained without some level of risk. The relationships between risk and expected return is described in two models for valuing assets under uncertainty: the capital asset pricing model (CAPM) which links expected return to a single source of risk, and the Fama and French (2002) three-factor model which implies that there are three risk factors for which investors may demand compensation.

Lange et al. (2007) describe risk in banks as the unanticipated portfolio or operational change that creates unanticipated claims on earnings and capital. To minimize any risk that could lead to potential loss, management's task in managing risk is to reduce the impact of the value of the bank resulting from unanticipated changes. The role of corporate governance is also to reduce the amount of unanticipated change and prepare

contingency response measures for a wide range of outcomes. Lange et al. (2007, p. 13) describe the risks faced by financial intermediaries. These include interest rate, liquidity, exchange rate, credit, funding and solvency risk (see Appendix 2). As shown in Appendix 5, BIS (2009b) categorises risk in accordance with bank financial, operational, analytical and policy risk. Even though it is important that banks' corporate governance risk management framework addresses all types of risks, this thesis will focus on liquidity and solvency risks due to its complexity. Liquidity risk refers to the sudden surge in liability withdrawals that may require a financial institution to liquidate assets in a very short period of time and at less than fair market prices. Insolvency risk is the risk that a financial institution may not have enough capital to offset a sudden decline in the value of its assets.

Ho and Lee (2004) claim that 'the business model of a firm cannot be as simple as 'the boss's risk tolerance function or an extension of a vanity game'. Furthermore, they state that the salient aspects of managing the business have to be tied together by finance principles'. Ho and Lee (2004) define risk management as the quality control of finance, by ensuring the smooth functioning of the business model and the corporate model in accordance with the design of the business processes. The risks of these processes need to be measured, monitored, reported and managed continually.

Considering the current stochastic environment and the recent financial crisis, banks are now concerned with how financial risk is managed, not only to ensure financial stability, but also because a debate has arisen about whether it increases shareholder value or not. These relationships between the value of a firm and its financial policies were initially established by Moxigliani and Miller (1958). Other researchers, such as Smith and Stulz (1985) have also demonstrated that risk management can add value by reducing taxes, reducing the cost of financial distress, and facilitating optimal investments.

The major aim of the financial system is to facilitate interactions between the savers or providers and users of funds, and in doing so, banks are able to achieve their fundamental objective to maximize shareholder's wealth. However, in order for banks to be able to operate efficiently in the market and increase financial returns for their owners, bank managers need to be able to identify the opportunities and risks associated

with each strategy. If they fail to identify, monitor, manage and reduce risk, the bank's objectives will not come to fruition.

The literature has many examples where uncertainty has been incorporated in banking and finance models. These include stochastic models based on portfolio selection theory (Markowitz 1959; Cohen & Thore 1970; Crane 1971; Booth 1972; Kallberg et al. 1982; Pyle 1971; Brodt 1978), chance-constraint programming (Charnes & Thore 1996; Charnes & Littlechild 1968; Pogue & Bussard 1972), sequential decision theory (Wolf 1969; Bradley & Crane 1972) and dynamic programing (Samuelson 1969; Merton 1969; Melton 1990; Eppen & Fama 1971; Mulvey & Vladimirou 1992) which uses a generalised network program for dealing with financial planning problems under uncertainty. Simulation analysis has long been a useful tool for evaluating the performance of financial management (Olafsson 2002; Collier 2009). The task of risk management is to reduce the impact of unanticipated change on the value of the institution. Simulation optimisation can be used to minimise risk by setting policies and implementing policies through constraints in the model.

2.3.1 Committee of Sponsoring Organisations

Choong (2009) describes internal control as an accounting and audit mechanism to ensure that work, resources and people can be controlled to improve efficiency and mitigate loss, either due to honest or dishonest intention. The Committee of Sponsoring Organisations mission (COSO) developed an internal control mechanism framework to improve the quality of financial reporting through business ethics, effective internal controls and corporate governance. The COSO framework defines internal controls as a process. Developed by directors, managers and others to ensure the achievement of objectives, they are widely accepted as international standards:

I. Control environment

II. Risk assessment

III. Control activities

IV. Information and communication

V. Monitoring

COSO defines enterprise risk management as:

> *…a process, effected by an entity's board of directors, management and other personal, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risks to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives. (COSO 2004, p. 6)*

These components just outlined are commonly used in the financial models as they can provide a guide to good internal control to any medium and large organisations (Chong 2010). In fact, internal control is now part of good corporate governance in many countries, for example, the US Sarbanes-Oxley Act (2002) also known as the *Public Company Accounting Reform and Investor Protection Act* (in the Senate) and *Corporate and Auditing Accounting and Responsibility Act* (in the House of Representatives).

Achieving satisfactory control over the entity's control structure is the ultimate responsibility of the board of directors. As explained by Choong (2009), the objectives of the control structure are to ensure that control mechanisms monitor and minimise various business risks; identify and minimise risk relevant to the business of the company; and comply with laws, rules, regulations and good ethics. In other words, good corporate governance practices are outlined in the ASX Corporate Council Government core principles and help facilitate the implementation of good corporate governance (see Appendix 2.1).

2.3.2 Risk Management under Basel III Framework

Management of liquidity and capital has gained considerable attention since the GFC. For example, in 2009 a report by the Supervisors Group (2009) linked poor liquidity transfer pricing to the funding and liquidity issues witnessed in several bank failures. Following this study, Grant (2011) identified practices for liquidity transfer pricing (LTP) by drawing on responses to an international survey covering 38 large banks from nine countries. This survey showed that many LTP practices were largely deficient, lacking LPD policies, employing inconsistent LTP regimes, relying on off-line processes to manually update changes in funding costs, demonstrating poor oversight of LTP processes, and having liquidity cushions that were too small to withstand prolonged market disruptions. In light of these findings, the Bank for International

Settlements (2011) recommended that, in order to properly manage liquidity risk, banks needed to charge interest rates based on marginal costs of funds that are matched to the maturity of the products or business activities at origination. Furthermore, in:

> *…sizing liquidity cushions, banks should use the results of stress-testing and scenario analyses, which include idiosyncratic and market-wide disruptions, furthermore bank's liquidity cushions should be of the highest quality to ensure liquidity can be generated when needed. (BIS 2011, p. 2).*

Contagion is a major issue in the finance sector. Bessis reported that the:

> *…1.2 trillion commercial paper market, the most liquid market in the US in 2007, dried up very quickly after the first phases of the crisis. Liquidity froze, making funding shrink and turning financing into a major issue for borrowers. (Bessis 2010. p. 13)*

This liquidity contagion demonstrates that banks need to hold higher levels of liquidity in order to protect themselves from exposure to liquidity risk (APRA 2011). Apart from liquidity, capital Basel III requires banks to raise the level and quality of regulatory capital in the global banking system to provide an additional layer of capital to be set by national regulators based on the credit cycle (APRA 2013b). The intention is that regulators adjust the buffer so as to have a countercyclical influence, raising it in good times, and then releasing it to support lending when credit is tight. Under the existing prudential framework, there are four categories of capital including: fundamental Tier 1 capital, residual Tier 1 capital, upper Tier 2 capital and lower Tier 2 capital. Under Basel III these categories were replaced with a Tier 1 Capital consisting of common equity Tier 1 capital, an additional Tier 1 capital, and Tier 2 capital.

As Debelle (2010, p. 1) explained:

> *Ultimately, the future is uncertain, in the sense that it cannot be quantified. The goal should be to design systems that are as robust as possible to this uncertainty. A system with less leverage is one obvious means of enhancing robustness.*

Generally speaking, market conditions have changed and banks are now required to take a more responsible, pro-active approach to managing capital risk. Frans (2011) explains that capital management can only be conducted in close operation with risk management and that the main capital function is to buffer against unexpected loss and optimise performance. However, Frans also pointed out that many financial institutions were late in recognising that their capital positions are of greater risk to their existence than their inability to generate profits, and that risk managers have lost touch with one of their main responsibilities of capital preservation. In fact, some capital managers have insufficient knowledge of the importance of risk management to help preserve their capital.

2.4 Assets and Liability Management for Banks

The ALM problem has received considerable attention since the GFC. Stiglitz (2010, p. 19) argues that:

> *…interconnectedness of bank balance sheets can facilitate the spread of shocks affecting an individual bank to other financial institutions and that liquidity shocks to one bank can lead to losses at other banks in the economy because their claims on the troubled bank decline in value.*

When banks do not structure their balance sheets to manage risk and to enhance performance for both the short and long term, financial collapse is possible and could be inevitable. Hence, the lesson to learn is that the 2008 financial crisis was clearly the result of a failure to incorporate sound risk management into the decision making process of financial service providers, particularly in banks.

Due to the abovementioned problems, strategic ALM has now become a major concern in today's banking environment (Seshadri et al. 1999; Kosmidou et al. 2004; Moorad 2007; Alexandre 2007; Kapan and Minoiu 2013). One of the first studies in this area was produced by Chambers and Charnes (1961). Their ALM model was used as a single optimization profit function subject to the relevant linear constraints determining the optimal portfolios of individual banks over several time periods using mathematical programing. Later studies that built on the important work of Chambers and Charnes were Cohen and Hammer (1967), Komer (1971), Roberson (1972), Lifson and Blackman (1973), and Fielits and Loeffler (1979).

The literature has provided ample evidence that the ALM model is an important tool to manage risk. Examples of such studies in which goal programming techniques have been used in the field of financial planning and portfolio selection include Kvanli (1980), Lee and Lero (1973), Lee and Chesser (1980), Baston (1989), Sharma et al. (1995) and Kosmidou (2004). Mulvey and Ziemba (1998) presented a detailed overview of asset and liability modelling which included models for individuals and institutions such as banks and insurance companies, and Zoupounidis (1999) developed a multi-criteria optimisation for assets and liabilities.

Kuzy and Ziemba (1986) employed a multi-period stochastic linear program to manage assets and liabilities in light of uncertainties in cash flows, costs of funds and return on investment for banks. Banks must determine the optimal trade-off between risk, and return and liquidity. Furthermore, their research underlined that an ideal operational model should provide 'simultaneous considerations of assets and liabilities to satisfy basic accounting principles and match the liquidity of assets and liabilities'. Furthermore, it is important to incorporate interest rates uncertainty into the decision making processes because it is detrimental to the financial well-being of the bank.

Strategic ALM has become a major concern in today's banking environment, making the seminal ALM model even more important. For example, Seshadri et al.'s (1999) research employs a quadratic optimiser inserted in an ALM simulation model to assist with the process of asset and liability selection in a stochastic interest rate environment. Similarly, Kusy and Ziemba (1986) employed a multi-period stochastic linear program with a simple resource to model the ALM in the banking sector while maintaining computer feasibility, and Korhonen (1987) applied two-stage goal programing to model the management of the domestic and foreign currency dominated assets and liabilities of a bank.

Greuning and Bratanovic (2009) explain that corporate governance refers to the governance structure of key players and their relationships between participants in the governance system. Kaen (2003) emphasized that a connection between risk management and corporate governance can be made by asking how risk management creates value for the owners of an organisation.

Bessis (2010) emphasised that the goal of ALM is to expose risk mismatch, and maintain risk within bounds, while optimizing the risk-return profile of the balance sheet, through both on-balance sheet actions (business policy) and off-balance sheet instruments (derivatives).

2.4.1 Risk Management in ALM

Earlier studies have demonstrated that ALM is useful in managing risk. For example, Korhonen and Wallenius (1998) applied a two-stage goal programing model to simulate the management of domestic and foreign currency dominated assets and liabilities of a bank. Tektas et al. (2005) developed an ALM model using goal programming to analyse distinct risk-taking behaviours of two medium-scale banks. Seshadri et al. (1999) employed a quadratic optimiser in an ALM simulation model to assist in the process of asset and liability selection in a stochastic interest rate environment. Gondzio and Kouwenberg (2000) found that both assets and liabilities are crucial in effective risk management. This is supported by Dash and Kajiji (2003) who confirmed that ALM can provide a useful model to enhance decision-making as it integrates long-run equilibrium liability efficiency while taking into account asset allocation strategies that avoid risk arising from a bank's exposure to credit, capital and interest rate risk. Kosmidou and Zopounidis (2005) also found that ALM is important in managing various risks while maintaining appropriate combination of assets and liability. This thesis uses ALM using the Basel Committee framework for managing liquidity and capital risk. As discussed previously, the corporate governance is meant to implement policies that will ensure that the bank operates at an optimal level of efficiency and therefore achieves the optimal level of profits.

2.5 Relationship between Corporate Governance Mechanism, Risk Management and ALM

The strategic management of asset and liabilities in the banking sector has become a major concern after the GFC, as commercial banks failed to efficiently structure their balance sheets to withstand unforeseen liquidity and capital requirements. This inefficiency in balance sheet structure was confirmed in a March 2013 Google scholar search, revealing a massive 4,050,000 items relating to ALM and 11,700,000 relating to weak ALM in banks. This overwhelming amount of research clearly reflects the lack of

confidence in the financial system and failures in corporate governance risk management. As Debelle (2010, p. 1) point out:

> *Risk was mis-assessed by financial institutions, risk managers, investors and regulators. There was a false comfort taken from a misplaced belief that risk was being accurately and appropriately measured. To some extent, the technology provided risk managers with a false sense of security. Risk may well have been accurately measured for the particular regime that the economy and markets were operating in. But the risk assessment was not robust to a regime change that took the models out of their historical comfort zone. Not enough account was taken out of uncertainty.*

This misperception of risk was partly caused by agency problems arising from conflicts of interest between the principal and agent. Agency theory can be viewed as the cost of structuring, monitoring and bonding a set of contracts (Jensen & Meckling 1976; Fama and Jensen 1983; Fama, 1980) and agency cost can be managed using corporate governance mechanisms for risk management. If banks have adequate risk management contingency plans, they can control the negative consequences of agency problems, such as occurred during the 2008 financial crisis. As mentioned by Bario et al. (2001), risk is inherently difficult to measure, and there is a tendency (even if modest) for people to underestimate risk in good times and overestimate risk in bad times. This would potentially amplify the financial dimension of an economic cycle and induce financial instability. This infers that risk is mis-measured in the upswing of the business cycle, indicating that a more activist role for prudential and or monetary policy balance is needed.

Greuning and Bratanovic (2009) explained that the balance sheet structure lies at the heart of the ALM process. Furthermore, the composition of a bank's balance sheet asset and liabilities is one of the key factors in determining the level of risk faced by institution. Therefore, any changes in policies on the relative structure of assets and liabilities should be a conscious decision of the bank's policy maker which is the board of directors.

2.6 Goal Programing Models for Bank ALM

Another important concept in the literature is using goal planning to manage various risks in order to achieve conflicting goals. Black et al. (2003) pointed out that the main problem managers face in ALM is to manage all risk, rather than just focus on certain factors within each risk category. Asset and liability managers need all the information to provide an overall risk view at an institutional level. Similarly, Kosmidou and Zopounidis (2004) conclude that the adoption of ALM is an important factor in minimising exposure to various risks in banks, while maintaining an appropriate combination of assets and liabilities that satisfy the goals of the financial institution. This will be discussed in more detailed in Chapter 4.

2.7 Managing the Stochastic Environment Using Simulation

The measurement of performance and productivity has garnered significant interest amongst both academics and industry in the past two decades. For example, according to Lambert and Larcker (1987), efficiency is one of the most important performance measures of a business, and using recognised and valid measures is critical in increasing the efficiency of organisations. Performance and productivity measures are important, however in order for these measures to be of greater significance, it is important to take into account uncertainty. The literature holds many examples in which uncertainty has been involved (Cohen & Thore 1970; Crane 1971; Booth 1972; Kallberg et al. 1982; Pyle 1971; Brodt 1978). The majority of these models originate from portfolio selection theory (Markowits 1959), with others using chance-constraint programing (Charnes & Thore 1996; Charnes & Littlechild 1968; Pogue & Bussard 1972), sequential decision theory (Wolf 1969; Bradley & Crane 1972), dynamic programing (Samuelson, 1969; Melton 1969, 1990; Eppen & Fama 1971) and dynamic generalised network program for financial planning problems under uncertainty (Mulvey & Vladimirou 1992). In a stochastic world, there would be perfect information relevant for decision making therefore banks need to determine the optimal decisions with regards to which loans and investments to make, how to finance them (taking deposits or issuing equity), how much liquidity and capital to hold, and how interest rate margins and fees respond to financial conditions. Account uncertainty also needs to be assessed.

Levary and Seitz (1990) explained that simulation is a technique that measures and describes various characteristics of performance measures of a model when one or more values for the independent variables are uncertain. Simulation analysis has been used in linear programming, integer programming and goal programming. It is an excellent technique, because decision makers can experiment with the model and obtain 'what if' questions, and also obtain an output that describes the financial management consequences that will result from a change in the independent uncertain variable. It is useful because it evaluates answers various what-if questions and helps managers make informed decisions in an uncertain capital environment.

The Australian banking industry's risk profile is complex. Banks, like any other business, are faced with a number of risks: liquidity, operational, credit, solvency and commodity price, foreign exchange, and interest rate risks. Hence any rational decision needs to involve choices selected from a number of alternatives and be directed towards an organisational goal. The objectives also need to take into account the current risk profile of the banks. Tektas et al. (2005) highlight that efficient asset and liability management requires maximising banks' profit, as well as controlling and reducing risks.

Simulation analysis has long been a useful tool for evaluating the performance of financial management (Olafsson 2002). A recent study conducted by Collier (2009) also discussed the uncertainty associated with the value of the dependent variable in introducing an element of risk to decision making. Any decision made on the basis of this value is based on incomplete information and therefore not all decisions will produce the intended results. As uncertainty increases, so does the risk of failure: this risky environment can affect rational behaviour. Simon (1947, p. 75) explains that rationality is the 'concern with the selection of preferred behaviour alternatives in terms of some systems of values whereby the consequences of behaviour can be evaluated'. Clearly if risk is not identified, measured and managed, the decision will not be a rational one. Simulation analysis is considered a superior method of analysis, because decision makers can experiment with the model and obtain what-if questions which will help managers make informed decisions in an uncertain environment.

The task of risk management is to reduce the impact of unanticipated change on the value of the institution. Simulation optimisation can be used to minimise risk by setting

policies and implementing these policies through constrains in the model. These constraints include the risk tolerance of the bank. Ludovicus (1995, p. 7) explained that:

> *Static models do not make optimal use of the opportunity to react to future circumstances, while dynamic models can be employed to compute policies that consist of actions to be taken now, and sequences of reactions to future development.*

Taking into consideration all of the above, the aim of corporate governance is to implement policies that will ensure that the bank operates at an optimal level of efficiency by minimising the level of uncertainty.

2.8 Limitations of the Existing Literature

Drawing from literature related to corporate governance and financial accounting (Negakis 2005; Cotter & Zimmer 1999; Lang & Lundholm 1996; Sloan 1996), financial accounting information and firm performance (Tangen 2004; Carlin & Mayer 2000; Tadesse 2000), risk management and corporate governance (Buhsman 2001; Murphy 1999b; Aboody & Kasznik 1999) and risk management and finance, this study develops an integrated bank asset and liability model that which ensure enhanced economic performance and minimising financial risk using corporate governance policies. Even though the literature is immense, previous models have failed to link the cross-disciplinary aspects needed to formulate an appropriate ALM model for use in the banking sector.

Another limitation in the literature is that most financial models are deterministic and static. However, as the world is stochastic, Kosmidou and Zopounidis (2001) proposed the need to investigate the role of exogenous factors and economic parameters within the market in order to develop an ALM model for banks that incorporates changing interest rates. The current research fills a gap by implementing Kosmidou and Zopounidis' recommendations to investigate efficient risk management in the context of corporate governance, using simulation analysis to ascertain the independent variables that can use what-if questions to help managers make informed decisions in a stochastic environment.

It is well understood that implementing good corporate governance can lead to improvements in the implementation of good risk management and improved financial performance (Bushman & Smith 2001; Bessis 2010). However, no studies have addressed the role of corporate governance mechanisms from a risk management perspective, and how these mechanisms can be used to implement financial management strategies that improve banks' financial performance and reduce problems of agency cost, inefficient decision making, unnecessary loss, and even future corporate collapse (Bushman & Smith 2001; Brown et al. 2011). Therefore, to fill this gap, the current study applies corporate governance mechanisms in an ALM model for an Australian bank.

Corporate governance literature is also concerned with the impact of regulatory requirements. For example, the 2011 Bank for International Settlements publication *Liquidity Transfer Pricing: A Guide to Better Practice*, revealed that liquidity cushions were too small to withstand prolonged market disruptions, and contained assets that were thought to be more liquid than they actually were (BIS 2011b). To date, no study has researched the implementation of Basel III liquidity cushions and the impact these will have on ALM strategies from a corporate governance perspective used in a case study. Finally, this thesis fills a gap in the literature by enhancing understanding of corporate governance mechanisms and their efficient application to ALM in an Australian context. Also, by implementing Basel III liquidity requirements in stochastic goal ALM, banks can successfully reduce agency cost and thus improve performance.

Taking into consideration all of the above, the aim of corporate governance is to implement policies that will ensure that the bank operates at an optimal level of efficiency and therefore achieves the optimal level of profits. By implementing internal and external corporate governance mechanisms, organisations can take a pro-active approach to managing risk. In this way, corporate governance implementation of robust risk management strategies can be improved to ensure that shareholders are satisfied and depositors' funds secured, thus enhancing the investor confidence essential for success in both the organisation and wider economy.

2.9 Conclusion

Despite the large body of theoretical and empirical research into corporate governance, risk management, financial accounting information, financial planning and ALM, no other studies have developed a comprehensive ALM model that incorporates corporate governance, risk management and financial planning within an Australian setting for a bank. However, research in this area is important because it addresses current issues of corporate governance and risk management inefficiencies that could lead to potential loss to all stakeholders. At the micro and macro level, positive relationships exist between good corporate governance and risk management. Corporate governance mechanisms also play a crucial role in mitigating risk.

This thesis draws from the research conducted by Kosmidou and Zopounidis (2001), who developed an ALM goal programing model that has been used as foundation for the research. Furthermore, the thesis draws from theories presented in corporate governance, risk management and finance to formulate an ALM model using mathematical constraints under the new Basel III liquidity and capital framework. The incorporation of these theories from various disciplines is important because they assist in strengthening an ALM model that achieves the potentially conflicting goals of maximising profit and minimising risk to realise both short and long-term economic and social sustainability objectives. This thesis uses a corporate governance framework applied to a stochastic goal programming ALM model, and simulating the implementation of sound risk management policies that incorporate the ASX corporate governance council's recommendation Principle 7. This principle is used to recognise and manage risk by focusing specifically on liquidity and insolvency risk. In this way, effective governance mechanisms can ensure that the interests of all stakeholders are served.

Long-term strategic success for firms can also be assured when they are governed in ways that permit at least minimal satisfaction for all stakeholders including capital market (shareholders), product market stakeholders (customers and suppliers) and organisational employees (managerial and non-managerial employees). Unfortunately, the single equation models ignore much of the interdependence that characterizes the modern world with the most important models in economics and business being

simultaneous in nature. In practice, the economic world is full of the kind of feedback effects and dual causalities that require the application of simultaneous equations.

Chapter 3
Conceptual Framework

3.1 Introduction

In order to design a bank asset and liability management model using a corporate governance (CG) framework that is suited for use in banks under the new Basel III framework, a methodology based on the review of current literature on corporate governance, risk management, and asset and liability management presented in Chapter 2, is developed. This methodology is used to construct the conceptual corporate governance framework using Basel III framework applied to a stochastic goal programming asset and liability management (ALM) model is explained.

In order to include the relevant theories and concepts identified in Chapter 2 within a mathematical model, the proposed conceptual framework is structured to incorporate good corporate governance principles. As this requires operationalization of this framework, the use of goal programming and simulation analysis is in keeping with the main objective of the thesis, which is to use a bank asset and liability goal management model that assists measuring the impact of Basel III on net interest income, return on equity and return on assets. This framework is created by constructing a positive empirical model using simulation optimisation methodologies to conduct stress tests for two crisis scenarios: an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%; and an increase of 10% in net cash outflow and a decrease in interest income of 10%. Finally, the conceptual framework is used to assist in simulating potential policy responses guided by governance to the challenges faced by the banks.

As strategic asset and liability management has become a major concern in today's banking environment, with assets and liability being managed simultaneously, ALM is important because it can quantify and control the various risks that banks encounter. However, the recent financial crisis experience showed that ALM had not been appropriately executed; resulting in the numerous banks failures that helped precipitate the 2008 financial crisis. This has sharply highlighted the need for ALM models to incorporate a more integrated approach that emphasises ALM strategies of good

corporate governance, efficient risk management and strategic financial planning. This view has been widely supported in the literature, for example Greuning and Bratanovic (2009) pointed out that:

> *…corporate governance provides a disciplined structure through which a bank sets its objectives and the means of obtaining them, as well as monitoring the performance of those objectives and that effective corporate governance encourages a bank to operate in a safe and sound manner and to use its resources more efficiently. (p. 41)*

In this thesis, good corporate governance is simulated by implementing risk management policies that comply with the new Basel III liquidity and capital framework, hence resulting in a more responsible framework for ALM that enhances asset management, liability management, and capital management to manage risk.

The recommendations made by Greuning and Bratanovic (2009) are important because the integration of corporate governance, risk management and financial management will result in a more responsible framework for ALM that enhances asset management, liability management, liquidity and capital management to manage risk. Furthermore, including corporate governance ALM strategy is based on the interest of all stakeholders including the bank itself, this approach is more responsible for ALM for banks. By implementing corporate governance that includes risk management principles and practices, ALM will be more focused, specific and comprehensively synchronized with the strategic direction of the bank.

Hart (1995) highlighted that all individuals within an organization can be instructed to maximize profit or net market value, or to minimize costs. However, there is a trade-off between incentives (profit) and risk sharing, i.e. a large part of the principal agent literature has been concerned with determining the optimal balance between efficiency and risk-bearing. In the context of this thesis, this means that an optimal balance sheet structure will achieve the corporate governance objectives of risk minimisation (interest rate, credit risk, liquidity and insolvency risk) and enhances financial performance (return on equity (ROE), return on assets (ROA) and net interest income (NII)). As Calder (2008, p. 97) states, “Profits are, in part, the reward for successful risk-taking in

business, the purpose of internal control is to help manage and control risk appropriately rather than to eliminate it".

3.2 Conceptual Framework of the Integrated Model

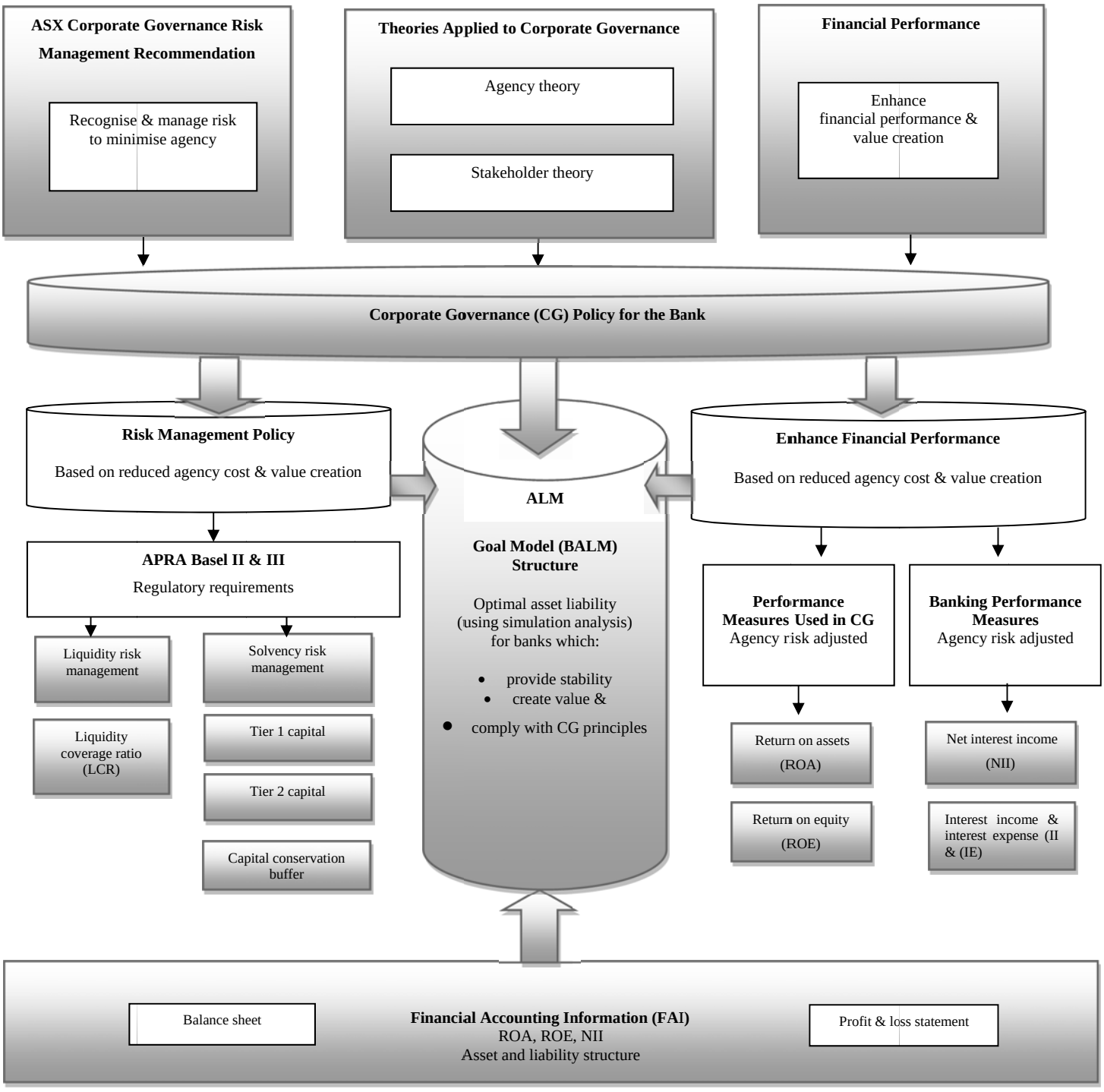
This thesis draws primarily from the research conducted by Kosmidou and Zopounidis (2001), which developed a goal programing ALM model. Using this model as a foundation, corporate governance and risk management theories and practices are incorporated into the asset and liability management model recommended by the ASX Good Corporate Governance Practices, which allow the overall operation of an organization and help control any agency problems resulting from separation of ownership (Bohen 1995).

As most econometric applications are inherently interdependent in nature, and the best approach to understanding their complex relationships is to provide feedback loops within the conceptual framework, the conceptual framework in Figure 3.1 below draws from corporate governance theories applied to risk management and finance, taking into account all aspects of the organization as a whole in order to manage the assets, liability and equity (Kosmidou and Zopounidis 2001). By implementing this framework, the bank can ensure that there are adequate control mechanisms for minimising agency cost, the interests of all stakeholders are served, and financial performance is maximised (Busman 2001).

OECD principles of corporate governance (OECD 2004, p. 4) explained that:

> *Corporate governance is only part of the larger economic context in which firms operate that includes, for example, macroeconomic policies and the degree of competition in product and factor markets. The corporate framework also depends on the legal, regulatory, and institutional environment. In addition, factors such as business ethics and corporate governance awareness of the environmental and societal interest of the communities in which a company operates can also have an impact on its reputation and its long-term success.*

Figure 3.1: Theoretical and Conceptual Frameworks: Developing of the New Asset and Liability Management Goal Model that Incorporates Corporate Governance, Risk Management, Financial Performance and Financial Accounting Information



Corporate governance has become an important factor in managing organizations in the current complex global environment (Abdullah and Valentine 2009). However, although there are many ways to describe corporate governance, it can be broadly defined as the responsibility and accountability of management for the overall operation of an organization (Bohen 1995). More recently however, corporate governance has been defined as the system of controls that helps a corporation effectively manage, and administer its direct economic resources (Hirschey 2009). The fundamental theories in corporate governance began with agency theory, which then expanded into stewardship theory, and stakeholder theory and evolved into resource dependency theory, transaction cost theory, legitimate theory and social contract theory. Hence, "it is suggested that a combination of various theories is best to describe an effective and good governance practice rather than theorizing corporate governance based on a single theory" (Abdullah 2009, p. 1). The following sections discuss the main theories that apply to this thesis, including agency theory and stakeholder theory.

As discussed previously, good corporate governance is important for all organisations, especially banks which have a fiduciary duty to so many stakeholders. Therefore, the conceptual framework (Figure 3.1) illustrates the link between corporate governance, risk management and asset and liability management, using financial accounting information. The conceptual framework in this study considers the three important corporate governance theories of agency theory and stakeholder theory to optimise asset and liability in order for banks to provide stability, create value and comply with corporate governance principles.

In line with the seventh ASX corporate governance principle which recommends that firms need to recognise and manage risk, the conceptual framework is designed to manage liquidity, solvency and credit risk through the implementation of mathematical constraints that manage interest risk by using simulation techniques to measure and describe various characteristics of bottom-line performance measures. This accords with the seventh ASX corporate governance principle, which recommends enhancing efficiency and financial performances by reducing agency and transaction costs and creating value. Evidence from empirical research suggests that ROA and ROE are useful ratios in measuring the effectiveness of a corporate governance policy (Bessis

2010). This framework also uses financial measures such as net interest income and interest expense as financial performance measures (see Chapter 2).

As discussed previously in Chapter 2, corporate governance influences firm performance (Bushman and Smith 2001) and reveals whether corporate governance is directing and monitoring a top-level manager's decisions efficiently. Good corporate governance ensures that the agency problem is minimised and that managers are making optimal decisions that maximise firm performance. For this reason, the thesis framework presented in Figure 3.1 is broad in scope and nature, and comprehensively numbered for ease of reference when explaining the simultaneous integrated relationship occurring in asset and liability management in the order of the numbering below, and more fully explained in the following sections:

- Corporate governance policy for banks
- Corporate governance theories
- Agency theory
- Stakeholder theory
- Corporate governance recommendation
- Recognise and manage risk to minimise agency
- Enhance financial performance and value creation
- ALM goal model: Optimal asset liability for banks which provide stability, create value and comply with corporate governance principle.
- Risk management policy: Based on reduced agency and value creation.
- Regulatory compliance – Basel II and III (reduced solvency and liquidity risk)
- Enhance financial performance: Based on reduced agency cost and value creation.
- CG performance measures (increase ROA and ROE, agency risk adjusted)
- Efficiency measures (reduced interest expense and increased net interest income agency risk adjusted.
- Financial accounting information

3.3 Corporate Governance Policy for Banks in Australia

The conceptual framework of this study draws from corporate governance theories. Evidence from empirical research suggests that the implementation of good corporate governance practices will ensure that banks can enhance their risk management and financial performances (Busman and Smith 2001). In this context, managers are responsible for overall operations which include managing risk and enhancing performance; but due to separation of ownership and control, agency problems can arise (see Chapter 2). Therefore, good corporate governance needs to ensure that there are adequate control mechanisms for minimising agency cost so that the interests of all stakeholders can be served (Bessis 2010).

As explained by Greuning and Bratanovic (2009, p. 5):

> *…the quality of corporate governance has become a much debated topic, and the approach to regulation and supervision is changing dramatically, this means that banks need to consider the new banking environment and increased market volatility has necessitated an integrated approach to asset-liability and risk management techniques.*

Their study has reconfirmed that the quality of bank management is determined by its corporate governance, particularly in the risk management process which ensures that both dimensions of corporate governance and risk management within a new asset and liability management goal model (BALM) are integrated. This framework addresses the importance of implementing good corporate governance through the implementation of risk management mechanisms, as well as the need to enhance financial performance using financial measures from accounting and finance. In all instances of risk management however, present risk management strategies must be measured before they can be improved. Therefore, this proposed framework embeds extended appropriate dimensions of measures of corporate governance and asset and liability management, using goal programing and simulation analysis.

A recent study conducted by Love (2010, p. 45) reported that corporate governance mechanisms can improve operating performance in several ways:

- with better oversight, managers are more likely to invest in value-maximizing projects and be more efficient in their operations;
- following the above, fewer resources will be wasted on non-productive activities; and
- better governance reduces the incidence of tunnelling, asset-stripping, related party transactions, and other ways of diverting firm assets or cash flows from equity holders.

If investors are better protected and bear less risk of losing their assets, they should be willing to accept a lower return on their investment. This will translate into a lower cost of capital for firms and hence high income; and the availability of external finance may also be improved, allowing firms to undertake an increased number of profitability opportunities.

In addition, the integration of corporate governance through implementation of risk management policies by identification, quantification and monitoring of risk profiles, is likely to enhance the chance to achieve the goal of corporate financial management to maximize value of the bank, as defined by its profitability and risk level (Greuning and Bratanovic 2009).

3.4 Theories Used in the Proposed Framework

The conceptual framework (Figure 3.1) illustrates links between the three theories used in corporate governance. Evidence from research suggests that these corporate governance theories highlight the challenges that organisations face in their efficient management (Bushman, 2002; Greunning and Bratanovic 2009; Kaushik, 2012). In order to address the conflicting interests described in agency theory (Jensen and Mekling 1976), corporate governance control mechanisms need to ensure that firms eliminate the potential divergence of interests between managers and stakeholders (Busman 2001). This will help alleviate the agency problem and achieve corporate governance goals (see Section 3.2.1).

Jensen and Meckling (1979) define agency theory as the relationship between the principals (shareholders) and agents (company executives and managers) in a corporation. If both parties to the relationship are utility maximisers, there is good

reason to believe that the agent will not always behave in the best interest of the principal, meaning that managers have incentives to pursue their own interest at the expense of shareholders. Based on this premise, in order to protect shareholders and managers from conflicts of interests, organisations need adequate monitoring and control mechanisms (Fama and Jensen 1983). These corporate control mechanisms ensure that firms eliminate the potential conflict of interest between managers and stakeholders (Busman 2001), help alleviate the agency problem, and achieve corporate governance goals. As there is ample evidence that agency problems were one of the main contributors to the 2008 financial crisis (Stiglitz 2010) agency theory has become of major concern in corporate governance literature, and the fundamental underpinning of this thesis.

As discussed in Chapter 2, Shareholder theory is defined as accountability to more than just shareholders, to include all those who can be affected by the achievement of the firm's objectives (Freeman 1984; Freeman et al. 2004). In context of the important role that banks play in our society, it is difficult to draw boundaries when stakeholders go beyond those individuals that have a direct relationship to the bank. For this reason, this thesis argues that corporate governance policies need to manage risk and enhance performance in a way that allows the broader society to benefit from positive externalities. As many authors support the view that it is difficult to draw boundaries, this thesis argues that corporate governance policies need to manage risk and enhance performance so that society can positively benefit from externalities (Clarke 2004; Beckrman 2011).

Using Cyert and March's (1963) transaction cost theory, this thesis also presents the firm as an organization comprised of people with different views and objectives, which in many circumstances are conflicting. More recently, Abdullah (2009) pointed out that the underlying assumption of transaction theory is some firms have become so large that they in effect substitute for the market in determining allocations of resources. He maintained that the organizational structure of a firm can determine price and production.

The above three corporate governance theories highlight the challenges that bank managers face in efficiently managing their organisations. However, their internal corporate governance mechanisms can help alleviate agency cost, enhance allocative

efficiency, and monitor and facilitate the achievement of organisational goals (Greuning and Bratanovic 2009; Hadi and Abdul 2011; Banerjee 2013). As confirmed by Love (2010), better governance can increase the efficiency and output of firms and make investors' funds more productive.

3.5 ASX Corporate Governance Recommendations

The ASX Corporate Governance Council considers that their ASX Corporate Governance Principles and Recommendations represent a distillation of practices that can assist companies to implement a robust corporate governance framework. These recommendations are not prescriptions; they are guidelines, designed to produce an outcome that is effective and of high quality and integrity (ASX 2010). In this study, the theoretical framework presented in Figure 3.1 is used to implement the ASX Corporate Governance Principle 7 of recognising and managing risk. To ensure that companies establish a sound system of risk oversight and management of internal control ASX (2012, p. 12) includes the following:

- *Recommendation 7.1: Companies should establish policies for the oversight and management of material business risks and disclose a summary of those policies.*
- *Recommendation 7.2: The board should require management to design and implement the risk management and internal control system to manage the company's material business risks and report to it on whether those risks are being managed effectively. The board should disclose that management has reported to it as to the effectiveness of the company's management of its material business risks.*
- *Recommendation 7.3: The board should disclose whether it has received assurance from the chief executive officer (or equivalent) and the chief financial officer (or equivalent) that the declaration provided in accordance with section 295A of the Corporations Act is founded on a sound system of risk management and internal control, and that the system is operating effectively.*
- *Recommendation 7.4: Companies should provide the information indicated in the guide to reporting on Principle 7.*

The notion for implementation of ASX corporate governance Principle 7, is that the literature has confirmed that when companies recognise and manage risk, they enhances their financial performance (see Chapter 2).

The ASX corporate governance Principle 7 of recognising and managing risk, ensures that companies establish a sound system of risk oversight and management of internal control, (ASX 2012, p. 12). This thesis focuses on simulating the implementation of the risk management policy (Basel III framework) and report to it on whether those risks are being managed effectively through the output the bank asset and liability management model generates.

As highlighted by Laughlin (2015), the duty of the board of directors is to have an adequate risk management framework that first ensures that the bank complies with the Basel III minimum liquidity and capital regulatory requirements. However, it is a corporate governance risk management policy for the bank to hold excess capital (equal to 4.8%) based on industry practice. From a liquidity perspective, it is a corporate governance policy decision to hold more than the minimum of 100% of the liquidity cover ratio.

In this study, the conceptual framework highlights the relationship with, and importance of corporate governance. This is closely related to corporate strategy adopted for using in the risk policies. Such policies involve specifying the types and degrees of risk that a company is willing to accept in pursuit of its financial goals. It also provides crucial guidelines for management to manage risk in order to meet desired company risk profile. The OECD corporate governance recommendation emphasises that the board should fulfil certain key functions including: reviewing and guiding corporate strategy; major plans of action; risk policy; annual budgets and business plans; setting performance objectives; monitoring implementation and corporate performance; and overseeing major capital expenditure, acquisitions and divestitures.

According to OECD (2004) principles, the board's main responsibility is to monitor managerial performance and achieve adequate returns for shareholders, while preventing any conflicts of interest and managing competing demands on the corporation. "The corporate governance framework should ensure the strategic

guidance of the company, the effective monitoring of management by the board's accountability to the company and the shareholders" (OECD 2004, p. 59).

An important corporate governance responsibility is to set up internal programs and procedures that are in compliance with the applicable laws, regulations and standards (OECD 2004). The OECD corporate governance Principle 7 focusses on the responsibility of the board, emphasising that "the corporate governance framework should ensure the strategic guidance of the company, the effective monitoring of management by the board, and the board's accountability to the company and the shareholders" (OECD 2004 p. 58). This principle recommends that in a corporate governance strategy, the board is responsible for monitoring managerial performance while achieving adequate financial returns for both shareholders and other stakeholders, thus preventing conflicts of interest and balancing conflicting demands on the organisation.

Since corporate governance responsibility is to monitor managerial performance, corporate strategy for risk management policies has become increasingly important. Such policies involve specifying the types and degree of risk that a company is willing to accept in the pursuit of enhancing financial performance. For example, Aebi et al.'s (2012) research combines and further develop relevant previous findings to analyse the performance of banks during the 2008 financial crisis, focussing in three major areas: corporate governance, enterprise risk management and bank performance. Their findings indicate that banks in which the CRO reports directly to the board of directors, performed significantly better than other banks in the financial crisis; while banks in which the CRO reports to the CEO, performed significantly worse than other banks. Their findings highlight the importance of risk management in the corporate governance of banks, and that banks need be better prepared to face any future financial crisis, by significantly improving the quality and profile of risk management functions through the implement action of appropriate risk governance with CEO and CRO at the same level reporting to the board of directors. However, these authors argue that this strategy may come at the cost of lower performance in a normal market environment.

3.5.1 Recognising and Managing Risk to Reduce Agency Cost

The ASX corporate governance Principle 7 is 'Recognise and manage risk'. The literature highlights that risk management is one of the corporate governance mechanisms that is used to reduce agency cost (Abdulah 2009; Kaen 2003). Risk management policies influence decision making, and therefore in the context of this thesis, corporate governance risk management policy aims to minimise risk such as liquidity, solvency, credit and interest rate risk.

The modern corporation's fundamental goal is to continuously create and add value to its business (Kaen 2003; Calder 2008). However, the current traditional risk management strategies are not adequate to control the interdisciplinary impacts of corporate governance, accounting practices, financial planning under uncertainty and regulation. The UK corporate governance framework stressed that the objective of balancing profit is to maximize against risk reduction (Calder 2008). Therefore, there is a need to develop a new integrated framework for modelling and analysing asset and liability management issues by simultaneous consideration of these impacts.

3.6 Major Regulators in Australia

Further to these recommendations, in the context of banks the Australian Prudential Regulation Authority (APRA), Australian Security and Investments Commission (ASIC), and the Reserve Bank of Australia (RBA) are the major regulators responsible for ensuring stability and efficient operations within the financial system (Sounders and Cornet. 2011; Gans et al. 2012; Lange 2013). As discussed in Chapter 1, the financial system is critical to the operation of the overall economy, due to its relationship to every other sector (McGrath and Viney 1997). Consequently, government regulation plays a crucial role in ensuring efficiency within the financial system, serving as a vehicle to achieve the macro and microeconomic objectives of a nation, including, allocative, productive, technical and dynamic efficiency. In this context, the role of corporate governance is to be responsible for ensuring that the organization complies with APRA's Prudential Standards for ADIs, including Basel II and III liquidity and capital requirements, and also ensure that the management of financial institutions make prudent decisions that minimise institutional failures and protect depositors (APRA

2012d). For this reason, the conceptual framework of this study includes both the regulatory requirements of Basel III liquidity and solvency requirements of APRA.

Banks should consider the new Basel III requirements, not only from a regulatory perspective, but also as an opportunity to develop robust risk management policies that enhance financial performance and investor confidence. Greuning and Bratanovic (2009) quoted the former U.S. SEC Chairman William Donaldson:

> *Simply complying with the rules is not enough. They should, as I have said before, make this approach part of their companies' DNA. For companies that take this approach, most of the major concerns about compliance disappear. Moreover, if companies view the new laws as opportunities—opportunities to improve internal controls, improve the performance of the board, and improve their public reporting—they will ultimately be better run, more transparent, and therefore more attractive to investors. (Greuning and Bratanovic 2009, p. 71)*

The study framework also integrates the non-regulatory requirements of ASX corporate governance recommendation Principle 7 for recognising and managing risk, in particular credit risk through the implementation of mathematical constraints and simulation analysis to manage interest rate risk and describe various characteristics of bottom-line performance measures. As banks have a social and regulatory duty to minimize risk in order to enhance financial performance, in the context of regulatory compliance, a study by Mullineux (2007a) emphasized that bank managers have a fiduciary duty to both depositors and shareholders to solve the principal-agent problem.

3.7 Corporate Governance Role in Regulatory Compliance Requirements of Banks

The conceptual framework implements that the ASX corporate governance Principle 7 of recognise and manage risk in order to establish a sound system of risk oversight and management and internal controls (ASX 2012, p. 12). In implementing this principle, the current framework emphasises one major responsibility of corporate governance which is to ensure that banks comply with Basel III regulatory requirements of liquidity and capital. Bruce et al. (2013) explained that the main analytical paradigm shift which followed the 2008 financial crisis was been a rediscovery of the financial cycle as the key factor underlying severe financial crises. Hence, the main policy paradigm shift has been a strengthening of the macro prudential or systematic orientation, even though the

new Basel III regulations ensure that banks comply with liquidity and capital requirements pose a challenge to banks performance, the role of corporate governance is to ensure that the likelihood of future financial failure is reduced.

Bruce et al.'s (2013) research discusses aspects of a macro prudential framework that shows how the countercyclical capital buffer envisaged in Basel III takes into account properties of the financial cycle and strengths and weaknesses of macro-stress tests. Furthermore, they explain how best to monitor financial systems in the broader economy in order to detect signs of vulnerability that might lead to future bouts of financial instability and how to set prudential policy accordingly. Furthermore, Basel III clearly emphasises the important role that capital and liquidity play in making the system more resilient. While it is certain that the new regulation promotes stability, it is a major challenge for banks to comply with the new liquidity and capital regulatory requirements and at the same time ensuring they remain competitive and profitable in the short and long run.

3.8 Integration of Corporate Governance and Liquidity Risk Management Policies

In analysing the role of liquid assets for resource allocation in the contexts of asset and liability management for banks, regulation plays a crucial role, particularly requirements relating to liquidity and capital. Liquidity is an important factor in investment decisions, asset pricing for bonds and stocks, portfolio diversification, and management of financial risk. Many studies have attributed a positive relationship between corporate governance and liquidity in lowering agency cost, leading to a smaller adverse selection cost when the quality of corporate governance improves (Kanagaretnam et al. 2007; Goh et al. 2008; Chung et al. 2010). In a more recent study, Lei et al. (2013) used a sample of Chinese A-share firms listed on the Shenzhen and Shanghai stock exchange between 2006 and 2007 to study the relationships between liquidity and corporate governance mechanisms such as managerial compensation, controlling shareholders monitoring and board independence. Their findings demonstrated that there is a positive relationship between good corporate governance and liquidity, meaning that different types of agency conflicts are reduced.

First liquidity, or the ability to fund increases in assets and meet obligations as they come due, is crucial to the ongoing viability of any banking organisation (See Appendix

3). Therefore, managing liquidity is among the most important activities conducted by banks. Sound liquidity management can reduce the probability of serious problems. And indeed, the importance of liquidity transcends the individual bank, where a liquidity shortfall at a single institution can have system-wide repercussions (see Chapter 2). For this reason, the analysis of liquidity requires bank management not only to measure the liquidity position of the bank on an ongoing basis, but also to examine how funding requirements are likely to evolve under various scenarios, including adverse conditions (BIS 2008).

As liquidity is an important factor in investment decisions, there is a voluminous amount of information pertaining to asset pricing for bonds and stocks, portfolio diversification, and management of financial risk. Many studies (for example Chung et al. 2010; APRA 2010, 2014) have attributed a positive relationship between corporate governance and liquidity in lowering agency cost – leading to a smaller adverse selection cost when the quality of corporate governance improves (Kanagaretnam et al. 2007; Goh et al. 2008; Chung et al. 2010). There are many ways to directly measure liquidity, including trading cost, depth, price impact, and bid-ask spread (Lei et al. 2013). In analysing the role of liquid assets for resource allocation in the contexts of asset and liability management for banks, regulation plays a crucial role.

APRA recommends that banks implement and maintain liquidity management strategies that are in line with operations of the Authorised Deposit Institutions (ADI) to ensure that they have sufficient liquidity to meet any obligations that fall due in both domestic and overseas markets. APRA (2014c) emphasised that banks' liquidity management strategies should, where appropriate, include scenario analyses of domestic and foreign currency liquidity to ensure that ADIs can operate under a wide range of operating conditions. Firstly, they must deal with the going-concern of normal behaviour of cash flows in the ordinary course of business, and secondly they must deal with the name crisis occurring in the behaviour of cash flows occurring in adverse operating circumstances specific to the ADI when there is significant difficulty in rolling over or replacing liabilities. The APRA publication *APRA Draft Prudential Practice Guide APG 210: Liquidity* (2014a) highlighted that the responsibilities of the board and senior management for liquidity risk management requirements is to establish a risk management framework that manages liquidity risk, annual contingency funding

strategies, including future cash flow of assets and liabilities, stress testing, liquid asset diversification, and adequate CLF and the LCR levels.

3.9 Optimal Integrated Asset and Liability Management Goal

The asset and liability management goal draws from theories of corporate governance and employs the two ASX corporate governance recommendations (Greuning and Bratanovic 2009) including: recognition and management of risk, with the aim of minimising agency problems (Collier 2009) and enhancing financial performance (Xu et al. 2013), to reduce agency costs and create value. This model is developed by implementing two corporate governance objectives, first to identify and manage risk, and second to enhance financial performance. To accomplish these goals, the model in this thesis is based on the objectives of reducing agency cost, and maximising shareholder value.

As dynamic asset and liability management models aim to find optimal investment strategies under uncertainty, the simultaneous stochastic consideration of common risk factors in assets and liabilities can be highly advantageous in risk prevention (Kosmidou and Zopounidis 2004). Banks assets are allocated based on the liability structure of the balance sheet, making it possible to reduce risk in the entire portfolio. The main asset and liability management objective in this study is to look at complex organizations in an integrated way, and develop corporate governance policies that integrate liquidity, capital and funding management, while ensuring sustainable business growth. However, as competition amongst banks for attracting deposits and obtaining capital has become more intense in current market conditions it is important to view asset and liability management in a more dynamic way using a centralised overall strategic approach to the structure of the balance sheet. This is influenced by the bank's corporate governance goals and objectives, while taking into account regulatory requirements such as liquidity and Basel requirements.

Basel III requirements in asset and liability management are an important dimension of risk governance. Therefore in taking an integrated approach, the bank infrastructure needs to be aimed at supporting liquidity, capital and funding requirements. The analysis of these three key integrated areas ensures that corporate governance objectives are achieved within the liquidity, funding and capital constraints of the bank. The

current literature highlights that institutions tend to regard capital analysis not from the perspective of capital itself, but from its relationships to the types of funding, and size and structure of balance sheets. These strategic approaches to liquidity management have always been important in the risk management area, not only from the banks' perspective, but also from a regulatory perspective (Greuning and Bratanovic 2009).

As there are numerous factors affecting financial performance, the asset and liability management goal model of this study is based on an approach in which the central concern of corporate governance is integrated with risk management and financial performance (see Figure 3.1). An integrated approach to asset and liability management requires an assessment of corporate governance mechanisms, including the theories used, regulatory requirements, ASX risk management recommendations, and the 1999 OECD recommendations (OECD 2004).

The UK corporate governance framework states that the "objective of balancing profit maximization is to guard against risk" (Frenkel 2005). This means that an optimal balance sheet structure will achieve the corporate governance objectives of risk minimisation (interest rate, credit risk, liquidity and insolvency risk) and enhanced financial performance (ROE, ROA, NII). As Calder (2008, p. 97) states, "Profits are, in part, the reward for successful risk-taking in business, the purpose of internal control is to help manage and control risk appropriately rather than to eliminate it".

3.10 Integrated Corporate Governance through Risk Management Policy

As the goal of risk management is to control risk (Bessis 2010), the conceptual framework of this study incorporates theories from corporate governance and the ASX Corporate Governance Principle 7 of recognising and managing risk, (companies should establish a sound system of risk oversight, management and internal control). In the conceptual framework, risk management policy aims to reduce agency, while creating value by managing risk through regulatory compliance of Basel III requirements. This framework is sub-divided into two sections: Regulatory Compliance – Basel III (reduced solvency risk) and (reduced liquidity risk).

As risk management is concerned with rational decision-making under uncertainty (Mertzanis 2013), this research emphasises the need for risk measures that deal adequately with rare/extreme events, such as the recent financial crisis. However, in the

modern complex financial world, such risk measures can only be effective if they take into consideration the endogeneity of risk. Arbi et al. (2012, p. 325) pointed out that "banks were pushed by their boards to maximize shareholder wealth before the crisis and took risks that were understood to create wealth but later turned out poorly in the crisis". To avoid this problem, this thesis argues that the role of corporate governance is to have both policies that maximise profit, and policies that identify, manage and minimise risk. Furthermore, the 'ultimate responsibility for sound and prudent management of an APRA-regulated institution rests with its board' (Laughlin 2015, p 7).

3.11 Enhancement of Financial Performance and Value Creation

Based on prior literature that shows that corporate governance leads to risk minimisation (Bessis 2010) and enhanced performance (Xu et al. 2013), this thesis uses corporate governance performance and banking performance measures. The conceptual frameworks draws from corporate governance theories, risk management theories and the ASX corporate governance recommendation Principle 7 to recognise and manage risk, with the aim of minimising agency. The performance and banking variables considered in this conceptual framework are explained in Section 3.14 and 3.15.

The Basel Committee on Banking Supervision (2010) explains that the "new capital conservation buffer of 2.5% comprised of Common Equity Tier 1, is established above the regulatory minimum capital requirement" (p. 55). Common equity Tier 1 is used to meet the minimum capital requirement (including the 6% Tier 1 and 8% total capital requirements if necessary) before the remainder is used to contribute to the capital conservation buffer. These requirements are in line with those recommended by authors including Brezeanu et al. (2011), Anderson et al. (2007) and Forsberg (2004), who emphasised that corporate governance does in fact impact on capital structure. Hence, in terms of asset liability management, capital structure demonstrates the bank's risk appetite and availability of funds that contribute to profitability.

Furthermore, Gitzmann and Ireland (2005) explained that company financial structures can be preserved as receptors of various factors derived at firm and industry levels, including institutional, political and social. Another important factor that influences the financial structure (ALM) for banks is regulation. This argument is supported by Brezeanu et al. (2011, p. 153) who states that "capital structure bears the mark of the

board of directors' decision in respect to the company's financing policy, being deeply linked with the corporate governance area".

As management needs to hold sufficient capital to ensure the on-going viability of the institution and the maintenance of customer confidence, the thesis model includes a constraint on the minimum amount of capital necessary to sustain customer confidence in the institution. This capital provides the basis for growth of the institution, and once the institution has commenced operations, the ability to develop a capital base will determine the rate at which the institution is able to grow. Growth in capital also represents growth in shareholder wealth when it is generated internally. However, when external sources of capital are used, tapping into these may dilute the value of returns to existing shareholders who may decide that a preferable way to generate an increase in wealth would be to retain some of the profits in the form of income not disbursed as dividends.

3.12 Relationship Between an Integrated CG Approach and Banks Financial Performance

Theory and practice in the field of finance have demonstrated that one of the objectives of any organisation is to maximise profit. The assumption of profit maximization is frequently used in microeconomics because it predicts business behaviour reasonably accurately (Pindyck and Rubinfeld 2005). However, the question of whether firms actually do seek to maximize profit has been controversial, for example Anthony (1960) argues that profit maximization may not be a valid assumption to explain either how businesses actually behave or how they should behave. Another example is Alchlan (1950) who explained the analysis of economic behaviour as relying heavily on decisions made by rational units customarily assumed to be seeking perfectly optimal situations (profit maximization and utility maximization), given that there is "imperfect foresight and human inability to solve complex problems containing a host of variables even when an optimal is defined" (p. 212). However, Pindyck and Rubinfeld (2005) argued that firms that do survive in a competitive industry make long-run profit maximization one of their priorities. Hence, given the competitive nature of the banking industry, this researcher assumes that the board of directors has two goals, to maximize profit and to manage risk, in order to continue to attract funds and ensure survival.

One way to achieve this goal is to manage the organization in an efficient manner to achieve cost minimization, for example, structuring the balance sheet in order to obtain funds at lower cost and therefore increasing the gap between cost and revenue. However, in banking, the relationship between maximising profit and minimising cost is highly complex, since obtaining funds usually increases cost, while maximising profit increases risk. Hence, risk minimization and profit maximization goals are by nature conflicting. This dilemma between risk and return means that in order to achieve the corporate governance objectives of risk minimization and profitability maximisation, asset and liability management model needs to set appropriate quantities and types of asset and liability requirements to yield optimal outcomes. Therefore, in this study enhanced financial performance in banks is based on reduced agency and transaction cost for value creation. These are measured by increases in net interest income, return on equity, return on asset and minimisation of interest expense.

There is a direct relationship between corporate governance and financial performance, as corporate governance is a relationship among stakeholders that is used to determine a firm's direction and to control its performance (Bushman and Smith 2001; Greuning and Bratanovic 2009); it is how firms monitor and control a high-level manager's decisions and actions affecting the implementation of strategies. Good corporate governance ensures that the agency problem is minimised and that managers are making optimal decisions that maximise firm performance. In other words, firm performance reveals whether corporate governance is directing and monitoring a high-level manager's decisions efficiently.

The conceptual framework includes both corporate governance performance and efficiency measure. The following sections explain how they incorporate corporate governance theories and ASX corporate governance recommendations.

3.13 Performance Measures Used in Corporate Governance

The conceptual framework (Figure 3.1) illustrates that the ALM goal model draws from theories of corporate governance, employing ASX Corporate Governance recommendations to enhance financial performance. The two variables identified in the corporate governance literature used to measure financial performance are ROA and ROE (Xu et al. 2013).

3.14 Performance Measures Used in Banking and Finance

The conceptual framework also includes two performance measures from prior literature, including net interest income (NII), interest income (II) and reduced interest expense (IE) (see Chapter 2). Taking into account the Asset and Liability Goal model, the conceptual frameworks draws from corporate governance theories and incorporates ASX corporate governance principles. These two performance measures are agency risk adjusted in order to provide stability and create value (Sounders and Cornet 2011).

3.15 Financial Accounting Information in Banks

The last part of the conceptual framework deals with the financial accounting information that is provided in the ALM model using data from financial reports – mainly from balance sheets, and profit and loss statements. Here accounting numbers are the main indicators of a banks' performance, and therefore can be used as data to measure the efficiency of its corporate governance policies (Bushman and Smith 2001).

The conceptual framework of this study draws from governance, finance, accounting and economic literature; although existing literature in the area of banking and finance usually utilises two disciplines, including finance and accounting, or accounting and corporate governance (Fulhieri and Sominen 2012). The model in this thesis adopts a simultaneous integrated multidisciplinary stochastic asset and liability goal management model to incorporate knowledge and methods from four disciplines: corporate governance; risk management; financial accounting information; and financial planning. This model is primarily drawn from the research conducted by Kosmidou and Zopounidis (2001), who developed a goal programming ALM model. Using their study as a foundation for this thesis, corporate governance and risk management theories and practices have been incorporated into the asset and liability management model

recommended by the ASX Good Corporate Governance Practices ensure to that corporate governance mechanisms minimise agency cost and ensure that the interests of all stakeholders are served in order to maximise financial performance.

3.16 Conclusion

The methodology used to construct the conceptual corporate governance framework using Basel III framework applied to a stochastic goal programming ALM model has been discussed in this chapter, including the ASX Corporate Governance Recommendation Principle 7 to recognise and manage risk to reduce agency cost.

In this chapter, the major regulators in Australia and the role of corporate governance in regulatory compliance requirements of banks has been discussed to include how these regulations have influenced the optimal integrated ALM goals to manage liquidity and solvency risk, enhance financial performance, and create value. In order to select the efficiency and banking variables used in this study, the performance measures used in corporate governance, the efficiency measures used in banking and finance, and the role of financial accounting information have also been discussed.

The research methodology used in this study has included: mathematical programming techniques; simple methods of multi-objective linear programming; goal programming; goal programming as an extension of linear programming; deviational variables and pre-emptive priority factors; weightings of deviational variables; and goal programing limitations. The packages used for linear programing in the conceptual framework will be discussed in the following Chapter 4.

Chapter 4
Methodology

4.1 Introduction

In measuring the impact of Basel III on the balance sheet structure of the financial and banking performance in an Australian bank, stress testing and analyses of potential corporate governance responses are conducted. Taking into account the aims of this study, the literature has highlighted that an asset and liability management (ALM) model is one of the most important tools in corporate governance strategic planning (Basel III Implementation), and that the most widely used methodology is linear goal (multi-objective) programing.

In this chapter, the research methodology used in this study will be discussed, including: some literature on mathematical programming techniques; simple methods of multi-objective linear programming; goal programming; goal programming as an extension of linear programming; deviational variables and pre-emptive priority factors; weightings of deviational variables; goal programing limitations; and packages used for linear programing in the conceptual framework.

Ragsdale (2012) has emphasised that the advantage of multiple objectives programming is that it not only takes into account the optimisation criteria, but also a variety of objectives. As the dynamic nature of ALM is one that deals with minimisation and maximization objectives, using a simple multi-objective linear programming would be able to solve the simultaneous contradicting objectives occurring in a banking context. Furthermore, Kalirajan and Shand (1992) define allocative efficiency as the ability of the firm to maximize profit by equating a firm-specific marginal value product with specific marginal costs, Through the use of goal programming when a firm allocates the optimal amounts of assets, liability and capital, allocative efficiency can be achieved which can result risk minimization and profit maximization.

Goal programming is used in this study, as it has been used extensively in ALM models (Kosmidou and Zopounidis 2001). According to Steuer (1996), goal programing is a multi-criteria decision making method used to solve multi-variables, constrained

resource and other similar problems that have multiple goals, particularly multi-objective linear programming which deals with problems of minimization or maximization of various objective functions. This feature of goal programing is useful in banking ALM models, as many goals are conflicting in nature, for example risk minimization and profit maximization, and therefore it is designed to enable us to make sense of observations and other data in situations where it is important for us to understand what is going on and how to achieve multiple objectives.

4.2 Mathematical Programming Techniques

Many authors have emphasized that mathematical programming techniques are useful in decision making (Kusy and Ziemba,1986; Chambers and Charnes, 1961; Ragsdale 2012). Other authors, such as Liu and Chen (2015), demonstrated that linear programming involves creating and solving optimization problems with linear objective functions and linear constraints in the model, hence linear programming can be applied in many business situations. Subsequent literature has presented examples of numerous types of functions that can be used to represent the objective function and constraints in mathematical programming models (Tutuncu 2003). That can be either linear (forming straight lines or flat surfaces) or non-linear (forming curved lines or curved surfaces). Furthermore, the optimal values of decision variables in these models need to be taken on within integer and fractional values to achieve optimal results.

4.3 Simple Methods of Multi-Objective Linear Programming

Multi-objective linear programming developed in the framework of multi-criterial analyses during the 1970s and later, has constituted a philosophy that prevails as a realistic framework for modelling decision making problems with multiple criteria. Multi-objective linear programming is superior to linear programming since it can achieve a variety of goals simultaneously. The literature confirms that the advantage of multiple objectives programming is that it not only takes into account the optimisation criteria, but also a variety of objectives, (Ragsdale 2012; Teghem et al. 1986). In searching for an optimal solution to a multi-objective system, a method that simultaneously optimizes all the necessary functional goals is required.

Kosmidou and Zopounidis (2004) explained that the multiple objective function in linear programming can be described as follows: Max $\{g_1(x), g_2(x),..., g_n(x)\}$; Subject to: $x \in F = \{x \in R^1 / Ax \leq b, x \geq 0\}$; where F = Set of feasible solutions, a system of linear inequalities; $g_1(x)$, $i = 1,2,...,n$ = the objectives functions of each problem defined as $g_1(x) = \sum_{j=1}^{i} c_{ij} x_j$, where $c_{ij,} i = 1,2,..., n,$ $j = 1,...,l$ are the coefficients of decision variables $x_1, x_2,..., x_1$ in the objective function g_1; A = m x l matrix with the coefficient of the decision variables in the m linear constraints; and b = m x 1 vector with the real coefficient of constraints. This method is useful as it achieves a solution that optimizes simultaneously all the function-goals, and therefore used in this thesis, the following section explains further.

4.4 Goal Programming

Goal programming is:

> *…an optimization method, which considers both multiple-attributes as well as multiple objectives is often referred to as a satisfying technique, one that on optimization, yields as a result "as close as possible" to the stated goals, it is a method that optimizes in the algorithmic sense. (Dash and Kajiji 2002, p. 249)*

Goal programming techniques help to find the best values for each variable in a particular criterion (Baker 2011). In this thesis, goal programming will be used to facilitate the efficient use of resources by determining the best values for a bank's balance sheet structure in which several activities compete for limited resources.

As discussed previously, managing resources efficiently is important, as this enhances financial performance. However, since profits and risk are inversely related, managing both is a challenge. Tektas et al. (2005, p. 140) argued that:

> *…there is no way simultaneously to maximize return (or profits) and minimize risks but banks can only make risk/return trade-offs and attempt to maximize returns for whatever aggregate level of risk they choose to undertake".*

Therefore, taking into account the trade-off between risk and return, goal programing is used in this thesis, as it enhances decision making by finding the optimal balance sheet

structure that achieves an optimal trade-off between the conflicting goals and objectives of the bank.

As discussed previously, the role of corporate governance is to ensure the board of directors is accountable and responsible for developing policies that minimize risk through liquidity and capital policies, while ensuring profitably (Laughlin 2015). As discussed previously, using a goal programing methodology is useful as it allows the decision maker to incorporate a variety of goals and constraints (Ragsdale 2012), while taking into account the conflicting bank objectives of risk minimization and profit maximization to help achieve goals that can conflict. Therefore, the goal programming methodology used in this thesis uses the ALM model presented by Kosmidou and Zopounidis (2001), which presents all the assets, liabilities and capital variables of a bank in its balance sheet.

In regards to risk management, the implementation of Basel III liquidity and capital regulatory requirements ensures that the balance sheet structure can be tested in order to minimize liquidity and capital risk and improve financial performance. The aim is to identify the best possible composition of the model within an uncertain environment, by incorporating corporate governance and risk management mechanisms applied to the ALM of the ANZ Bank. The model manages financial risks, including liquidity and capital risk by implementing mathematical constraints, which are discussed in Chapter 5.

Goal programming optimization is applied within the context of Australian banks, using a case study approach focusing on ANZ, which is one of the four major banks in Australia. The goal programing methodology is applied to the ANZ Bank's ALM model to manage risk and return, and to achieve the corporate governance objectives which aim to reduce financial risk and enhance financial performance. Financial risk and uncertainty cannot be eliminated, but goal programing optimization technique finds the optimal balance (sheet structure) values of decision variables in a given model. The optimal values include the amount and type of assets, liabilities and capital that the bank should hold in the balance sheet in order to achieve conflicting goals risk and return, while taking into account uncertainty. Using simulation analysis could provide bank managers the opportunity to examine different scenarios that can be used to identify, manage, monitor and control risk by developing policies to reduce financial distress.

This means that the integrated ALM model in this thesis, not only uses an integrated corporate governance and risk management framework, but also uses simulation analysis to provide forward looking stress testing scenarios under simulated interest rate, risk weighted and cash outflow scenarios.

According to Steuer (1996), goal programing is a multi-criteria decision making method used to solve multi-variables, constrained resource and other similar problems that have multiple goals. The goal programming model involves solving problems containing not one specific objective function, but rather a collection of objectives that need to be achieved. Therefore, goal programming is used in this study, as it has been used extensively in ALM models (Kosmidou and Zopounidis 2001).

This is in contrast to the multi-objective linear programming that deals with problems of minimization or maximization of various objective functions. As the dynamic nature of ALM deals with minimisation and maximization of objectives, using a simple multi-objective linear programming would be able to solve the simultaneous contradicting objectives occurring in a banking context. Therefore, as banking risk management pursues many different objectives, goal programming will provide the possibility of proposing a variety of objective functions within the same optimisation problem prepared in this study.

4.4.1 Goal Programming as an Extension of Linear Programming

Many authors claim that in solving large scale problems with multiple objectives, goal programming is useful (Lin and O'Leary 1993). In other research, Zeleny (1982) advised that goal programming and linear programming perform significantly different functions, including achieving multiple objectives, and dealing with conflicting goals, respectively. In goal programming, the decision maker determines the goals though an objective function, formulating them on the basis of deviational variables, pre-emptive priority factors and weighting of deviational variables. Kosmidou (2004, p. 86) describes the process:

$$Minimize: Z = \sum_{j=1}^{n} cjxj$$

Subject to: $\sum_{j=1}^{n} a_{ij} x_j \geq b_i$, for $i = 1,...m$

$x_j \geq 0$, for $j = 1,...,n$

Where:

$x_1, x_2, ...x_n$ are non-negative decision variables; $c_1, c_2, ...c_n$ are contribution coefficients that represent the marginal contribution to Z for each unit of respective decision variable; and $a_{ij}, i = 1,...,m, j = 1,...,n$ are technological coefficients of the decision variables x_j (Padberg 1995). Fang and Padberg (1995) described linear programming as requiring the following assumptions. First, proportionality assumptions: each unit of each decision variables x_j contributes to c_j units of the objective function and a_{ij} units in the i^{th} constraint. Second additive assumptions: the contribution to the objective function and the technological coefficient in the constraints are independent of the values of the decision variables. Third, divisibility assumption: decision variables are permitted to be non-integer or have fractional values, and certainty assumptions: all parameters, a_{ij}, b_i and c_j must be known with certainty.

Kosmidou and Zopounidis (2004) explain that regardless of the types of constraints included in the linear programming model, requirements represented by the constraints must be satisfied in order to have a feasible solution (p. 87).

$$f_i(x) = \left| \sum_{j=1}^{n} a_{ij} x_j - b_i \right| \text{ for } i = 1,...,m$$

Since goal programing is trying to achieve various goals, Charnes and Cooper (1977) presented a generally accepted statement of a goal programing model:

Minimize: Z = $\sum_{i \in m} (d_i^+ + d_i^-)$

Subject to: $\sum_{j=1}^{n} a_{ij} x_j - d_i^+ + d_i^- = b_i$, for $i = 1,...,m$

$d_i^+, d_i^-, x_j \geq 0$, for $i = 1,...,m \quad j = 1,...,n$

Where:

d_1^+ = a positive deviation variable or over-achievement of goal b_i ; d_1^- = a negative deviation variable or under-achievement of goal b_i ; and b_i = arithmetic value of goal i . The value of Z is the sum of all deviations. Furthermore, the deviation variables are related to the functions where:

$$d_i^+ = 1/2\left[\left|\sum_{j=1}^{n} a_{ij}x_j - b_i\right| + \left(\sum_{j=1}^{n} a_{ij}x_j - b_i\right)\right] \text{ and}$$

$$d_i^- = 1/2\left[\left|\sum_{j=1}^{n} a_{ij}x_j - b_i\right| + \left(\sum_{j=1}^{n} a_{ij}x_j - b_i\right)\right]$$

The general form of a goal programming model is as follows:

$$\text{Min Z} = \sum_{i=1}^{n} p_i f_i(d_1^-, d_1^+, d_2^-, d_2^+, ..., d_n^-, d_n^+)$$

Subject to:

$$\sum_{j=1}^{l} c_{ij}x_j + d_i^- - d_i^+, \quad i = 1,2,...,n$$

$$x \in F$$

$$d_i^- \geq 0, \quad d_i^+ \geq 0, \quad i = 1,2,...n$$

Where:

s_i: the arithmetic value of goal i; p_i : the priority weight of goal i; d_i^+ : over-achievement of goal s_i; d_i^- : under-achievement of goal s_i; $f_{i:}$: the linear function of the variables d_i^+ and d_i^- ; and F: the set of the feasible solutions. In goal programming, the decision maker determines the goals through an objective function, formulating them on the basis of the following three factors: deviational variables, pre-emptive policy factors and weighting of deviational variables. These are discussed in detail below.

4.4.2 Deviational Variables and Pre-emptive Priority Factors

Kosmidou and Zopounidis (2004) explain that, in contrast to linear programming which maximizes or minimizes an objective function, goal programming minimizes the deviations from the pre-specified goals which are defined over the multiple objective functions of the problem. Ragsdale (2012) emphasised that the decision maker in goal programming determines the goals though an objective function, formulating goals with priority levels according to the significance of the overall model. For example, when the priority of a goal is equal to one, the corresponding goal is first in the hierarchy and thus should be accomplished prior to the examination of other goals to achieve priority levels. In other words, goal programming sets goals with priority levels based on their significance. The deviation variables are represented as d+ or d-, to indicate both positive and negative deviations from the goals. In order to establish clear priorities in goal programming, Ijiri (1965) introduced the idea of combining pre-emptive priorities and weightings in accounting problems using the following formulas.

$$\text{Minimize Z} = \sum_{i \in m} P_i \sum_{k=1}^{n_1} (w_{ik}^{+} d_i^{+} + w_{ik}^{-} d_i^{-})$$

Subject to:

$$\sum_{j=1}^{l} c_{ij} x_j + d_i^{-} - d_i^{+} = b_i, \quad i = 1,2,...m$$

$$d_i^{+}, d_i^{-}, x_j \geq 0, \text{ for } i = 1,...,m \;\; j = 1,...,n$$

Where:

P_i = the pre-emptive priority factors serve only as a ranking symbol, meaning that no substitutions across categories of goals will be permitted: $P_i \geq P_{i+1} \geq$, it is assumed that the ordering of deviations in an objective function will be minimized in descending order; it is assumed that no combination of relative weightings attached to the deviation variables can produce a substitution across categories in the process of choosing the x_j, and $w_{ik}^{+}, w_{ik}^{-} \geq 0$ represents the relative weights to be assigned to each of the $k = 1,...n_i$ classes within their categories when the value of p_i is assigned.

4.4.3 Weightings of Deviational Variables

Because the model has different goals, in order to simplify their relative importance, weightings are used. Here, Charnes and Cooper (1977) suggest using the weighted deviation variables to present their relevant significance in occurrence with priority factors. Their weighted goal programming model is as follows:

Minimize:

$$Z = \sum_{i \in m} w_i^t \ d_i^t + w_i^t d_i^t$$

Subject to:

$$\sum_{j=1}^{n} a_{ij} x_{j} - d_i^+ d_i^- = b_{i,} for, i=1,\ldots,m$$

$$d_i^+, d_i^-, x_j \geq 0, for\ i = 1, \ldots, n$$

A major advantage of goal programming is its simplicity and ease of use. This accounts for the large number of goal programming applications in many diverse fields. As weighted goal programs can be solved by widely available linear programming computer packages, finding a solution tool is not difficult in most cases. Lexicographic goal programs can be solved as a series of linear programming models, as described by Ignizio and Cavalier (1994). These can handle relatively large numbers of variables, constraints and objectives. Here a possible weakness is the ability of goal programming to produce solutions that are not Pareto efficient. However, this violates a fundamental concept of decision theory – that no rational decision maker will knowingly choose a solution that is not Pareto efficient. Furthermore, techniques are available to detect when this occurs, and project the solution onto a Pareto efficient solution in an appropriate manner.

4.4.4 Goal Programming Limitations

The literature highlights that goal programming is very useful (Gass 1987; Ragsdale 2012), because goal programming model can produce a variety of solutions that may allow at least one of the model's goals to be improved, while at the same time not worsening or degrading the other goals (Kosmidou & Zopounidis 2004). Some

literature suggests that despite its benefits, goal programming can present major problems, such as: issues of dominance, inferiority and efficiency in its solutions; issues of incommensurability; and the use of naïve relative weighting in goal programming models and redundancies (Cohen and Hammer 1967; Harrald et al. 1978; Hannan 1980; Zeleny 1982; Rosenthal 1983; Hannan 1985; Ignizio and Cavalier 1994; Gass 1987; Romero 1991; Min & Storbeck 1991).

According to Pareto (1896) and Romeo (1991), efficiency is at an optimal level if the economic situation of a group of people cannot be improved without worsening the economic situation of any one person who makes up the group. Therefore one goal programming solution is the Pareto efficiency in which no other feasible solution can achieve the same or better result in a group of goals existing in an objective function, while at the same time being better off than one or more other individual objectives that exist in the model.

The literature has highlighted that goal programming model can permit a variety of alternative solutions that may allow at least one goal to be improved, while at the same time not worsening or degrading the other goals (Ragsdale 2012). Here the aim would be to determine the weights of each goal. In this case, an analytical hierarchy process can provide a more structured approach for determining the scores and weights for the goal objectives. In Chapter 5, the weight given to each goals will be explained.

4.5 Managing Risk through Simulation Analysis

Simulation analysis has long been a useful tool for evaluating the performance of financial management (Olafsson 2002; Collier 2009; Bilston and Rodger. 2013; Bilston et al. 2015). As discussed, risk cannot be eliminated; it can only be managed by using mathematical techniques. Levary and Seitz (1990) illustrated that a simulation technique can be used in linear programming, and that integer programming and goal programming are useful for obtaining answers to ‘what if’ questions within a financial model. The simulation technique can obtain an output that describes the financial management consequences that result from any change in the independent uncertain variable. For this reason, simulation is considered a superior method of analysis that helps managers to make informed decisions in an uncertain environment.

Collier (2009) discussed the uncertainty associated with the value of the dependent variable when an element of risk is introduced in the decision making problem, therefore a simulation technique will be used in this thesis because it can provide information that helps managers manage risk better (Ragsdale 2012). For example, by using this technique managers can experiment with the model to obtain answers to various what-if questions and make informed decisions in an uncertain environment (Brealy & Myers 1997).

In order to manage the extreme uncertainty facing banks, the model in this study uses simulation optimisation methodologies that create stress test scenarios that may negatively affect access to liquidity and threaten capital structure. This will allow banks to formulate more reliable asset liability management strategies to reduce the impact of unanticipated change on the value of the institution. The simulation optimisation is used in this study to minimise risk by setting policies and implementing policies through constraints in the model to specify the risk tolerance set by the bank (refer to Chapter 2).

One of the Basel III recommendations is that banks are required to conduct stress testing in order to manage uncertainty (BIS 2008). Therefore, in accordance with the discussion above, this thesis uses simulation analysis to effectively manage risk (APRA 2009) and enhance decision making in order to reduce agency cost and achieve the objectives of all stakeholders.

4.6 The Model Adopted for Case Study Analysis

In order to undertake this research, data was collected from the ANZ Bank in Australia, covering eight financial years from 2006 to 2013. Since the stochastic ALM model takes into account interest rates uncertainty, data on this uncertain variable (interest rates) was collected from ANZ financial statements. In order to test the impact of good corporate government practices that implement risk management strategies in ALM models, this thesis will use a case study approach that is commonly used by others in this area, for example, Kosmidou and Zopounidis (2004), Fisher (2001), Black et al. (2003) and Tektas et al. (2005).

4.7 Description of Sample Data

The goal programming model of this study has been developed in an eight-year time frame. This model uses data from financial statements of the ANZ Bank including balance sheets, and profit and loss statements from 2006 to 2015. This model contains forty-two structural variables of which ten correspond to assets (Ai=1,...,10), six to liabilities (Lj,=1..., 6) and three to capital (Ci=1,...,3). The following section defines the variables.

4.8 The Decision Variables

Decision variables used in specifications for the ALM model of this study were obtained from the ANZ Bank. Listed in the tables below are the variables that have been selected for this study. Table 4.1 describes the ten types of assets used in this model, together with the introduced components in each category, while Table 4.2 provides the liability and capital components of each variable listed, in detail. Table 4.3 lists the capital variables, Table 4.4 lists the financial performance measures, and Table 4.5 includes the ratios used in this thesis.

Table 4.1: Asset Variables

Assets	Symbol	Variables
Cash-liquid assets	A1	Coins, notes and cash at bankers
		Money at call, bills receivable and remittances in transit
		Other banks' certificates of deposit
		Securities purchased under agreement to resell in < three months
		Settlement balances owed to ANZ
		Collateral paid: Alternative liquid assets (ALA)
Trading securities 1	A2	Listed: Other securities and equity securities
		Unlisted: ANZ accepted bills
		Unlisted: Other securities and equity securities
Trading securities 2	A3	Unlisted: Commonwealth securities
		Unlisted: Local, semi-government and other government securities
Derivative financial instruments	A4	Foreign exchange contracts
		Commodity contracts
		Interest rates contracts
		Credit default swaps
Available-for-sale assets 1	A5	Listed: Other government securities
		Unlisted: Local and semi-government securities
		Unlisted: Other government securities
Available-for-sale assets 2	A6	Listed: Other securities and equity investments
		Unlisted: Other securities and equity investments
		Unlisted: Loans and advances
Net loans and advances 1	A7	Overdrafts
		Credit card outstanding
		Term loans – non-housing
		Commercial bills
		Hire purchase
		Lease receivables
		Other
Net loans and advances 2	A8	Net loan and advances
		Due from other financial institutions < three months
		Due from other financial institutions > three months
Net loans and advances 3	A9	Term loans – housing
Shares (controlled entities) and other Assets	A10	Total shares in associates
		Total shares in joint venture entities
		Customers' liability for acceptances
		Current tax assets
		Deferred tax assets
		Goodwill and other intangible assets
		Other assets
		Premises and equipment

Note: Asset classifications are based on ANZ (2015) Annual Reports classification. Alternative liquid assets (ALA) are assets qualifying as collateral for the CLF.

Table 4.2: Liability variables

Liabilities	Symbol	Variables
Deposits and other borrowings	L1	Collateral received Due to other financial institutions Certificates of deposit Term deposits Other deposits bearing interest and other borrowings Deposits not bearing interest Commercial paper Securities sold under repurchase
Deposits and other borrowings	L2	Borrowing corporations' debt
Derivative financial instruments	L3	Foreign exchange contracts Commodity contracts Interest rates contracts Credit default swaps
Payables and other liabilities	L4	Creditors Accrued interest and unearned discounts Defined benefit plan obligations Accrued charges Security settlements Other liabilities
Provisions	L5	Employee entitlements Restructuring costs and surplus leased space Non-lending losses, frauds and forgeries Other provisions
Other liabilities	L6	Bonds and notes Liability for acceptances Loan capital Current tax liabilities Deferred tax liabilities

Note: Liabilities classifications are based on ANZ (2015) Annual Reports classification.

Table 4.3: Financial Performance Measure

Capital variables	Symbol	Variables
Capital variables	CET1	Common equity Tier 1
	Tier1	Additional Tier 1 capital
	CCB	Capital conservation buffer
	TC	Total capital

Note: Capital variables are based on Basel III classification.

Table 4.4: Financial Performance Measure

Performance measure	Symbol	Variables
Financial performance variables	II	Interest income
	IE	Interest expense
	NII	Net interest income
Profit	PBT	Profit before tax
	DP	Difference between profit before tax and NII
	PAT	Profit after tax

Table 4.5: Other Ratios

Ratios	Symbol	Variables
Capital ratios:	CET1 ratio	Common equity Tier 1 ratio
	Tier1 ratio	Additional Tier 1 Capital ratio
	CCB ratio	Capital conservation buffer ratio
	TC ratio	Total capital ratio
Liquidity ratio:	LCR	Liquidity coverage ratio
Financial performance ratios:	ROE	Return on equity
	ROA	Return on assets

Note: Capital and liquidity ratios are based on Basel III classification.

4.9 Packages Used for Linear Programming in the Conceptual Framework

Various mathematical programming packages can be used to solve optimisation problems, including spreadsheets which use specialised mathematical programming packages such as: LiNDO, CPLEX, MathPro, MPSX and Risk Solver Pro. Other mathematical programming packages include the latest versions of Excel, Quattro Pro and Lotus 1-2-3; all have a built-in spreadsheet optimisation tool (Solver). However, the system used in this thesis is Excel Solver, because it offers greater capacity, faster speed, several easy-to-use features, and is widely used in the field of risk management. The next section will demonstrate in detail the mechanics of using Solver in Excel to obtain the optimal asset and liability mix that can achieve the corporate governance goals, finance goals and capital market goals required by banks.

4.10 Conclusion

In this chapter, the research methodology used in this study was discussed, including: some literature on mathematical programming techniques; simple methods of multi-objective linear programming; goal programming; goal programming as an extension of linear programming; deviational variables and pre-emptive priority factors; weightings of deviational variables; goal programing limitations; and packages used for linear programing in the conceptual framework.

The framework was carried out through the construction of a positive empirical model using simulation optimisation methodologies as the foundation to develop a goal programming model in an uncertain environment. The GFC has demonstrated the importance of the role of corporate governance in banks, showing that corporate governance mechanisms are useful in mitigating risk and enhancing sustainable financial performance, and changes in the Basel liquidity and capital requirements

(Basel III) help promote financial stability. Therefore, these two mechanisms are integrated in the conceptual framework of the thesis.

A number of optimisation techniques were investigated to arrive at the mathematical programing model suited to the task of this thesis. Goal programming was chosen due to the fact that banks face numerous challenges, including the achievement of conflicting goals (risk minimization and profit maximization). As this technique requires operationalization of the conceptual framework, the use of goal programming and simulation analysis is in keeping with the thesis objective which is to develop a new asset and liability goal management model that assists the profit maximization and risk management goals in banking.

A major challenge in implementation of the Basel III requirements is the uncertainty of the effect it will have on the structure of the balance sheet, which consequently impacts on the risk profile and profitability of the bank . As a result, simulation analysis has been adopted to overcome this challenge and comply with the new Basel III requirements of stress testing. The development of an integrated bank asset and liability goal management model as a diagnostic tool, using multidisciplinary theoretical approach to promote technical robustness, is discussed in Chapter 5.

Chapter 5
An Integrated Bank Asset and Liability Goal Management Model

5.1 Introduction

Although many scholars and policy makers have debated the cause of the 2008 financial crisis, however the causes can be partly attributed to a failure in corporate governance. Key corporate governance issues include: inappropriate use of securization (Iannuzzi and Berardi 2010; Shiller 2008; Minton et al. 2009); self-interest culture where the concerned players act without any regard for social welfare (Krisnaswami 2011; Iannuzz and Berardi 2010); misaligned risk tolerance (Vasudev et al. 2012); low levels of liquidity and capital (Viral 2012); and excessive leverage and risk taking (Vasudev et al. 2012). These studies highlighted that the recent financial crisis has raised important issues regarding corporate governance and the traditional risk management practices, and also pointed out that banks should adapt new approaches in risk management, which should promote stronger integration between of both corporate governance and risk management with a stronger focus not only on short-term financial performance, but longer sustainable financial performance that benefits shareholders and society.

The Financial Crisis Inquiry Commission examined the causes of the 2007-2008 financial crisis in the U.S., highlighting that as it was the result of human action and inaction, the crisis was avoidable. The FCIC major findings are summarised as follows (FCIC, p. 18):

- *widespread failures in financial regulation and supervision proved devastating to the stability of the nation's financial market;*
- *dramatic failures of corporate governance and risk management at many systemically important financial institutions were a key cause of this crisis;*
- *a combination of excessive borrowing, risky investments, and lack of transparency put the financial system on a collision course with crisis;*
- *the government was ill prepared for the crisis, and its inconsistent response added to the uncertainty and panic in the financial markets;*
- *there was a systemic breakdown in accountability and ethics;*
- *collapsing mortgage-lending standards and the mortgage securitization pipeline lit and spread the flame of contagion and crisis;*
- *over-the counter derivatives contribute significantly to this crisis; and*

- *failures of credit rating agencies were essential cogs in the wheel of financial destruction.*

Therefore, if the financial crisis is partly attributed to the factors listed above and it is the role of corporate governance to develop a framework that depends on legal, regulatory and institutional environments with the inclusion of business ethics (OECD 2004, p. 4), good corporate governance of an organisation requires the implementation of policies that ensure the proper use of securitisation, optimal levels of risk tolerance, and appropriate levels of liquidity and capital.

In the context of this thesis, the recommendations made by Greuning and Bratanovic (2009) are important because the integration of corporate governance, risk management and financial management can result in a more responsible ALM framework that enhances asset management, liability management, liquidity and capital management to manage risk. Furthermore, the inclusion of a more responsible corporate governance ALM strategy needs to be based on the interest of all stakeholders. By implementing a corporate governance that includes risk management principles and practices, ALM will be more focused and comprehensively synchronized with the strategic direction of the bank.

As discussed previously, banks play an important role in the economy. The principle function of banks is to bring together lenders (suppliers of funds) and borrowers (demanders of funds). Other functions include: minimising the cost of obtaining funds; monitoring borrowers; pooling risk; and creating liquidity to allocate the savings to borrowers. In this complex system, banks are an integral part of the efficient function of the economy and thereby impacting the wellbeing of society.

This means that banks have a fiduciary duty not only to shareholders but to society as well. It is for this reason that the role of corporate governance is vital to ensure that banks introduce social policy to protect all stakeholders. A recent study by Banerjee (2013) quoted Sir Adrian Cadbury, UK, Commission Report: Corporate Governance 1992:

> *Corporate governance is concern with holding the balance between economic and social goals and between there to encourage the efficient use of resources*

> *and equally resources. The aim to align as nearly as possible the interest of individuals, corporation and society. (p. X)*

Since corporate governance refers to the relationship between economic and social goals, it is therefore:

> *…the framework of rules, relationships, systems and processes within and by which authority is exercised and controlled in corporations. Corporate governance influences how the objectives of the company are set and achieved, how risk is monitored and assessed, and how performance is maximised. (ASX 2010, p. 5)*

And since there is no single model for good corporate governance, the ASX Corporate Governance Council's recommendations are not mandatory; however they provide a reference point for companies about their corporate governance structures and practices. Therefore this thesis framework is based on the ASX Corporate Governance Principle 7 of recognising and managing risk, in particular Recommendation 7.2 that recommends the board should require management to design and implement the risk management and internal control system. This is achieved by simulating the implementation of Basel III liquidity and capital regulatory requirements.

In the context of this thesis, the good corporate governance Principal 7 is used to ensure the banks comply with APRA's Basel III, with the aim to minimize financial risk and the probability of another costly financial crisis. In this way, they fulfil their ~~s~~ fiduciary duty to shareholders and society, as having controls systems that ensure adequate levels of liquidity and capital to protect shareholders, customers and society.

A significant role of banks is to manage the relationship between risk and return more prudently than any other institutions. Profit maximization is one the objectives of corporate governance and a fiduciary duty, as shareholders are profit-driven, and will seek to obtain the highest return on funds they have risked by investing in an institution. If the bank does not provide a satisfactory return, it will cause investors to move investment. However, pursuing profit maximization leads to the bankers' dilemma of how far the risk return profile of the bank should operate. Hence, a safe approach means

less risk exposure and lower returns, a risky approach may lead to higher profit, but may threaten long-term viability of the bank; therefore managing risk is important.

Risk management is the culture, processes and structures that are directed towards taking advantage of potential opportunities while managing potential adverse effects (COSO 2015). Therefore, this thesis aims to look into a new approach which integrates corporate governance and risk management in order to manage the risk and return relationship taking into account shareholders and social goals. This is because every business decision has an element of uncertainty and carries a risk that can be managed through effective implementation of corporate governance policies.

Because maximizing profitability and minimizing risk are by nature conflicting goals, banks need to manage them carefully to avoid the wider social repercussions caused by financial contagion. However, managing the balance sheet structure can facilitate the achievement of a profitability goal by taking into account the balance between risk and return, and shareholder and social objectives. Since the balance sheet structure determines the level of risk and return for each allocated investment, corporate governance policies can be implemented by determining the amount and types of assets, liabilities and capital the bank must hold in its balance sheet. These policies include the enhancement of banking performance (net interest income (NII), and financial performance return on equity (ROE) and return on assets (ROA)), while managing risk to ensure that banks comply with Basel III liquidity and capital regulatory requirements in order to reduce liquidity and capital risk.

Literature confirms that implementation of a good corporate governance policy that determines its amounts of assets and liability, can lead to improvements in financial performance (Busman 2001; Greunning and Bratanovic 2009; Bessis 2010). Hence, maintaining the appropriate balance sheet structure, including adequate levels of liquidity and capital means that agency cost can be reduced, since agency cost arises because of core problems such as conflicts of principle between shareholders and management. In general, shareholders wish for management to run the company in a way that enhances value for them. However, agency problems can occur when managers wish to grow their company in ways that maximize personal power and wealth, which may not be in the best interest of shareholders, and in the case of banks,

society. Clearly, financial improvements occur when good corporate governance is implemented.

Jensen and Meckling (1976) define agency theory as the relationship between the principals (shareholders) and agents (company executives and managers) in a corporation. If both parties in the relationship are utility maximisers, there is good reason to believe that the agent will not always behave in the best interests of the principal, meaning that managers have incentives to pursue their own interest at the expense of shareholders. Based on this premise, in order to protect shareholders and managers from conflicts of interest, organisations need adequate monitoring and control mechanisms (Fama and Jensen 1983). In the context of this thesis, good corporate governance in banks plays a crucial role in both the management of risk and implementation of financial management strategies to enhance performance and eliminate problems of agency cost, inefficient decision making, unnecessary loss and future corporate collapse. The research of Bushman and Smith (2001) and Brown et al. (2011) highlights the need for banks to have a behavioural change that addresses the problem of lack of accountability, and motivates them to become more vigilant, accountable and responsible in their approach to management of risk and financial performance.

In this context, this thesis develops an asset and liability management (ALM) model that incorporates corporate governance objectives from two perspectives, risk management and financial performance. As liquidity and capital control systems protect shareholders, customers and the whole society, banks need to fulfil their fiduciary duty by managing risk and return on behalf of both shareholders and society. Furthermore, integrating corporate governance policies that allocate resources efficiently will ensure that any organization has long-term viability (Saunders and Millon 2011). The following section will discuss in detail how a corporate governance and risk management framework is used in the ALM model of this thesis.

Dash (2002, p. 247) argued:

> *…that bank asset and liability management has proven to be an effective tool in the ongoing effort to mitigate the ill effects of allocation inefficiency that may arise from a bank's exposure to credit, capital and interest rate risk".*

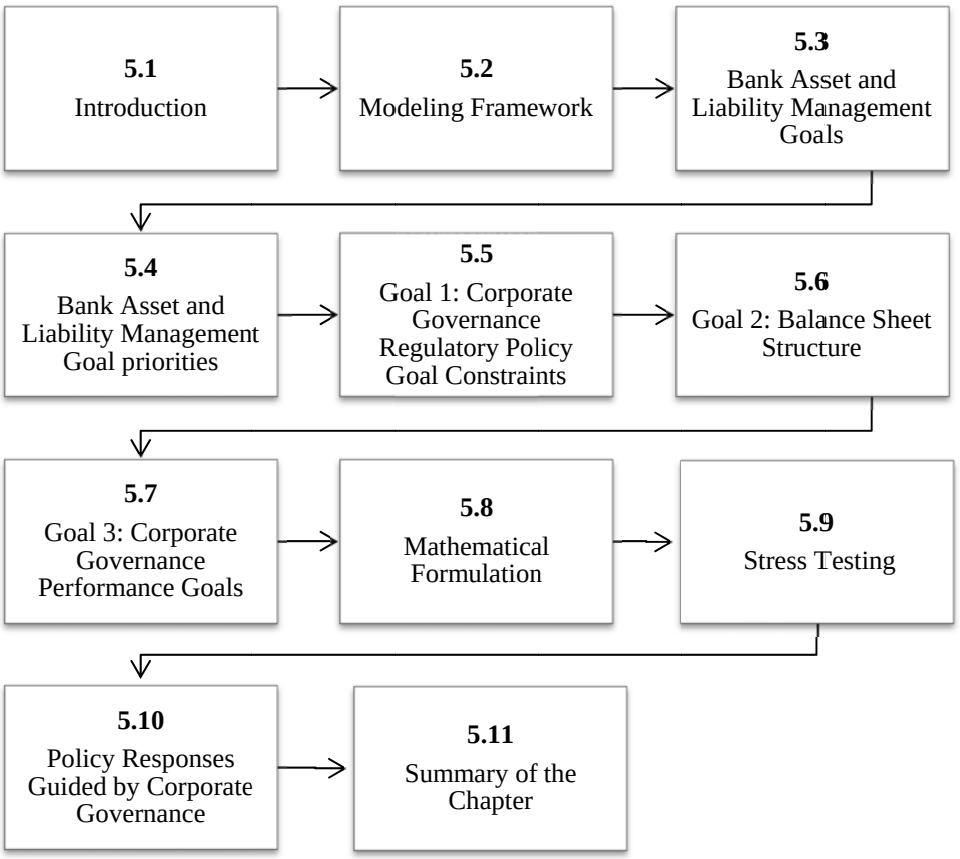
Therefore, ALM can be used to facilitate the efficient use of resources by determining the best values of a bank's balance sheet structure, including the types and amounts of assets, liabilities and equity the bank must hold, and in which several goal objectives conflict.

Even though ALM models have been extensively used for managing financial risk, many of these models have only incorporated traditional risk management policies (Kusy and Ziemba 1986), which were not enough to prevent the 2008 financial crisis. Bushman and Smith (2001) concluded that corporate control mechanisms can assist in reducing any inefficiencies that arise from moral hazard and adverse selection, thus minimising the probability of risk failure and providing the means by which managers can be disciplined to act in shareholders' interests. Since banks operate under government supervision and a comprehensive body of banking laws and regulations, they need to fulfil their fiduciary duties to all stakeholders. In this way, corporate governance can enhance relationships between stakeholders by determining the firm's direction and controlling its performance (Bushman and Smith 2001). For these reasons an ALM model within a corporate governance and risk management framework is used in this thesis.

As discussed previously, goal programming optimization is applied within the Australian banks system, using a case study approach focusing on ANZ, which is one of the four major banks in Australia. The goal programing methodology is applied to the ANZ bank's ALM model to manage risk and return, and achieve the corporate governance objectives. Financial risk and uncertainty cannot be eliminated, but goal programing optimization technique finds the optimal balance (sheet structure) values of decision variables in a given model. The optimal values include the amount and type of assets, liabilities and capital that the bank should hold in the balance sheet in order to achieve conflicting goals risk and return, while taking into account uncertainty. Using simulation analysis could provide bank managers the opportunity to examine different

scenarios that can be used to identify, manage, monitor and control risk by developing policies to reduce financial distress. This means that the integrated ALM model in this thesis, not only uses an integrated corporate governance and risk management framework, but also uses simulation analysis to provide forward looking stress testing scenarios under simulated interest rate, risk weighted and cash outflow scenarios. The chapter outline is summarised in Figure 4.1.

Figure 5.1: Chapter 5 Outline



5.2 Modelling Framework

This thesis has developed a new ALM model based on the APRA capital requirements of Basel II in Model 1, and incorporated Basel III liquidity and capital regulatory requirements of APRA in Model 2.

The proposed approach to analysing the impact of Basel III liquidity and capital regulatory requirements on financial risk and performance and ALM under forward looking scenarios in banking is to first build an ALM model using APRA Basel II regulatory requirements. Next, an ALM model is built using Basel III regulatory requirements while taking into account the implementation phases using simulation and stress testing analysis. Both models will be identical in terms of assets, liability and equity variables, and differ in terms of liquidity and capital regulatory policy constraints.

As discussed in the previous section, Goal 1 for the bank ALM presented in Model 1 is to ensure that the bank's corporate governance regulatory policy complies with APRA's Basel II capital requirements for managing solvency risk. This model implements Basel II Capital constraints including: a minimum common equity capital equal to 2%; minimum Tier 1 capital equal to 4%; and minimum Tier 2 capital equal to 4%.

BALM-B3 implements the APRA Basel III liquidity and capital requirements for managing liquidity and solvency risk. However, since these requirements have been introduced in phases commencing January 2013 to be fully implemented by 2019, BALM-B2 is simulated at different phases of the implementation process in order to analyse the full impact of Basel III (see Table 5.2).

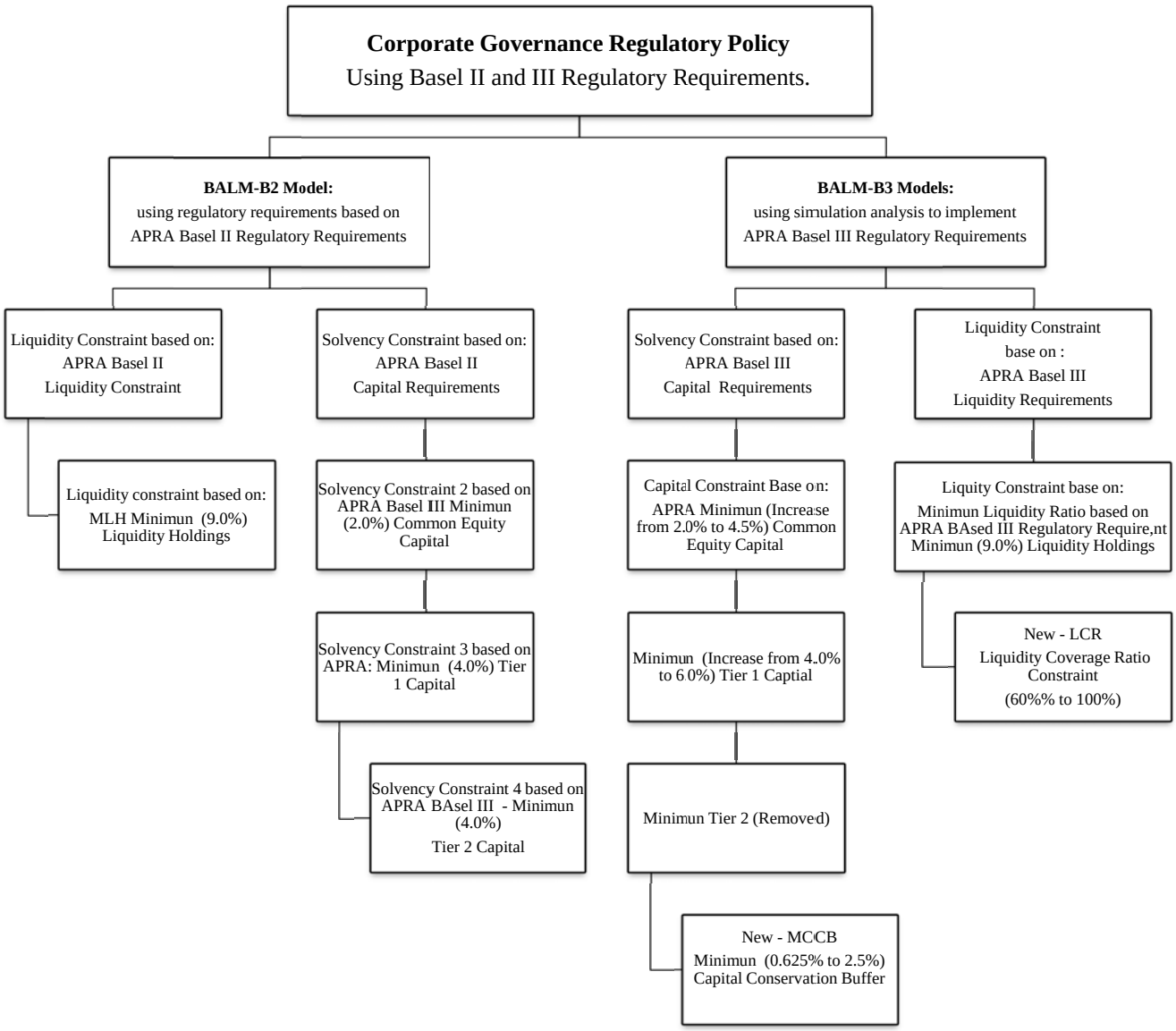
In order to manage liquidity risk, BALM-B3 implements the LCR requiring banks to maintain unencumbered high-quality assets sufficient to meet 100% (or more) of net cash outflows over 30-day periods under simulated stress scenarios. Liquidity constraints in this model include minimum liquidity holdings equal to 9%, with the new LCR constraint starting at 60% and fully implemented at 100% (RBA 2015).

In order to manage solvency risk in BALM-B3, APRA Basel III Capital Constraints are first implemented by setting the minimum common equity capital requirement at more than double – from 2% to 4.5% introduced in phases commencing 1 January 2013 and

completed in January 2015. Second, the minimum Tier 1 capital is increased from 4.0% to 6%, with Tier 2 not being implemented due to changes in the Basel III capital requirements. Finally, the capital conservation buffer is implemented at different stages starting from 0.625% and completed at 2.5%.

Implementation of good corporate governance ensures that banks fulfil the new Basel III regulatory requirements, with both ALM models being simulated, first by using Basel II Liquidity and Capital requirements (BALM-B2) and then by using Basel III Liquidity and Capital requirements (BALM-B3), In accordance with APRA recommendations that banks conduct stress testing and the Basel III requirement of implementation stages.

Figure 5.2: Summary of Corporate Governance Using Basel II and Base III Regulatory Requirements



5.3 Bank Asset and Liability Management (BALM) Goals

Kusy and Ziemba (1986) defined an ALM model as "an intertemporal decision-making optimization tool to determine a bank's portfolio of assets and liabilities given deterministic rates of returns and cost (interest rates), and random cash flows (deposits)" (p. 360). ALM models have since become increasingly important because they take into account all aspects of the organization to optimize management of the balance sheet structure (Kosmidou and Zopounidis 2001). In the context of this thesis, the bank ALM model aims to achieve three main goals (refer to Figure 4.2).

Goal 1, Corporate Governance Regulatory Policy, which aims to ensure that the bank implements ASX corporate governance recommendation Principle 7 (ASX 2015), to recognise and manage risk and therefore, applying Basel III Liquidity and capital regulatory requirements, is sub-divided into two aims – the management of liquidity and solvency risk using goal programming. This goal aims to ensure that banks fulfil their social duty of complying with the new regulatory requirements and to satisfying all stakeholders. Goal 2, Bank Strategy Policy, aims to manage assets and liabilities of the bank, taking into account the bank's strategy direction and historical data growth trends.

Goal 3, Corporate Governance Financial Performance Goal Policy, aims to improve financial performance and satisfy shareholders and stakeholders while fulfilling the bank's social responsibility (Bessis 2010) This goal is based on corporate governance principles to maximize financial performance, taking into account that the role and responsibility of corporate governance is to ensure that organisations enhance their financial performance to fulfil their social duty of satisfying all stakeholders. This goal is sub-divided into two aims: banking efficiency performance to minimises interest expense and enhance interest income and NII; and financial performance to enhance ROE and ROA. An overview of these three key goals is outlined in the following sections.

5.3.1 Corporate Governance Regulatory Policy (Goal 1)

In the context of banks they are required to comply with APRA Basel III requirements. Corporate Governance Regulatory Policy (Goal 1) is divided into two parts (Goal 1a and Goal 1b). Goal 1a, Corporate Governance Regulatory Policy, includes managing liquidity risk to ensure that the bank complies with APRA's Basel III Framework,

which focusses on the short-term stress testing of LCRs and long-term structural liquidity mismatch measurement of net stable funding ratios. These changes in regulatory requirements (see Table 5.1) mean that liquidity needs to be managed in the same way as capital.

Figure 5.3: Goal 1 Corporate Governance Regulatory Policy

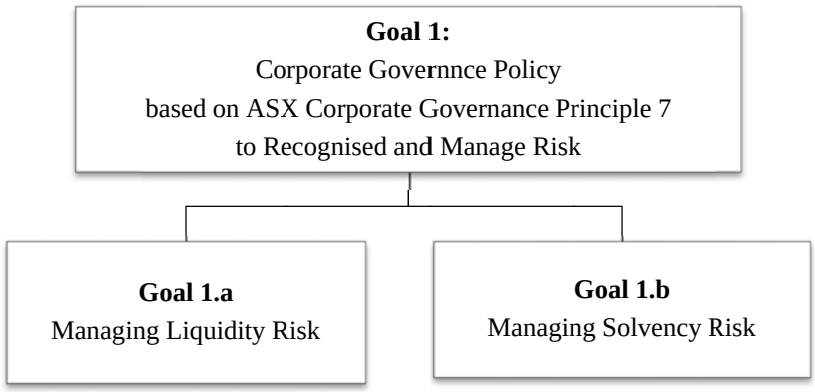


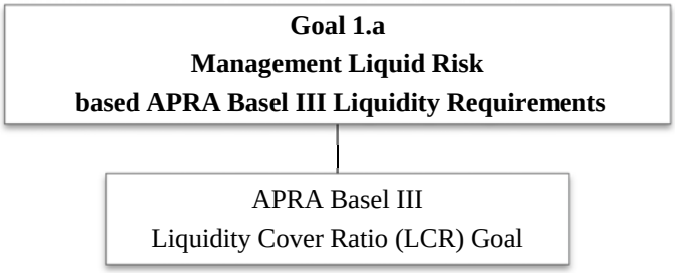
Table 5.1: Corporate Governance Regulatory Policy using APRA Basel III Liquidity and Capital Requirements for BALM-B2 and BALM-B3 Models

APRA - Basel liquidity and capital regulatory requirement		BALM-B2 Model: Basel II	BALM-B3 Model: Basel III implementation phases						
		2012	Phase 1* 2013	2014	Phase 2* 2015	Phase 3* 2016	2017	2018	Phase 4* 2019
Liquidity Regulatory requirements	Minimum liquidity holding	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%	9.0%
	Minimum liquidity ratio	0.0%	0.0%	0.0%	100%	100%	100%	100%	100%
Capital regulatory constraints	Minimum common equity capital	2.0%	3.50%	4.0%	4.5%	4.5%	4.5%	4.5%	4.5%
	Minimum capital conservation buffer	0%	0%	0%	0%	0.625%	1.250%	1.875%	2.5%
	Minimum common equity plus capital conservation buffer	2.0%	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
	Minimum Tier 1	4.0%	4.0%	5.5%	6.0%	6.0%	6.0%	6.0%	6.0%
	Minimum Tier 2	4.0%	Removed	Removed	Removed	Removed	Removed	Removed	Removed
	Basel III minimum capital ratio requirement plus capital conservation buffer		**8.0%**	**8.0%**	**8.0%**	**8.625%**	**9.25%**	**9.875%**	**10.5%**

5.3.1.1 Goal 1a Managing Liquidity Risk

Goal 1a, managing liquidity risk, aims to ensure that the bank complies with APRA's new regulatory liquidity requirements based on the Basel III framework. These liquidity requirements are useful as they measure the bank's liquidity in relation to its total liabilities. The ALM model goal is to ensure the banks comply with the new APRA Basel III liquidity cover ratio requirement.

Figure 5.4: Goal 1a Managing Liquidity



5.3.1.2 Goal 1b Managing Solvency Risk

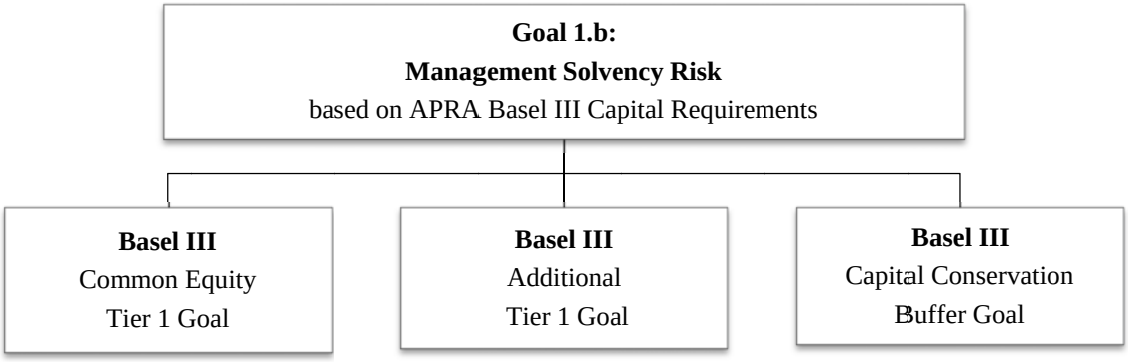
Goal 1b, managing solvency risk, aims to ensure that the bank complies with APRA's new regulatory capital requirements based on the Basel III framework Tiers 1 and 2, and the Basel III capital conservation buffer. These solvency ratios are useful as they measure the bank's capital in relation to its total weighted assets, based on a credit risk approach in which weightings are applied to balance sheet assets. The ALM model in this thesis has three sub goals, to ensure the bank meets its common equity Tier 1 and additional Tier 1, and capital conservation buffer regulatory requirement.

The thesis assumes the bank would maintain the same level of business mix (product strategies, operations, geographical diversification) throughout the time period (2012-2019), assuming forward-looking average balance sheet growth is based on the current business mix. Other assumptions include the implementation of Basel III framework, which forms part of the corporate governance risk compliance framework and the non-regulatory risk management policies in banks are based on industry practices, therefore this thesis simulated the current corporate governance policies to: 1) hold excess capital equal to 4.8%, based on industry practice; and 2) to hold more than the minimum of 100% of liquidity cover ratio (RBA 2015). In the context of this thesis both regulatory

and non-regulatory corporate governance policies are implemented in the BALM model.

The regulatory duty of the board of directors is to have adequate risk management policies that ensure the bank's compliance with Basel III minimum liquidity and capital regulatory requirements. Non-regulatory risk management policies in banks are based on industry practices, which include corporate governance policies to: 1) hold excess capital equal to 4.8%, based on industry practice; and 2) to hold more than the minimum of 100% of liquidity cover ratio.

Figure 5.5: Goal 1b Managing Solvency Risk



5.3.2 Goal 2 Bank Management Strategy Policy

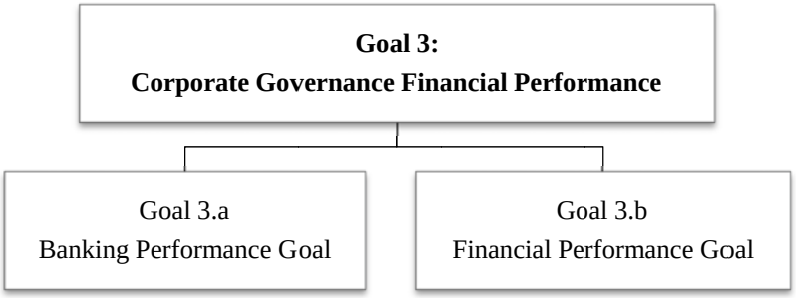
Goal 2, bank management strategy policy, aims to manage assets and liabilities of the bank, taking into account the bank's strategic direction and historical data growth trends. Goal 2 is divided into two parts (refer to Figure 5.6), Goal 2a liability management policy and Goal 2b asset management policy. Both aim to manage the assets and liabilities of the bank while taking into account the bank's strategic policy. These goals are set with both minimum and maximum allowed categories of assets and liabilities based on historical data growth trends, while allocating resources efficiently through the use of optimization. Individual liability and asset management goals will be discussed in detail in Section 5.6.

Figure 5.6: Bank Management Strategy Policy

5.3.3 Goal 3 Corporate Governance Financial Performance Goal

Goal 3, corporate governance financial performance goal policy, aims to enhance financial performance and satisfy shareholders and stakeholders while fulfilling the bank's social responsibility (Bessis 2010) Corporate governance financial performance Goal 3 policy is divided into two sub goals. First, the corporate governance banking efficiency performance Goal 3.a policy which includes three banking performance measures including interest income, interest expense and net interest income, constraints. Second, corporate governance performance Goal 3b policy constraints which includes two performance measures used in the corporate governance literature, ROE and ROA constraints.

Figure 5.7: Goal 3 Corporate Governance Financial Performance



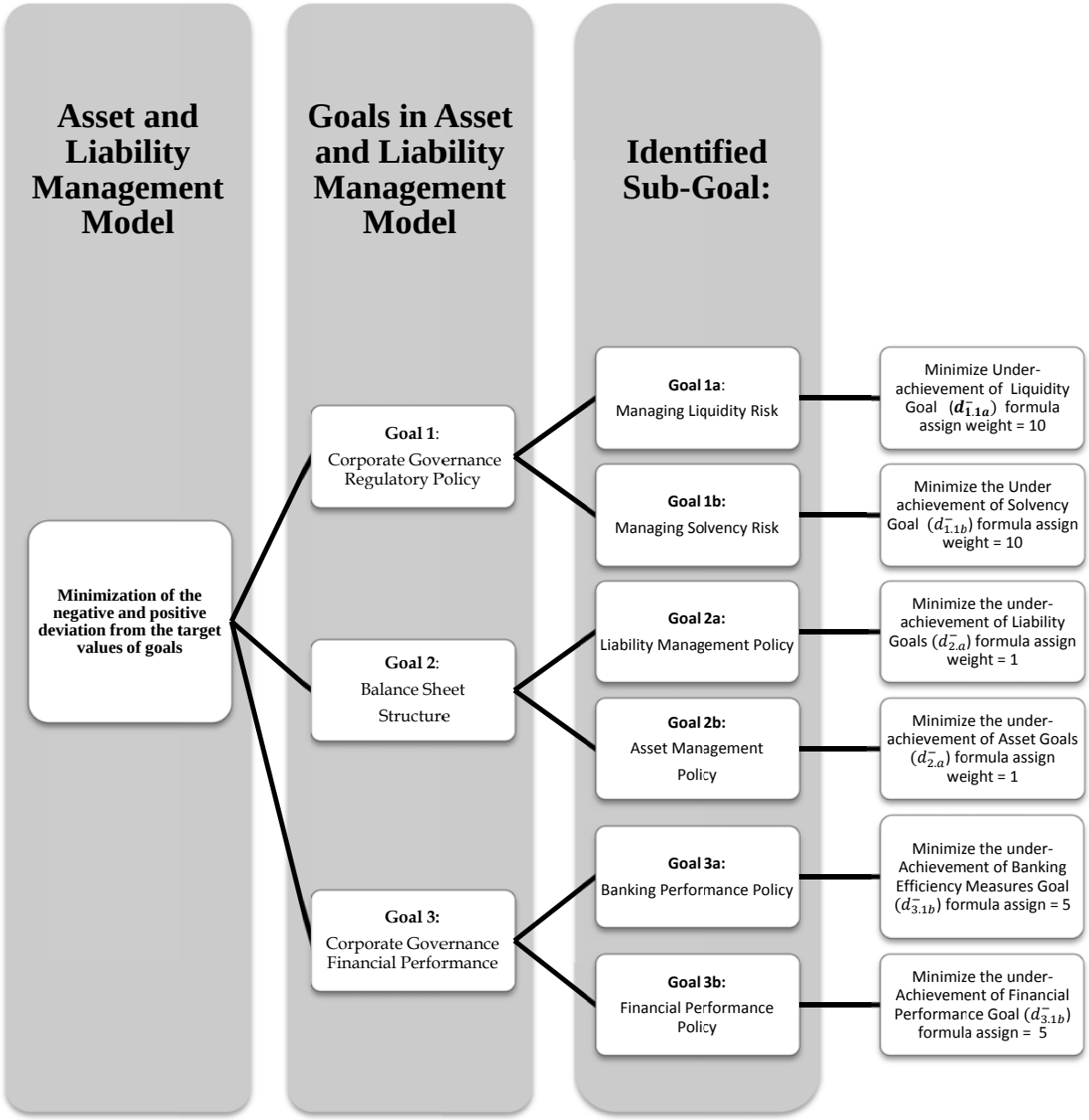
As mention previously, the bank balance sheet structure will determine the net interest and ROE, and therefore determine shareholders' return and profitability. Another important issue to consider is how bank managers manage risk in both sides of the balance sheet (see Figure 4.8). Literature has highlighted that risk management is

important, because if the bank does not manage risk prudently, it could suffer great losses or even worse cause financial contagion (Sorge 2004). However, when the bank manages financial risks efficiently it can have a positive impact on financial performance.

5.4 Bank Asset and Liability Management Goal Priorities

Figure 5.7 summarises the goal programing objective function in terms of the thesis goals in the ALM model. It also shows the minimization of the deviation (negative and positive) from the target values of each goal; weightings are given according to the importance of each goal, 10 being the most important. Given that it is a corporate governance goal to ensure that Australian banks comply with APRA Basel III liquidity and capital regulatory requirements, higher weightings equal to 10 are given to the liquidity and capital goals. Financial and banking performance goals have lower weighting equal to 5, even though they are very important for the short and long-term survival. If banks do not have adequate levels of liquidity and capital – and if a crisis was to occur again – it can lead to bank failure and even financial contagion. Listed below is a summary of the goals of the ALM model.

Figure 5.8: Asset and Liability Management Model Goals



5.4.1 Mathematical Formulation

As discussed previously, ALM is useful in decision making, and the goal programing technique facilitates the modelling for various goals and constraints. The next section provides an overview of the mathematical formulation including the goals and constraints discussed in Section 5.3. For the purpose of simplification, the formulas are listed in the following tables. Table 5.2,summarises the corporate governance goal formulas and Table 5.3 has the basic model for balance sheet variables, and goal and constraint formulas Table 5.4 summarises the corporate governance financial performance goals. Section 5.5 explains the formulas in detail.

Table 5.2: Summary of Corporate Governance Goal Formulas

Goal	Sub-Goal	Basel III Liquidity and Capital Regulatory Ratios	Goal and Constraint Formula
Corporate Governance Regulatory Policy	Managing Liquidity Risk	Liquidity Coverage Ratio (a)	$LCR_{it} - d^{+}_{1.a} + d^{-}_{1a} = LCRR_i + EL_i$ $LCR_{it} \leq LCRR_i + EL_i$
	Managing Solvency Risk	Common Equity Capital Ratio (b)	$CET1_{it} - d^{+}_{1.1b} + d^{-}_{1.1b} = B3\ CET1_{it} + EC$ $CET1_{it} \leq B3\ CET1_{it} + 4.2$
		Tier1 Capital Goal (c)	$Tier\ 1\ Ratio - d^{+}_{1.1b} + d^{-}_{1.1b} = B3\ Tier\ 1_{it}$ $Tier\ 1\ Ratio \leq B3\ Min\ Tier\ 1_{it}$
		Capital Conservation Buffer Goal (d)	$CCB_{it} - d_{1.3b} + d_{1.3b} = B3\ CCB_{it}$ $CCB_{it} \leq B3\ Min\ CCB_{it}$

Notes: a. Liquidity cover ratio refers to Section 5.5.1, formulas 1 & 1.1.
b. Common equity capital ratio refers to Section 5.5.2.2, formulas 2 & 2.1.
c. Tier 1 capital goal refer to Section 5.5.2.3, formulas 3 & 3.1.
d. Capital conservation buffer refer to Section 5.5.2.3, formulas 4 & 4.1.

Table 5.3: Basic Model for Balance Sheet Variables, and Goal and Constraint Formulas

Goal	Sub-Goals	Variables	Goal Formulas	Constraint Formulas
Balance Sheet Structure Goals	Asset Management Goals (a)	Cash-Liquid Assets Goal	$A1_t - d^+_{A1} + d^-_{A1} = 1.02083 \times a_{it}$	$A1_t \geq a_{it}$ $A1_t \leq 1.02083 \times a_{it}$
		Trading Securities 1 Goal	$A2_t - d^+_{A2} + d^-_{A2} = 1.0937 \times a_{it}$	$A2_t > a_{it}$ $A2_t \leq 1.0937 \times a_{it}$
		Trading Securities 2 Goal	$A3_t - d^+_{A3} + d^-_{A3} = 1.02962 \times a_{ij}$	$A3_t \geq a_{ij}$ $A3_t \leq 1.2962 \times a_{ij}$
		Derivative Financial Instruments Goal	$A4_t - d^+_{A4} + d^-_{A4} = 1.01618 \times a_{ij}$	$A4_t \geq a_{ij}$ $A4_t \leq 1.01618 \times a_{ij}$
		Available-for-sale assets 1 Goal	$A5_t - d^+_{A5} + d^-_{A5} = 1.027 \times a_{ij}$	$A5_t \geq a_{ij}$ $A5_t \leq 1.027 \times a_{ij}$
		Available-for-sale assets 2 Goal	$A6_t - d^+_{A6} + d^-_{A6} = 1.06 \times a_{ij}$	$A6_t \geq a_{ij}$ $A6_t \leq 1.06 \times a_{ij}$
		Net loans and advances 1 Goal	$A7_t - d^+_{A7} + d^-_{A7} = 1.0893 \times a_{ij}$	$A7_t > 1.0893 \times a_{ij}$ $A7_t \leq 1.0893 \times a_{ij}$
		Net loans and advances 2 Goal	$A8_t - d^+_{2.6b} + d^-_{2.6b} = 1.110 \times a_{ij}$	$A8_t \leq a_{ij}$ $A8_t \geq 0.110 \times a_{ij}$
		Net loans and advances 3 (Mortgage Loans) Goal	$A9_t - d^+_{2.6b} + d^-_{2.6b} = 1.81 \times a_{ij}$	$A9_t \leq a_{ij}$ $A9_t \geq 1.881 \times a_{ij}$
		Shares in controlled entities and other assets Goal	$A10_t - d^+_{10} + d^-_{10} = 1.01 \times a_{ij}$	$A10_t \geq a_{ij}$ $A10_t \leq 1.01 \times a_{ij}$
	Liability Management Goals (b)	Deposit and other borrowins 1 Goal	$L1_t - d^+_1 + d^-_1 = 1.1194 \times b_{it}$	$L1_t > b_{it}$ $L1_t \leq 1.1194 \times b_{it}$
		Deposit and other borrowins 2 Goal	$L2_t - d^+_2 + d^-_2 = -1.1912 \times b_{it}$	$L2_t \geq b_{it}$ $L2_t \leq 1.1912 \times b_{it}$
		Derivative Financial Instruments Goal	$L3_t - d^+_{l3} + d^-_{l3} = 1.1442 \times b_{it}$	$L3_t \geq b_{ij}$ $L3_t \geq 1.1442 \times b_{ij}$
		Payables and Liabilities Goals	$L4_t - d^+_{l4} + d^-_{l4} = -1.033 \times b_{it}$	$L4_t \geq b_{it}$ $L4_t \geq 1.033 \times b_{it}$
		Provisions Goal	$L5_t - d^+_{l5} + d^-_{l5} = 1.029 \times b_{it}$	$L5_t \geq b_{it}$ $L5_t \geq 1.029 \times b_{it}$
		Other Liabilities Goal	$L6_t - d^+_{l6} + d^-_{l6} = 1.0441 \times b_{it}$	$L6_t \geq b_{it}$ $L6_t \geq 1.0291 \times b_{it}$
	Balance Sheet Constraints	Total Assets Growth Constraint Constraints	$\sum_{i=1}^{10} TA_t \geq ETA_{it}$	$\sum_{i=1}^{10} TA_t \leq ETA_{it} \times GA_i$
		Total Liability Growth Constraint	$\sum_{i=1}^{6} TL_t > ETL_{it}$	$\sum_{i=1}^{6} TL_t \leq GL_i \times ETL_{it}$
		Balance Sheet Structure Constraints	$\sum_{t=1}^{i=1} TA_{it} - TL_{it} = NC_{it}$	

Notes: a. For asset management goals formulas refer to Section 5.6.2.
b. For liability management goals formulas refer to Section 5.6.1.
c. For balance sheet constraints refer to Sections 5.6.1 and 5.6.2.

Table 5.4: Summarise the Corporate Governance Financial Performance Goals

Goal	Sub-Goals	Measurement	Goal/Constraint Formula
Corporate Governance Financial Performance	Banking Financial Performance	Interest Expence	$\sum_{i}^{3} IPL_{it} \times AR_{it} - d_{3.2a} + d_{3.2a} = 1.005 \times k_{it}$ $\sum_{i}^{3} IPL_{it} \times AR_{it} \leq 1.005 \times k_{it}$
		Interest Income	$\sum_{i}^{7} IEA_{it} \times AR_{it} - \sum_{i}^{3} IPL_{it} \times AR_{it} - d_{33a} + d_{3.3a} = k_i \times EII_{it}$ $\sum_{i}^{7} IEA_{it} \times AR_{it} - \sum_{i}^{3} IPL_{it} \times AR_{it} \geq k_i \times EII_{it}$
		Net Interest Income	$\sum_{i}^{7} IEA_{it} \times AR_{it} - \sum_{i}^{3} IPL_{it} \times AR_{it} - d_{33a} + d_{3.3a} = k_i \times EII_{it}$ $\sum_{i}^{7} IEA_{it} \times AR_{it} - \sum_{i}^{3} IPL_{it} \times AR_{it} \geq k_i \times EII_{it}$
	Financial Performance	ROE	$ROE_{it} - d^{+}_{3.1b} + d^{-}_{3.1b} = EROE_i$ $ROE_{it} - d^{+}_{3.1b} + d^{-}_{3.1b} > EROE_i$
		ROA	$ROA_{it} - d^{+}_{3.2b} d^{-}_{3.2b} = EROA_i$ $ROA_{it} \geq EROA_i$

Notes: a. For interest expense refer to Section 5.7.1, formulas 8 & 8.1.
b. For interest income refer to Section 5.7.1, formulas 9 & 9.1.
c. For net interest income refer to Section 5.7.1, formulas 10 & 10.1.
d. For ROE refer to Section 5.7.2, formulas 11 & 11.1.
e. For ROA refer to Section 5.7.2, formulas 12 & 12.1.

5.5 Corporate Governance Regulatory Policy Goal Constraints

A corporate governance policy for banks focuses on the management of liquidity and capital risk by ensuring the implementation of APRA regulatory requirements based on Basel III liquidity and capital requirements (Greuning and Bratanovic 2009). Basel III will be implemented gradually, and expected to come into full effect by 2019. The Basel III requirements and implementation dates are listed in Table 5.1. This thesis not only manages liquidity and capital within the current Basel III requirements, but also implements the liquidity and capital regulatory requirements that are to be implemented within the current bank risk management framework.

5.5.1 Goal 1a Corporate Governance Regulatory Policy: Managing Liquidity Risk

Based on the ASX corporate governance principle which recommends that firms need to recognise and manage risk, Goal 1.a has been identified as one of the most important goals in the model. Corporate governance Goal 1 relates to how the bank identifies and manages the liquidity risk that occurs when there is a sudden surge in liability withdrawals that require a financial institution to liquidate its assets in a very short period of time and at less than fair market prices. This thesis measures liquidity risk as the as ratio of liquid assets to current liabilities.

The Basel Committee on Banking Supervision Principle 4 of Principles for Sound Liquidity Risk Management and Supervision (BIS 2008, p. 3) recommends that:

> *A bank should incorporate liquidity costs, benefits and risks in the internal pricing, performance measurement and new product approval process for all significant business activities (both on and off-balance sheet), thereby aligning the risk-taking incentives of individual business lines with the liquidity risk exposures their activities create for the bank as a whole.*

The new Basel III liquidity risk regulation imposes a significant challenge to banks of increasing existing liquidity measurement and management methods (Koglund 2011). This new regulation requires the new reporting and liquidity monitoring standards of: short-term stress testing of LCRs; long-term structural liquidity mismatch measurement – net stable funding ratios; and liquidity risk monitoring tools. These changes mean that

liquidity needs to be managed in the same way as capital, as explained by (Koglund 2011, p. 4):

> *Focusing on maintaining a high quality liquidity portfolio that can hedge out liquidity outflows under stress scenarios and integrate the liquidity pricing and hence incentive to raise liquidity as well as price costly liquidity according to the opportunity cost of raising the needed buffer.*

The document published by APRA on January 2014, entitled '*Prudential Standard APS 210 Liquidity*' (APRA 2014c), describes the methodology for managing liquidity risk based on the Basel III liquidity reforms involving new quantitative measures. The other liquidity measures are: the minimum liquidity holding (MLH) which came into effect in January 2014; the 30-day LCR to address acute stress scenarios, introduced in 2015; and the net stable funding ratio (NSFR) to encourage longer term funding resilience to be introduced in 2018. Due to limitations in the availability of data and the fact that the net stable funding ratio (NSFR) is to become fully effective by 2018, this measure will not be incorporated in the model. Since ANZ is one of the major banks in Australia and has to comply with the LCR, this thesis will focus the implementation of the LCR only, as the MLH approach is used by ADIs that have been exempted from the LCR requirement (APRA 2014c, p. 20).

5.5.1.1 Goal 1a Liquidity Coverage Ratio (LCR) Goal Constraint and Measurement

Building on the traditional liquidity risk concept (Greuning and Bratanovic 2009), the Basel III new liquidity requirement ratio of 2014 presented a new regulatory framework implemented by Australian Prudential Regulatory Authority. In order to comply with this requirement, ADIs must undertake scenario analyses of both domestic and foreign currencies to ensure that they can operate under a wide range of conditions (APRA 2014a). At minimum, ADIs must comply with the following scenarios: (a) going concern; (b) name crisis (until 31 December 2014); and (c) LCR (from 1 January 2015). This scenarios analysis are important because it ensures that ADIs are managing risk and uncertainty.

Koglund (2011 p. 4) explained that the LCR for both short term, 30-day stress scenarios and long-term net stable funding ratios (NSFR) is part of the regulatory reporting standards required by the Basel Committee (BIS 2008) Principles for Sound Liquidity

Risk Management and Supervision. However, this thesis will only focus on the LCR due to limitation of data availability. It was explained in the January 2014 APRA liquidity prudential standard publication that banks are required to maintain an adequate level of unencumbered high quality liquid assets (HQLA) to meet their liquidity needs for a 30-calendar day period under a severe stress scenario (APRA 2014a, p. 11).

The Basel III LCR requirement is important as it prevents banks from relying solely on anticipated inflows to meet their liquidity requirements. APRA requires ADIs to ensure a minimum level of HQLA holdings, with the amount of inflows that can offset outflows being capped at 75% of total expected cash outflow. This requires that banks must maintain the minimum amount of HQLA, which is equal to 25% of cash outflows (APRA 2014a, p. 19). This ratio forms part of the risk management policy constraints for the ALM model in this thesis. Since there are limitations in obtaining the data required to calculate LCR, cash outflows over 30 calendar days are simulated.

As shown in Table 4.4.1 stock of high liquid assets include A_1 (liquid assets), A_3 (trading securities) and A_5 (available for sale assets: government securities, local and semi-government securities).

Total net cash outflow is equal to total expected inflows minus total cash outflows. The RBA (2013, p.20) explained that total expected cash outflows are calculated by multiplying the outstanding balances of various categories or types of liabilities and off-balance sheet commitments by the rates at which they are expected to be run off or drawn down. Total expected cash inflows are calculated by multiplying the outstanding balances of various categories of contractual receivables by the rates at which they are expected to flow in under the scenario up to an aggregate cap of 75% of total expected cash outflow (APRA 2014b, p.10).

The LCR formula is listed as follows:

APRA LCR Formula (1 January 2015)

$$LCR = \frac{Stock\ High\ Liquid\ Assets_{it}}{Total\ Net\ Cash\ Outflows\ over\ the\ next\ 30\ calender\ days_{it}} \geq LCRR_{\mathrm{i}}$$

$$LCR = \frac{SHQLA_{it}}{TNCO_{it}} \geq LCRR_{\mathrm{i}}$$

Goal 1.1a aims to ensure that the bank stocks of highly liquid assets are able to meet the net cash outflows over the next 30 calendar days. The LCR was going to be implemented in phases, starting 1 January 2015 at value equal to 60% and fully implemented by 2019 (see Table 5.1). However, in Australia the RBA decided it should be fully implemented in 2015 (Debelle 2014). As mentioned before, since the total net cash outflows over the next 30 calendar days is currently not available, this figure is simulated using the average 3-months net cash outflow.

$$LCR_{it} - d_{1.a}^{+} + d_{1a}^{-} = LCRR_i + EL_i \quad (1)$$

Subject:

$$LCR_{it} \leq LCRR_i + EL_i \quad (1.1)$$

Where:

i = 1, and t = 1, 2, 3, 4, 5

The previous formula defines Goal 1.1a for the LCR, meaning that the stock of highly liquid assets must be greater than 100% of total net cash outflows (RBA 2015), plus the excess liquidity (23%) based on corporate governance policy minus the overachievement and underachievement from the target values of the goal.

Table 5.5: Description of Symbols and Data Sources for BALM Model: Basel III Liquidity Goal

Symbol	Description	Values/Data
$SHQLA_{it}$	Stock of High Quality Assets, including $(A1_t + A3_t + A5_t)$.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author. Refer Chapter 6,Section 6.5
$TNCO_{it}$	Total net cash outflows over the next 30 calendar day.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author. Refer Chapter 6,Section 6.5.
$LCRR_i$	Basel III LCR requirement defined by APRA.	Determined by APRA, equal to 100% Refer to Table 5.1
EL_i	Excess Liquidity based on corporate governance policy.	23%. Refer Chapter 6,Section 6.5.3
$d_{1.a}^{+}$	Positive deviation variable or over-achievement of goal b_i.	
$d_{1.a}^{-}$	Negative deviation variable or under-achievement of goal b_i.	

5.5.2 Goal 1b Corporate Governance Regulatory Policy: Managing Solvency Risk

Corporate governance policy Goal 1b deals with the ways in which banks identify and manage solvency risk in fulfilling APRA's Basel III Capital regulatory requirements. The solvency ratio measures a bank's capital in relation to its total weighted assets based on a credit risk approach in which risk weightings are applied to balance sheet assets (Lange et al. 2007). These risk weighted assets are divided into five categories of risk weights: 0%, 10%, 20%, 50% and 100%. These weightings are assigned based on the nature of the counterparty and perceived market risk, and therefore useful in measuring capital regulatory requirements. APRA Basel III capital regulatory requirements require banks to hold a minimum amount of capital in relation to the risk weighted assets each bank holds, including common equity Tier 1 and additional Tier 1. Table 5.5 presents the elements constituting common equity Tier 1, additional Tier 1 and capital conservation buffer.

Table 5.6: APRA Basel III Capital Regulatory Requirements Elements

APRA Basel III capital regulatory requirements	Elements
Common equity Tier 1 (CET1)	• Common shares issued by the bank that meet the criteria for classification as common shares for regulatory purposes (or the equivalent for non-joint stock companies); • Stock surplus (share premium) resulting from the issue of instruments including Common Equity Tier 1; • Retained earnings; • Accumulated other comprehensive income and other disclosed reserves; • Common shares issued by consolidated subsidiaries of the bank and held by third parties (minority interest) that meet the criteria for inclusion in Common Equity Tier 1; and • Regulatory adjustment applied in the calculation of Common Equity Tier 1.9.
Additional Tier 1 (Tier 1)	• Instruments issued by the bank that met the criteria for inclusion in Additional Tier 1 capital (and are not included in Common Equity Tier 1); • Stocks surplus (share premium) resulting from the issue of instruments included in additional Tier 1 capital; • Instruments issued by consolidated subsidiaries of the bank and held by third parties that meet the criterial for inclusion in Additional Tier 1 capital and are not included in Common Equity Tier 1; and • Regulatory adjustments applied in the calculation of Additional Tier 1 capital.
Capital conservation buffer (CCB)	• The capital conservation buffer of 2.5%, comprised of Common Equity Tier 1, is establishes above the regulatory minimum capital requirement.

Source: Adapted from (BIS 2011).

The BALM-B3 model implements constraints that ensure the bank meets it APRA Basel III capital regulatory requirements, including common equity Tier 1, additional Tier 1 and the capital conservation buffer (see Table 5.1). The additional capital will be raise assuming that:

APRA (2000a, p. 4) specifies that the ADIs that are predominantly banks:

> *…should have sound provisioning policies to ensure asset values, earnings and capital are accurately reported. An ADI's provisioning policy should cover both specific and general provisions. Specific provisions should be raised whenever reasonable doubt exists over the recoverability of particular exposures. General provisions cover the risks which are in an ADI's business but which cannot be attributed to particular exposures.*

The basic principle of capital adequacy is to define the minimum capital needed to allow a bank to sustain potential losses arising from all risks, and to comply with acceptable solvency levels. Bessis (2010, p. 35) explains that:

...when using economic measures of potential losses, the capital buffer sets the default probability of the bank, or the probability that potential losses exceed the capital base and that solvency risk is impaired by incurred losses and resulting in major capital injections by governments in the financial crisis.

Prior to the 2008 financial crisis, Basel II required that all banks in Australia hold 8% of capital on a risk weighted assets basis. However, as a result of the need to strengthen these requirements following the crisis, the new Basel III now expects banks to hold a total of 12% of capital on a risk weighted assets basis (APRA 2012e).

The APRA 23 November 2011 document entitled "Basel III Impact and Implications for Australia" stated that Australian banks were already well in excess of the coming 2013 Basel capital requirements, but common equity tier 1 (CET1) needed further increases to provide a buffer over 2016. Therefore, banks would need to replace most non-common equity during the five years of 2011-2016. As with other Australian banks, ANZ pursues an active approach to capital management regulatory compliance in which capital levels exceed APRA's level. Throughout the financial year of 2013, ANZ maintained compliance within the minimum Tier 1 and total capital ratios set by APRA and the US Federal Reserve, as well as maintained the applicable capitalisation rates set by local regulators in counties where ANZ operates (ANZ 2013).

As discussed in Chapter 3, this model implements concepts found in related disciplines. The proposed framework is structured to enable a mathematical model that incorporates the essential conflicting objectives of corporate governance, risk management and improve performance. This thesis has developed a new ALM model based on the APRA liquidity and capital requirements of Basel II in the BALM-B2 model, and incorporated Basel III liquidity and capital regulatory requirements of APRA in the BALM-B3 model. The following section discusses the capital requirements for the BALM-B3 model.

5.5.2.1 BALM-B3 (Based on Basel III Capital Regulatory Requirements)

The proposed approach to analysing the impact of Basel III liquidity and capital regulatory requirements on financial risk and performance and ALM under forward looking scenarios in banking is to first build an ALM model using APRA Basel II regulatory requirements. Next, an ALM model is built using Basel III regulatory

requirements while taking into account the implementation phases using simulation and stress testing analysis. Both models will be identical in terms of assets, liability and equity variables, and differ in terms of liquidity and capital regulatory policy constraints.

As discussed in the previous section, Goal 1 for the BALM model presented in Model 1 is to ensure that the bank's corporate governance regulatory policy complies with APRA's Basel II liquidity and capital requirements for managing liquidity and solvency risk. This model implements Basel II capital constraints including: a minimum common equity capital equal to 2%; minimum Tier 1 capital equal to 4%; and minimum Tier 2 capital equal to 4%. It also implements a Basel II liquidity constraint minimum liquidity holding equal to 9%.

5.5.2.2 Goal 1.1b Basel III Common Equity Capital Goal Constraint and Measurement

The common equity capital goal is to ensure that the bank complies with APRA Basel III capital regulatory requirements' The common equity capital ratio was phased in between 1 January 2013 and 1 January 2016. The transitional arrangements began at 2.0% of the risk weight assets and increased each subsequent year to reach its final level of 4.5% of risk weight assets on 1 January 2015. The thesis uses a progressive implementation approach using simulation to implement common equity capital ratio in the model.

Basel III – Common Equity Capital Goal (CETC)

Listed below is the calculation of common equity ratio (APRA 2012e):

$$Common\ Equity\ Capital\ Ratio = \frac{CET1_{it}}{RWA_{it}}$$

The following constraints shows that the bank CETC must meet the minimum Basel III common equity requirement defined by APRA and the corporate governance policy to hold 4.2% excess capital (EC) (refer to Table 5.7).

$$Common\ Equity\ Capital\ Ratio \geq B3\ CET1_{it} + EC$$

The goal is calculated as follows:

$$CET1_{it} - d^{+}_{1.1b} + d^{-}_{1.1b} = B3\,CET1_{it} + EC \quad (2)$$

Subject to:

$$CET1_{it} \leq B3\,CET1_{it} + 4.2 \quad (2.1)$$

Where i = 1, and t = 1, 2, 3, 4, 5.

Table 5.7: Description of Symbols and Data Sources for BALM Model: Basel III Common Equity Capital Goal

Symbol	Description	Values/Data
$CETC_{it}$	Common equity capital	Estimated values are obtained from Financial reports (2006-2015) and forecasted values are calculated by the author.
RWA_{it}	Risk weighted assets	Estimated values are obtained from Financial reports (2006-2015) and forecasted values are calculated by the author. Refer Chapter 6,Section 6.3
$B3\,CETC_{it}$	Minimum Basel III common equity requirement defined by APRA	Simulated values (2.0% - 4.5%). Refer to Table 5.1
EC	Excess capital based on corporate governance policy	(4.2%) Based on industry practice (refer to Chapter 6, section 6.2).
$d^{-}_{1.1b}$	Negative deviation variable or under-achievement of goal b_i	
$d^{+}_{1.1b}$	Positive deviation variable or over-achievement of goal b_i	

5.5.2.1 Goal 1.2b Basel III Tier 1 Goal Constraint and Measurement:

Tier 1 goal is to ensure that the bank complies with APRA Basel III capital regulatory requirements. Tier 1 is currently being be phased in between 1 January 2013 and 31 December 2018, becoming fully effective on 1 January 2019. Transitional arrangements begin at 4.0% of the risk weighted assets, and increase each subsequent year to reach the final level of 6% on 1 January 2019. A progressive implementation approach using simulation to implement Tier 1 capital ratio will be used in the model as:

$$Tier\ 1\ Ratio = \frac{Tier\ 1_{it}}{RWA_{it}} \geq B3\ \ Tier\ 1_{it}$$

The goal is calculated as follows:

$$Tier\ 1\ Ratio - \ d_{1.1b}^{+} + d_{1.1b}^{-} = B3\ Tier\ 1_{it} \quad (3)$$

Therefore:

$$Tier\ 1\ Ratio\ \leq\ B3\ Min\ Tier\ 1_{it} \quad (3.1)$$

Where:

i = 1, and t = 1, 2, 3, 4, 5

Since the new Basel III Tier 1 requirements are to implement a minimum increase from 4% to 6% in phases, the ALM model simulates each phase to show incremental impacts on the balance sheet structure and financial performance (see Table 5.8 below).

Table 5.8 Description of Symbols and Data Sources for BALM Model: Basel III Tier 1 Goal

Symbol	Description	Values/Data
$Tier\ 1_{it}$	Basel III Tier 1 capital requirement defined by APRA	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
RWA_{it}	Risk weighted assets	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author. Refer Chapter 6,Section 6.3
$B3\ Min\ Tier\ 1_{it}$	Minimum Basel III Tier 2 capital requirement defined by APRA	Simulated valued (4.0% – 6%) Refer Table 5.1
$d_{1.1b}^{-}$	Negative deviation variable or under-achievement of goal b_i	
$d_{1.1b}^{+}$	Positive deviation variable or over-achievement of goal b_i	

5.5.2.3 Goal 1.3b Basel III Capital Conservation Buffer Goal Constraint and Measurement

The Basel Committee on Banking Supervision (BIS 2008) explains that Basel III, the "new capital conservation buffer of 2.5% comprised of common equity Tier 1, is established above the regulatory minimum capital requirement" (p. 55). Common equity Tier 1 is used to meet the minimum capital requirement (including the 6% Tier 1 and 8% total capital requirements if necessary), before the remainder is used to contribute to the capital conservation buffer. These requirements are in line with those recommended by authors including Brezeanu et al. (2011), Anderson et al. (2007) and Forsberg (2004), who stressed that corporate governance does in fact impact on capital structure. Hence, in terms of asset liability management, capital structure demonstrates the bank's risk appetite and availability of funds, which contribute to profitability.

The capital conservation buffer of 2.5%, comprised of common equity Tier 1, is stablished above the regulatory minimum capital requirement. Capital distribution constraints will be imposed on a bank when capital levels fall into the conservation range as they experience losses.

Capital Conservation Buffer Progressive

The capital conservation buffer will be phased in between 1 January 2016 and 2018 becoming fully effective on 1 January 2019. APRA's transitional arrangement began at 0.0625% of the risk weight assets on the 1 January 2016 and will increase each subsequent year by an additional 0.625 percent points, to reach its final level of 2.5% of risk weight assets on 1 January 2019. The capital conservation buffer goal is to ensure that the bank maintains 0.625% of risk weighted assets as a conservation buffer, as listed below:

Capital conservation buffer (CCB) goal formula:

$$CCB\ Ratio = \frac{CCB_{it}}{RWA_{it}} \geq B3\ CCB_{it}$$

The following formula shows the adjusting of the B3 CCB formula for goal programing and Table 5.9 describes the symbols and data source. CCB should be greater than CCB times RWA minus the negative and positive deviation from the values of the target goal.

$$CCB_{it} - d_{1.3b} + d_{1.3b} = B3\ CCB_{it} \quad (4)$$

Where:

$$CCB_{it} \leq B3\ Min\ CCB_{it} \quad (4.1)$$

i = 1 and t = 1, 2, 3, 4, 5

Table 5.8: Description of symbols and data sources for BALM Model: Basel III Capital Conservation Buffer Goal

Symbol	Description	Values/Data
CCB_{it}	Basel III capital conservation buffer	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
RWA_{it}	Risk weighted assets	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author. Refer Chapter 6,Section 6.3
B3 CCB_{it}	Minimum Basel III capital conservation buffer	Simulated values (0.625%-2.5%) Refer Table 5.1.
$d^{-}_{1.3b}$	Positive deviation variable or over-achievement of goal b_i	
$d^{+}_{1.3b}$	Negative deviation variable or under-achievement of goal b_i	

APRA recommends that banks establish a crisis severity/stress level. The methodology used in this thesis uses simulation analysis in order to manage risk and uncertainty. In the context of managing solvency risk, credit adjusted assets are simulated using an average of the previous eight years and a range within 5% of the mean. Table 4.9 summarises the corporate governance goals and formulas that have been discussed in the previous section.

5.6 Goal 2 Balance Sheet Structure

The objective of investment management is to maximize the return on a portfolio constraints that address liquidity and market value volatility (Greuning and Bratanovic 2009). The bank ALM model in this thesis implements bank strategy and policy constraints based on previous investment strategy used by the bank, in the context of both liability and asset management constraints, these constraints are deterministic. The following sections explain in detail the ALM goals.

In order to achieve the BALM model goals of corporate governance, the model aims to: identify and manage risk by complying with APRA's regulatory requirements; achieve the bank strategy polices by managing the efficient allocation of assets and liability; and achieve the corporate governance goals to enhance banking efficiency performance and financial performance goals. In this way the model will be implementing various policy constraints related to each individual goal of the model. The justification and mathematical explanation of each goal, sub goal and related constraint will be provided. The constraints are implemented in designing the bank strategy goals, including liability management constraints and asset management constraints.

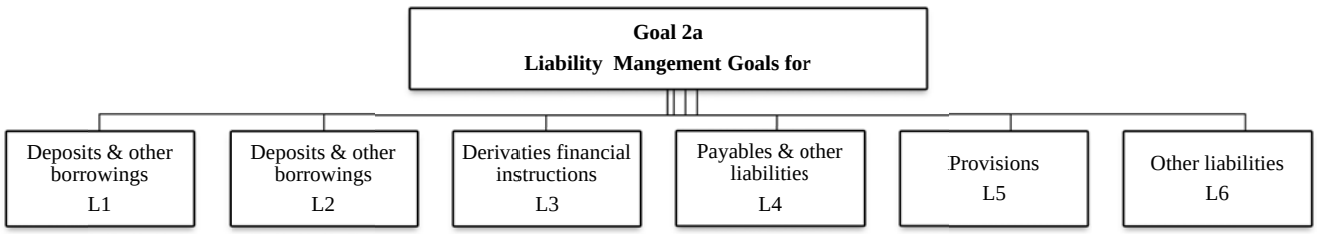
In order to achieve GOAL 1: corporate governance regulatory goal, the model simulates the implementation of two constraints, liquidity constraints and solvency constraints. The liquidity constraint includes the LCR constraint. The solvency constraints include the Basel III Tier 1 constraint, Basel III Tier 2 constraint and Basel III capital conservation buffer constraint. In order to achieve the BALM model goals of corporate governance, the model aims to: identify and manage risk by complying with APRA's regulatory requirements; achieve the bank strategy polices by managing efficient allocation of assets and liability; and implement liability management constraints and asset management constraints based on previous banks' performance to achieve the corporate governance goals to enhance banking efficiency performance and financial performance goals. In this way, the model will be implementing various policy constraints related to each individual goal of the model. The model implements: net interest margin constraint; interest income constraint; and interest expense constraint. The justification and mathematical explanation of each goal, sub goal and related constraint will be provided.

5.6.1 Goal 2a Liability Management Goal Policy

Apart from the fact that bank deposits are a source of funds that are crucial for growth, they are also a debt risk liability. Greuning and Bratanovic (2010) explained that the balance sheet component a liabilities indicates the levels and types of risk to which a bank is exposed. To addresses this exposure, corporate governance needs to set constraints that help strengthen risk management. If this risk is not efficiently managed, it will negatively impact on investor confidence, resulting in a decline in deposits that threatens the sustainability of the bank. Constraints can either be set by the bank or by regulations on particular categories of accounts. This includes both asset (X) and liability accounts (Y), with the minimum and maximum allowed for these categories being defined according to the bank's strategic policy.

The following sections explain in detail the liability management growth trend expected for each type of ANZ bank liability including: deposit to other financial institutions; deposits and other borrowings; derivative financial instruments; payables and other liabilities; provisions; other liabilities and total liability growth (see Figure 5.9).

Figure 5.9: Liability Management Goals



Liabilities Variables

L1 Deposits and other borrowings 1

In 2012, deposits were expected to rise more than the year 2012 and not expected to increase more than the previous average of 11.94%. Deposits and other borrowings include: certificates of deposit; term deposits; other deposits bearing interest and other borrowings; deposits not bearing interest; commercial paper; and borrowing corporations' debt. In 2012, these were calculated as follows.

$$L1_t - d_{l1}^{+} + d_{l1}^{-} = 1.1194 \times b_{it} \quad (5.1)$$

Subject to:

$$L1_t > b_{it} \quad (5.1.1)$$

$$L1_t\text{-} \leq 1.1194 \times b_{it} \quad (5.1.2)$$

Where:

i = 1 and t = 1, 2, 3, 4, 5

Details of b_{it} are presented in Table 5.9.

L2 Deposits and other borrowings 2

Deposits were expected to rise more than in 2012 and not expected to decline by an average of 19.12%. Deposits and other borrowings include: certificates of deposit; term deposits; other deposits bearing interest and other borrowings; deposits not bearing interest; commercial paper; and borrowing corporations' debt. In 2012, these were calculated as follows:

$$L2_t - d_{l2}^{+} + d_{l2}^{-} = -1.1912 \times b_{it} \quad (5.2)$$

Where:

$$L2_t \geq b_{it} \quad (5.2.1)$$

$$L2_t \leq 1.1912 \times b_{it} \quad (5.2.2)$$

i = 2 and t = 1, 2, 3, 4, 5

Details of b_{it} are presented in Table 5.9.

L3 Derivatives financial instruments

Derivative financial instruments were expected to rise more than the base year 2012 and not expected to increase more than the average growth rate of 14.42%. Derivative financial instruments include the following contracts and swaps: foreign exchange contracts; commodity contracts; interest rates contracts and credit default swaps. The optimisation formula is as follows:

$$L3_t - d_{l3}^{+} + d_{l3}^{-} = 1.1442 \times b_{it} \quad (5.3)$$

Subject to:

$$L3_t \geq b_{it} \quad (5.3.1)$$

$$L3_t \geq 1.1442 \times b_{it} \quad (5.3.2)$$

i = 3 and t = 1, 2, 3, 4, 5

Details are presented in Table 5.9.

L4 Payables and other liabilities

Payable and other liabilities are expected to rise more than the base year 2012 and not expected to decrease more than the average decline rate of 3.3%. Payable liabilities include: creditors, accrued interest and unearned discounts, defined benefit plan obligations, accrued charges, security settlements, other liabilities. These were calculated as:

$$L4_t - d_{l4}^{+} + d_{l4}^{-} = -1.033 \times b_{it} \quad (5.4)$$

$$L4_t \geq b_{it} \quad (5.4.1)$$

$$L4_t \geq 1.033 \times b_{it} \quad (5.4.2)$$

i = 4 and t = 1, 2, 3, 4, 5

Details are presented in Table 5.9.

L5 Provisions

Provisions were expected to rise more than the year 2012 and not expected to increase more than the average growth rate of 1.29%. Provisions include: employee entitlements, restructuring costs and surplus leased space, non-lending losses, frauds and forgeries and other provisions. These are calculated as:

$$L5_t - d_{l5}^{+} + d_{l5}^{-} = 1.0129 \times b_{it} \quad (5.5)$$

$$L5_t \geq b_{it} \quad (5.5.1)$$

$$L5_t \geq 1.029 \times b_{it} \quad (5.5.2)$$

i = 5 and t = 1, 2, 3, 4, 5

Details are presented in Table 5.9.

L6 Other liabilities

Other liabilities were expected to rise more than the year 2012 and not expected to increase more than the average growth rate of 4.41%. Other liabilities include: bonds and notes, liability for acceptances, loan capital, current tax liabilities and deferred tax liabilities. These are calculated as:

$$L6_t - d_{l6}^{+} + d_{l6}^{-} = 1.0441 \times b_{it} \quad (5.6)$$

$$L6_t \geq b_{it} \quad (5.6.1)$$

$$L6_t \geq 1.0441 \times b_{it} \quad (5.6.2)$$

i = 6 and t = 1, 2, 3, 4, 5

Details are presented in Table 5.9.

Table 5.9: Matrix for Liability Variables (b_{it}) of each time period

	BALM-B2	BALM-B3			
		Phase 1	Phase 2	Phase 3	Phase 4
	2012	2013	2015	2016	2019
	A$m	in A$m	in A$m	in A$m	in A$m
b_{it}	t=1	t=2	t=3	t=4	t=5
i = 1	474,633	474,633	577,045	645,922	905,924
i = 2	1,273	1,347	1,578	1,276	675
i = 3	52,639	47,509	81,270	92,988	139,290
i = 4	10,109	9,059	10,366	10,332	10,230
i = 5	1,201	1,228	1,074	1,088	1,130
i = 6	77,050	84,978	111,272	116,183	132,257

Total Liability Growth Constraint

In 2012, the following constraint assumed that liabilities were expected to increase not more than the previous year's (ETL_{it}) average growth of 10.75%, (GL_i) calculated as follows:

$$\sum_{i=1}^{6} TL_t > ETL_{it} \tag{5.7}$$

$$\sum_{i=1}^{6} TL_t \leq GL_i \times ETL_{it} \tag{5.7.1}$$

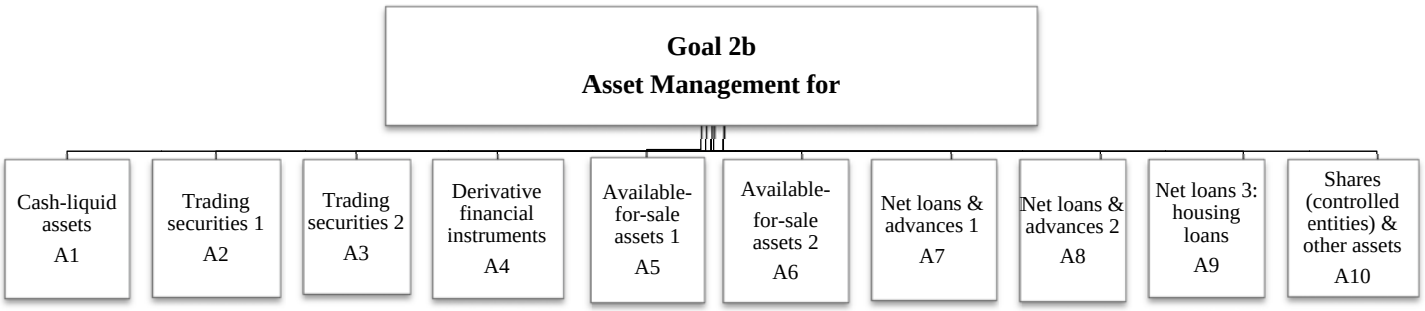
Where:

i = 6 and t = 1, 2, 3, 4, 5

5.6.2 Goal 2b Asset Management Policy Goals Constraints

In and liability management from a bank perspective, structuring the asset side of the balance sheet is important because it determines the interest income. Therefore from a financial performance perspective, corporate governance policy needs to set a risk managing policy that aims to ensure that the bank is able to operate efficiently and that the optimal income can be earned from diversification of assets, perhaps if these assets accounts are identified in order to define the minimum and maximum allowed in these categories, based on the strategy policy the bank has chosen. The asset management goals is to ensure that the bank allocates resources efficiently among the asset classes; this includes goals for each balance sheet asset, including: liquid assets; other financial institutions assets; trading securities; derivative financial instruments; available for sale assets; net loans and advances; shares (controlled entities); and other assets (see Figure 5.10).

Figure 5.10: Overview of Asset Management Policy Goals



A1 Cash-Liquid Assets Goal and Constraints

Using the compound annual growth rate (CAGR) method for calculating growth rates, liquid assets were expected to rise more than the base year (2012) and not expected to increase more than 20.83% which is the average growth rate of cash liquid assets. These include coins, notes and cash at banks, money at call, bills receivable and remittances in transit, other banks' certificates of deposit, and securities purchased under agreement to resell in less than three months, settlement balances owed by ANZ and collateral. These are calculated as follows:

$$A1_{\mathrm{t}} - d_{\mathrm{A1}}^{+} + d_{\mathrm{A1}}^{-} = 1.2083 \times a_{it} \quad (6.1)$$

Subject to:

$$A1_t \geq a_{it} \quad (6.1.1)$$

$$A1_t \leq 1.2083 \times a_{it} \quad (6.1.2)$$

Where:

i = 1 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A2 Trading Securities 1 Goal and Constraints

Trading securities were expected to rise more than the base year, and not expected to increase more than the average growth rate of 9.37%. Trading securities are: listed including other securities and equity securities; unlisted including Commonwealth securities, unlisted including local, semi-government and other government securities; unlisted including ANZ accepted bills; and unlisted including equity and other securities. These are calculated as follows:

$$A2_t - d_{A2}^{+} + d_{A2}^{-} = 1.0937 \times a_{it} \quad (6.2)$$

Subject to:

$$A2_t > a_{it} \quad (6.2.1)$$

$$A2_t \leq 1.0937 \times a_{it} \quad (6.2.2)$$

Where:

i = 2 and t = 1, 2, 3, 4, 5

Details of b_{it} are presented in Table 5.10.

A3 Trading Securities 2 Goal and Constraints

Trading securities were expected to rise more than the base year, and not expected to increase more than the average growth rate of 29.62%. Trading securities are: listed including other securities and equity securities; unlisted including Commonwealth securities, unlisted including local, semi-government and other government securities; unlisted including ANZ accepted bills; and unlisted including equity and other securities. These are calculated as follows:

$$A3_t - d_{A3}^{+} + d_{A3}^{-} = 1.2962 \times a_{it} \quad (6.3)$$

Subject to:

$$A3_t \geq a_{it} \quad (6.3.1)$$

$$A3_t \leq 1.2962 \times a_{it} \quad (6.3.2)$$

Where:

i = 3 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10

A4 Derivatives Financial Instruments Goal and Constraints

Derivative financial instruments were expected to rise more than the base year and not expected to increase more than the average growth rate of 16.18%. Derivative financial instruments include: foreign exchange contracts; commodity contracts; interest rates contracts; and credit default swaps. These are calculated as follows:

$$A4_t - d_{A4}^{+} + d_{A4}^{-} = 1.1618 \times a_{it} \quad (6.4)$$

Subject to:

$$A4_t \geq a_{it} \quad (6.4.1)$$

$$A4_t \leq 1.1618 \times a_{it} \quad (6.4.2)$$

Where:

i = 4 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A5 Available for Sale Assets 1 Goal and Constraints

The base year 2013 availability of sale assets were expected to rise above the then average growth rate of 27%. Availability of listed sale assets included: listed government securities, unlisted included local and semi-government securities; unlisted government securities. These are calculated as follows:

$$A5_t - d_{A5}^{+} + d_{A5}^{-} = 1.27 \times a_{it} \quad (6.5)$$

Subject to:

$$A5_t \geq a_{it} \quad (6.5.1)$$

$$A5_t \leq 1.27 \times a_{it} \quad (6.5.2)$$

Where:

i = 5 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A6 Available for Sale Assets 2 Goal and Constraints

The base year 2013 availability of sale assets were expected to rise above the average growth rate of 6%. Availability for sale assets 2 included: other securities and equity investments; unlisted securities and equity investments; and unlisted loans and advances. These are calculated as follows:

$$A6_t - d_{A6}^{+} + d_{A6}^{-} = 1.06 \times a_{it} \quad (6.6)$$

Subject to:

$$A6_t \geq a_{it} \quad (6.6.1)$$

$$A6_t \leq 1.06 \times a_{it} \quad (6.6.2)$$

Where:

i = 6 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A7 Net Loans and Advances 1 Goal and Constraints

Net loans and advances are divided into three types of assets based on the banks growth, decline trend of the financial data and mortgage loans. Type one net loans and advances (growth asset) included: overdrafts; credit cards outstanding; term loans for housing; commercial bills; and term loans for non-housing. This calculation takes into account the desired goal of management which is to maintain the forecast loan growth of 8.93%. As a result, net loans and advances type one is expected to rise more than the base year. These are calculated as follows:

Net loans and advances 1 (growth asset)

$$A7_{\mathrm{t}} - d_{\mathrm{A7}}^{+} + d_{\mathrm{A7}}^{-} = 1.0893 \times a_{it} \quad (6.7)$$

Subject to:

$$A7_t > 1.0893 \times a_{it} \quad (6.7.1)$$

$$A7_t \leq 1.0893 \times a_i \quad (6.7.2)$$

Where:

i = 7 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A8 Net Loans and Advances 2 Goal and Constraints

Based on an average of the data from loans granted in the year 2006-2013, the desired value target for the bank loans was set at a decline of 11.00%. Type two net loans and advances (declining asset) included: hire purchase; lease receivables; and other loans and advances. This calculation takes into account the desired goal of management which is to maintain the forecast loan decline. As a result, net loans and advances type two is expected to fall more than in 2013. These are calculated as follows:

$$A8_t - d_{A8}^{+} + d_{A8}^{-} = 1.110 \times a_{ij} \quad (6.8)$$

Subject to:

$$A8_t \leq a_{ij} \quad (6.8.1)$$

$$A8_t \geq 0.110 \times a_{ij} \quad (6.8.2)$$

Where:

i = 8 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A9 Net Loan and Advances 3: Housing Loans Goal and Constraints

Type three of net loans and advances included mortgage loans. Based an average of the data from loans granted in the year 2006-2013, the desired value target for the bank loans was set at a decline of 8.81%. This calculation takes into account the desired goal of management which is to maintain the forecast loan increase, as follows:

$$A9_t - d_{A9}^{+} + d_{A9}^{-} = 1.0881 \times a_{ij} \quad (6.9)$$

Subject to:

$$A9_t \leq a_{it} \quad (6.9.1)$$

$$A9_t \geq 1.0881 \times a_{it} \quad (6.9.2)$$

Where:

i = 1 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

A10 Shares (Controlled Entities) and Other Assets Goal and Constraints

Shares in controlled entities were expected to rise at the average eight year growth rate of -1.0%. These included: total shares in associates; total shares in joint venture entities; customers' liability for acceptances; current tax assets; deferred tax assets; goodwill and other intangible assets; other assets; and premises and equipment. These are calculated as follows:

$$A10_t - d_{10}^{+} + d_{10}^{-} = 1.01 \times a_{it} \quad (6.10)$$

Subject to:

$$A10_t \geq a_{it} \quad (6.10.1)$$

$$A10_t \leq 1.01 \times a_{it} \quad (6.10.2)$$

Where:

i = 10 and t = 1, 2, 3, 4, 5

Details of a_{it} are presented in Table 5.10.

Table 5.10: Matrix for the Asset Variables (a_{ij}) for each time period

	BALM-B2	BALM-B3			
		Phase 1	Phase 2	Phase 3	Phase 4
	2012	2013	2015	2016	2019
	A$m	in A$m	in A$m	in A$m	in A$m
a_{ij}	t=1	t=2	t=3	t=4	t=5
i = 1	36,578	51,025	82,466	99,645	175,793
i = 2	24,102	21,205	18,389	20,112	26,310
i = 3	16,500	20,083	30,611	39,679	86,419
i = 4	45,531	43,688	85,625	99,479	155,998
i = 5	13,390	16,067	25,012	31,866	65,901
i = 6	7,172	12,071	18,655	19,859	23,932
i = 7	200,860	219,685	257,701	277,140	358,200
i = 8	17,103	24,702	24,702	27,417	37,485
i = 9	19,938	23,264	22,311	22,089	21,435
i = 10	16,418	19,141	16,871	16,363	14,929

Total Assets Growth Constraint Constraints

The following constraint assumes that assets were expected to increase not more than the expected total assets (ETA_{it}) average growth (GA_i) of 11.15%.

(6.11)

$$\sum_{i=1}^{10} TA_t \geq ETA_{it}$$

$$\sum_{i=1}^{10} TA_t \leq ETA_{it} \; ETA \times \; GA_i$$

Where: (6.11.1)

i = 1 and t = 1, 2, 3, 4, 5

Goal 2: Balance Sheet Structure Constraints

As discussed previously, the objective of investment management is to maximize the return on portfolio constraints that address liquidity and market value volatility (Greuning and Bratanovic 2009). The BALM model in this thesis implements bank strategy and policy constraints based on previous investment strategy used by the bank, in the context of both liability and asset management constraints, these constraints are deterministic.

As the balance sheet structural constraints included the structure of the balance sheet, the accounting performance formula of Assets = Liabilities + Net Capital, means that bank management should determine specific goals for the optimal structure of each financial institution's assets and liabilities units of surplus and deficits – while balancing low costs and high returns. The structure of assets and liabilities is important because the various types of assets and liabilities that the bank holds will affect net interest, and therefore the ultimate profits of the bank.

The following constraint defines the equality between assets, liabilities and net worth. Based on financial accounting information (the average of shareholders' equity) obtained from the 2006 to 2015 ANZ financial statements. This is calculated as:

$$\sum_{t=1}^{i=1} TA_{it} - TL_{it} = NC_{it}$$

Where: (7)

i = 1, and t = 1, 2, 3, 4, 5

TA_{it}: *the element of i of assets*

TL_i: *the element of i of liabilities*

NC_{it} : *net capital*

d_1^+ = a positive deviation variable or over-achievement of goal b_i

d_1^- = a negative deviation variable or under-achievement of goal b_i

b_i = arithmetic value of goal i

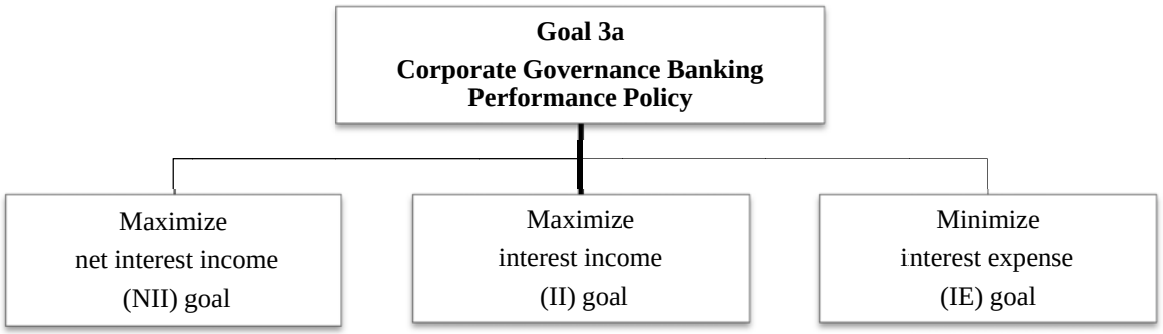
5.7 Goal 3 Corporate Governance Financial Performance Goals

5.7.1 Goal 3a Corporate Governance Banking Efficiency Performance Goal Policy

As discussed in Chapter 3, Brezeanu et al. (2011) argues that risk management strategies contribute to value maximization, furthermore one of the corporate governance objective is to enhance financial performance (Greuning and Bratanovic, 2009; Bessis 2010; Love 2010). The model in this thesis includes an additional measure that is used in the finance literature, NII (Sounders et al. 2008). This measure has been widely used in the finance literature. Lileikeene's (2008) research used NII, as it takes into account the change in the NII value subject to change in the interest rate. The NII values of interest rate sensitivity assets and interest rate sensitivity liabilities are used to assess the extent of change in NII, if the interest rate changes. Lileikeene (2008, p. 33) quoted Lee (2000) who maintains, that:

> *…asset management control must be coordinated with liability management control in such a way that asset and liability management would be characterized as a single internal system what would allow for maximal covering of the net interest income between returns on asset of the bank and incurred costs on attached funds, cost and income are attributed to both sides of the balance – assets and liabilities.*

Figure 5.11: Corporate Governance Banking Efficiency Performance Goal



Bessis (2010) explained that the balance sheet structure determines the value of interest expense, interest income and consequently NII. Greuning and Bratanovic (2009) defines the following: interest income originates from loan and all other advances extended by a bank, such as working capital, investment, housing foreign currency loans, instalments, overdrafts and credit cards; interest expense comprises interest paid on deposits and borrowings related to funding the loan portfolio; and NII, as the difference between a bank's interest income and interest expense and highlighted that "The net interest income is the core of a traditional bank's earnings, and the aim of the bank would normally be to keep the net interest income stable and growing" (Greuning and Bratanovic 2009, p. 103). In the context of this thesis, the ALM models goal policy is to maximizse the interest income of the bank and minimise of the interest expense, therefore enhancing NII. Listed below are the banking efficiency performance measures:

- Interest income (II) goal
- Interest expense (IE) goal
- Net interest income (NII) goal

Taking into account that the bank has implemented stricter liquidity and capital, these efficiency measures are therefore agency-risk adjusted. In the following sections the corporate governance financial performance goals and goal programming formulas, will be explained detail.

5.7.1.1 Goal 3.1a Interest Income Goal Formula

The interest income is calculated by multiplying interest earning assets (IEA_{it}) by the average interest rate on assets (AR_{it},) minus the negative and positive deviation from the values of the target goal, equal to the expected net interest income times the growth rate of net interest income (see Table 5.11), formulas listed below:

Goal:

$$\sum_{i}^{7} IEA_{it} \times AR_{it} \; - d_{3.1a} + d_{3.1a} \; = \; k_i \times EII_{it} \tag{8}$$

Subject to:

$$\sum_{i}^{7} IEA_{it} \times AR_{it} \; \geq = \; k_i \times EII_{it} \tag{8.1}$$

Where:

i = 1 and t = 1, 2, 3, 4, 5

k_{it} = The expected value for the NII goal based on previous performance.

Table 5.11: Description of symbols and data sources for BALM Model: Interest Income Goal

Symbol	Description	Values/Data Source
IEA_{it}	Interest earning assets: $where\ element\ i\ of\ asset,$ including $A2_{it}\ A3_{it}\ A5_{it}\ A6_{it}\ A7_{it}.$	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
AR_{it}	The average interest rate on interest earning assets	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
EII_i	The expected value for the goal for interest expense set by the bank.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author
$d_{3.1a}^{+}$	Over-achievement of the return goal r.	
$d_{3.1a}^{-}$	Under-achievement of the return goal r.	

5.7.1.2 Goal 3.2a Interest Expense Goal Formula

The interest expense is calculated by multiplying interest paying liabilities (IPL_{it}) by the average interest rate on liabilities (AR_{it}), minus the negative and positive deviation from the values of the target goal, as listed below:

$$\sum_i^3 IPL_{it} \times AR_{it} - d_{3.2a} + d_{3.2a} = k_i \times EIE_{it}$$

Subject to: (9)

$$\sum_i^3 IPL_{it} \times AR_{it} \leq k_{it} \times EIE_{it}$$

Where: (9.1)

i = 1 and t = 1, 2, 3, 4, 5

k_i = The expected value for the interest expense goal based on previous performance.

Table 5.12: Description of Symbols and Data Sources for BALM Model Interest Expense Goal

Symbol	Description	Values/Data Source
IPL_{it}	Interest paying liabilities, including ($L1_{it}$ $L2_{it}$ $L6_{it}$).	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
AR_{it}:	The average interest rate on interest paying liabilities.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author..
EIE_i	The expected value for the goal for interest expense set by the bank.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
$d_{3.2a}^+$	Over-achievement of the return goal r.	
$d_{3.2a}^-$	Under-achievement of the return goal r.	

5.7.1.3 Goal 3.3a: Net Interest Income Goal Formula

The net interest income goal is to ensure that NII is greater than the previous year and increases by the average 8-year growth trend equal to 0.91%. The NII is calculated by interest income less interest expense, minus the negative and positive deviation from the values of the target goal, as listed below:

$$\sum_i^7 IEA_{it} \times AR_{it} - \sum_i^3 IPL_{it} \times AR_{it} - d_{3.3a} + d_{3.3a} = k_i \times ENII_{it} \quad (10)$$

Subject to:

$$\sum_i^7 IEA_{it} \times AR_{it} - \sum_i^3 IPL_{it} \times AR_{it} \geq k_i \times ENII_{it}$$

Where: (10.1)

i = 1 and t = 1, 2, 3, 4, 5

k_i = The expected value for the net interest income goal based on previous performance.

Table 5.13: Description of Symbols and Data Sources for BALM Model: NII Goal

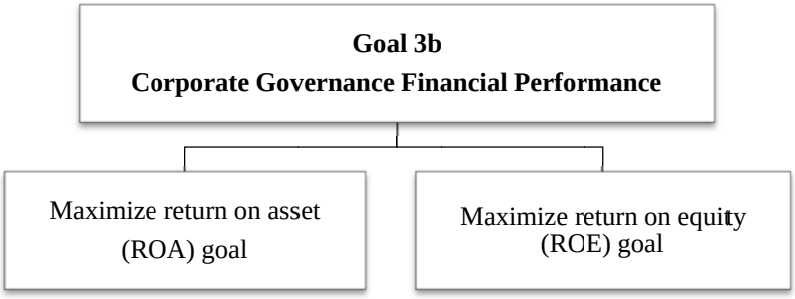
Symbol	Description	Values/Data
NII_{it}	Net interest income	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
EII_1	expectation value for the goal for NII set by bank	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
$ENII$	The expected value for the goal for net interest income based on previous performance.	Estimated values are obtained from financial reports (2006-2015) and forecasted values are calculated by the author.
$d_{3.3a}^+$	Over-achievement of the return goal r.	
$d_{3.3a}^-$	Under-achievement of the return goal r.	

5.7.2 Goal 3.b Corporate Governance Financial Performance Goal

The literature has highlighted that financial ratios are relevant and useful because they facilitate the interpretation of an entity's financial position by summarising large quantities of financial data to make qualitative judgements about a firm's financial performance (Bushman and Smith 2001; Xu et al. 2013).

Evidence from research suggests that there are several variables that influence the relationship between corporate governance and firm performance (Busman 2001). The model in this thesis uses financial ratios of the accounting base measures ROE and ROA (see Figure 5.9), as used by previous models to measure financial performance and reduce agency cost (Rechner and Dalton, 1991; Seshadri et al. 1999; Hanifa and Hudaib 2008; Epps and Cereola 2008).

Figure 5.12: Goal 3b Corporate Governance Financial Performance Goals



Listed below are the ratios used to analyse the financial performance of the ALM goal model in order to show the calculations of financial ratios used in the model of this thesis.

5.7.2.1 Goal 3.1b Return on Equity Ratio Goal Formula

The ROE goal is to ensure that the NII divided by equity is greater than the average 8-year ROE, hence providing improvements in financial performance. As listed below:

$$ROE_{it} = \frac{(NII_{it} - DP) * 0.7}{Total\ Capital\ _{it}}$$

Therefore:

$$ROE_{it} \geq EROE_i$$

The following formula shows the adjusting of the ROE formula for goal programing: ROE_{it} minus the negative and positive deviation from the values of the target goal. As listed below:

$$ROE_{it} - d^{+}_{3.1b} + d^{-}_{3.1b} = EROE_i \quad (11)$$

Subject to:

$$ROE_{it} - d^{+}_{3.1b} + d^{-}_{3.1b} > EROE_i \quad (11.1)$$

Where:

$EROE_i$: coefficient of expected ROE based on historical data;

NII_i: *the expected Net Interest Income*

DP: the average difference between profit before tax and NII

0.7: 70% Profit after tax

Total capital includes common equity Tier 1, additional Tier 1, and capital conservation buffer;

$d^{+}_{3.1b}$: the over-achievement of the return goal r;

$d^{-}_{3.1b}$: the under-achievement of the return goal r.

5.7.2.2 Goal 3.2b Return on Assets Goal Formula

The return on asset goal is calculated by dividing NII_{it} minus DP_t times .70 by total assets (TA), which should be greater than$EROA_i$, hence improvements in financial performance, as listed below:

$$ROA_{it} = \frac{(NII_{it} - DP_t) * 0.7}{Total\ Assets_{it}}$$

Therefore:

$$ROA_{it} \geq EROA_i$$

The following formula shows the adjusting of the ROA formula for goal programing; ROE should be greater EROA than ROA times equity, minus the negative and positive deviation from the values of the target goal.

$$ROA_{it} - d_{3.2b}^{+} d_{3.2b}^{-} = EROA_i \quad (12)$$

Subject to:

$$ROA_{it} \geq EROA_i \quad (12.1)$$

Where:

$EROA_i$: Coefficient of expected return on asset based on historical data;
NII_{it}: $the\ expected\ Net\ Interest\ Income$;
DP: the difference between profit before tax and NII;
0.7: 70% Profit after tax
$Total\ Assets_{it}$: $the\ total\ balance\ sheet\ assets$
d_k^+: Over-achievement of a goal
d_k^-: Under $-$ achievement of a goal

The ALM goal programming model objective function involves the minimization of the deviation d_k^+ and d_k^- from the target values of goals. However, in this model the goal priority is to first satisfy the regulatory objectives of liquidity and solvency. Other goals are then given second priority.

5.8 Mathematical Formulation: Goal Programming Objective Function

Due to the complexity of ALM, the goal programming technique is useful as its flexibility allows decision makers to incorporate a variety of goals and constraints (Kosmidou and Zopounidis 2004). Using this technique, the following formula demonstrates the current goals and constraints that the model hopes to solve, taking into account the corporate governance objectives of minimising risk strategies and enhancing financial performance. Taking into account the goals and constraints discussed in the previous section in developing an ALM goal programming model, a simplified form of the ALM objective function can be expressed as follows:

$$Min, z = \sum_{t=1}^{16} d_{ALt}^{+} + \sum_{t1}^{16} d_{ALt}^{-} + 10d_{Lt}^{+} + 10d_{Lt}^{-} + 10d_{St}^{+} + 10d_{St}^{-} + 5d_{BPt}^{+} + 5d_{BPt}^{-} + 5d_{FPt}^{+} + 5d_{FPt}^{-} \quad (13)$$

Where:

d_{ALt}^{+} = a positive deviation variable or over-achievement for all goals related to assets and liabilities.

d_{ALt}^{-} = a negative deviation variable or under-achievement for all goals related to assets and liabilities.

$10d_{Lt}^{+}$ = a positive deviation variable or over-achievement the liquidity goal related to assets and liabilities.

$10d_{Lt}^{-}$ = a negative deviation variable or under-achievement the liquidity goal related to assets and liabilities.

$10d_{St}^{+}$ = a positive deviation variable or over-achievement the solvency goal related to assets and liabilities.

$10d_{St}^{-}$ = a negative deviation variable or under-achievement the solvency goal related to assets and liabilities.

$5d_{BPt}^{+}$ = a positive deviation variable or over-achievement of all banking performance goals.

$5d_{BPt}^{-}$ = a negative deviation variable or under-achievement all banking performance goals.

d_{FPt}^{+} = a positive deviation variable or over-achievement all financial performance goals.

d_{FPt}^{-} = a negative deviation variable or under-achievement all financial performance goals.

The ALM goal programming model objective function involves the minimization of the deviation d_k^+ and d_k^- from the target values of goals. Each goal is given a different weighted value, depending on the importance of achieving the required goal. The selected weighted scheme assigns higher weights for both under or over achievement, as in this model, the goal priority levels is to first satisfy the regulatory objectives of liquidity ($10d_L^+ \; and \; 10d_L^-$) and solvency ($10d_S^+ \; and \; 10d_S^-$), then the other goals

levels are directed to other goals: banking performance ($5d_{BP}^{+}, 5d_{BP}^{-}$) and financial performance ($5d_{FP}^{+}, 5d_{FP}^{-}$). Therefore the bank ALM model gives first priority to the solvency goal and liquidity goal, and the second priority to the rest of the goals.

5.9 Stress Testing

Since financial risk and uncertainty cannot be eliminated, and given that optimization procedures find the best values of assets, liability and equity in the balance sheet model, it is important that these values take into account the financial risk profile of the bank. This simulation allows managers to examine different scenarios that manage risk more efficiently, by providing a range of outputs to identify, manage, monitor and control risk, and develop policies that help reduce financial distress. Such simulation can be used to create possible ways banks might develop and simulate an interest rate, risk weight and cash outflow scenario that encapsulates the interest rate movements emanating from the various economic conditions that impact on banking and financial performance.

Simulation optimization is useful in examining different scenarios within the maximum and minimum of the average value of the objective function, by providing a distribution of possible optimal outcomes. Similarly, constraints are typically expressed as statistical measures (average, percentile, standard deviation). Consequently, the simulation optimization goal identifies a solution (values for the decision) that produces an output containing randomness (or uncertainty) to behave in the most desirable way possible (Ragsdale 2012, p. 609) and therefore supports decision making.

Managing and achieving the two important corporate governance objectives of risk minimization and profit maximization is a challenging task, due to the interrelation between risk and return. Previous studies have emphasized the importance of the role of corporate governance in setting risk appetite; for example, Ganguin and Bilardello (2005) suggested that risk appetite should be set by the board of directors. Once risk tolerance is set, banks should then conduct stress testing in order to take a pro-active approach to managing risk (Bilston et al. 2015). However, as Debelle (2010) pointed out, Australian banks need to improve their stress testing methodologies.

5.9.1 Forward-looking and Stress Testing Scenarios

The model runs for the stress test are run using estimated 2019 data (projected from 2015) and simulating the implementation of Basel III liquidity and capital regulatory requirements under using corporate governance policy responses (see Table 5.14). In this thesis the BALM-B3 Phase 3 goal programming model (assuming that Basel III has been fully implemented) will be used to examine the implications of two stress scenarios: an increase of 5% in net cash outflow (NCO) and decrease in interest income of 5%; and an increase of 10% in net cash outflow and decrease in interest income of 10%. Both stress tests have been built on the capital assumptions used for calculating the minimum capital and excess industry capital required for compliance with the Basel III framework and Australian industry standards.

Stress Test 1 is calculated using risk weighted assets (RWA) and the liquidity cover ratio (LCR) assumption used in BALM-B3 model. The first test considers the impact of a decrease in interest income (II) by 5% and increase in net cash outflow by 5%. The model is then run to test whether the bank is able to meet its liquidity requirements and capital requirements, then compared with the BALM-B3. This is to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII) under stress scenarios. Stress Test 2 is also calculated using the risk weighted assets and liquidity cover ratio (LCR) assumption as a foundation to calculate a decrease in interest income (II) of 10% and an increase in net cash outflow by 10%. The model is then run to test whether the bank is able to meet its liquidity requirements and capital requirements, then compared with BALM-B3 model. These two scenarios are analysed by comparing the BALM-B2 and BALM-B3 models under normal economic conditions in order to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII) under stress scenarios and thereby addressing Research Aim 2 outlined in Chapter 1. Further details about the stress test are discussed in Chapter 8.

Table 5.14: Bank Asset and Liability Management (BALM) Input Framework

Balance sheet variables	**Model run: Basel II**	**Model runs: Basel III implementation simulations**			**Model runs: Stress tests and corporate governance policy responses**	
	BALM-B2	**BALM-B3 Phase 1**	**BALM-B3 Phase 2**	**BALM-B3 Phase 3**	**BALM-B3 stress test**	**BALM-B3 corporate governance policy response**
	Using Basel II framework in 2013	**Using Basel III framework in 2015**	**Using Basel III framework in 2016**	**Using Basel III framework in 2019**	**Using Basel III framework in 2019**	**Using Basel III framework in 2019**
Assets, liabilities and equity	2013 Actual data	2015 Actual data	2016 forecasted data using 2006-2015 data	2019 forecasted data using 2006-2015 data	2019 forecasted data using 2006-2015 data	2019 forecasted data using 2006-2015 data
	Model run using actual 2013 data implementing Basel II liquidity and capital regulatory requirements.	Model run using actual 2015 data implementing Basel III liquidity and capital regulatory requirements.	Model run using estimated 2016 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements.	Model run using estimated 2019 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements.	Model run using estimated 2019 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements under stress scenarios.	Model runs using 2019 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements using corporate governance policy responses

5.10 Policy Responses guided by Corporate Governance

Corporate governance Policy 3 relates to how the bank identifies and manages the interest rate risk incurred by a financial institution when the maturities of its assets and liabilities are mismatched. Since interest rates determine the cost of obtaining funds (interest expense) and simultaneously impact on income assets, any changes will impact on the net profit margin (NII). For example, when banks minimise interest expense and maximise interest income, this results in increased net interest margins that flow on to the ROA and finally increase shareholder returns. As movements of interest rates affect a bank's NII and flow on to the ROA before reaching shareholder returns, it is important to ensure that interest risk is managed.

As discussed in Chapter 2, management of interest rates is one of the most important aspects of risk management in banks, and since interest rates determine both interest income and expense, the composition of a bank's asset and liability balance plays an important role in managing interest rate risk (Kosmidou and Zopounidis 2004; Tektas et al. 2005; Fisher 2001). Therefore, due to the debates and controversies about current bank regulations not requiring capital to match interest rate risk, measurement techniques have been suggested including the gap, duration and simulation methods that are sensitive to both interest income changes and net market value of assets and liabilities that occur when there are changes in interest rates. The most widely used technique for financial risk management, and particularly for interest rate risk management, is the Monte Carlo simulation (Kosmidou and Zopounidis, 2004). In order to manage uncertainty due to the changes in interest rates that affect the BALM model, Kosmidou and Zopounidis (2004) recommend a parameter scenario analysis approach to managing interest rate risk.

As discussed previously, the model runs for the stress test are run using and simulating the implementation of Basel III liquidity and capital regulatory requirements under using corporate governance policy responses (see Table 5.14).

Using the estimated 2019 data projected from 2015 (Table 5.14), the BALM-B3 Phase 3 goal programming model (assuming that Basel III has been fully implemented) will also be used to investigate possible policy responses guided by corporate governance through: 1) mortgage rates policy – increasing net interest margins simulates the relative

impacts of five possible increases in interest rates for mortgage loans; and 2) obtaining funds rates policy – increasing net interest margins simulates the relative impacts of five possible decrease in interest in obtaining funds. These strategies may need to include an increase in interest rates, a reduction of interest rate expenses and operational costs, and additional funds obtained from shareholders in order to enhance financial performance. As raising interest rates and reducing interest rate expenses are the most significant variables affecting NII, ROE and ROA, these two corporate governance strategies will be tested in this chapter. This will be done through: 1) increasing interest in mortgage loans (simulating five possible increases in interest rates for mortgage loans: 10 basis points (bps); 30 bps; 50 bps; 70 bps; and 100 bps), while assuming no change in rates of obtained funds; and 2) assuming no change in mortgage rates and simulating five decrease scenarios of obtained funds (simulating five possible decreases in interest rates for obtaining funds loans: 5 bps; 10 bps; 15 bps; 20 bps; and 25 bps) These policy responses are discussed further in Chapter 9.

5.11 Summary of the Chapter

The 2007-2008 GFC highlighted that the Basel II regulatory requirements and risk management framework used by banks were not adequate in preventing financial contagion, this led to a review of Basel II which forced banks to readjust their risk management policies. This chapter discussed the details of the BALM goal model to demonstrate how good corporate governance principles can be implemented in a goal programing ALM model. This model implements good corporate governance principles of risk management and analyses the impact policies based on these principles have on both financial performance and banking efficiency performance. It has also explained how good corporate governance is incorporated in the model and why the thesis rises a case study approach.

As highlighted, corporate governance can ensure that banks comply with the new Basel III regulatory requirements, with the ALM models being simulated first by using Basel II liquidity and capital requirement, then using Basel III liquidity and capital requirements. Based on the recommendations of APRA that banks should conduct stress testing. The usefulness of the model was then used to justify a model revamp of the existing optimisation ALM model. Having developed a new model, the next chapter justifies application of a BALM model applied to the case study.

Chapter 6
Construction of Model Analysis for the Basel III Implementation

6.1 Introduction

Building on the development and justification of the bank asset and liability management (BALM) model presented in Chapter 5, this chapter compares current capital ratios of the four major Australian banks to underpin the assumptions of minimum Basel III capital and excess industry capital required for compliance with the Basel III framework and Australian industry standards. This chapter also discusses the measurements and assumptions used for a Basel III capital ratios framework including risk weighted assets for mortgage loans using a loan to valuation (LVR) ratio, the type of home loans (standard or non-standard loans) and whether the borrower takes out lenders' mortgage insurance or not. Following this, construction of the implementation of the new Basel III liquidity framework is presented, which includes the liquidity position in Australian banks and its challenges in meeting the new requirement. Lastly, the measuring issues and assumptions for Basel III liquidity framework are discussed in relation to the following four assumptions: cash inflow proxy, cash outflow proxy, net cash outflow and reliability of the liquidity cover ratio (LCR).

6.2 Progressive Implementation of Basel III Capital requirements

The capital variables used in this model have been selected because they are also regulatory requirements for banks that have been recommended by the Basel Committee to reduce capital risk. Additionally the literature has highlighted that the common equity ratio, Tier one ratio and capital conservation ratio are useful indicators in measuring capital risk. Goal 1: Corporate Governance Regulatory Policy aims to manage financial risk by implementing APRA Basel III capital regulatory constraints in order to manage capital risk. The new Basel III solvency ratios are useful as they measure the bank's capital in relation to its total weighted assets, based on a credit risk approach in which weightings are applied to balance sheet assets. The asset and liability management (ALM) model in this thesis has three sub-goals: to ensure the bank meets its Common

Equity Tier 1 and additional Tier 1 and capital conservation buffer regulatory requirement.

The BALM goal model output will be analysed in two parts. First, the impact of the implementation of Basel III capital regulatory requirements on the banks' capital structure and second, the impact on financial performance (return on equity (ROE)) and return on assets (ROA), banking performance (II, IE and NII) and the balance sheet structure. However, before analyzing these implications, the method and assumptions in which the risk weight assets have been calculated, are discussed in order to understand the context in which conclusions are made.

6.2.1 Capital Ratios in Australian Banks

Banking industry trends towards holding higher levels of capital play an important role in setting the capital goals and constraints for the BALM goal model in this thesis. As illustrated in Table 6.1, as of 2013, the minimum capital regulatory requirement ratio for the four major banks in Australia ranges from 11.8% to 12.3%, meaning that banks are holding excess capital from 3.7% to 4.8%. This means that banks are well capitalised in order to protect the interest of all stakeholders and therefore fulfil corporate governance objectives for managing risk. This highlights that the major banks in Australia are well capitalised, as they hold higher levels of capital than the minimum Basel capital regulatory requirement.

Table 6.1: Australian Major Banks, Capital Adequacy Ratio

	ANZ	CBA	NAB	WBC
Major banks	12.2%	11.2%	11.8%	12.3%
Minimum Basel III Capital Regulatory Requirements (2013)	7.5%	7.5%	7.5%	7.5%
Excess Capital Levels	4.7%	3.7%	4.3%	4.8%

Source: KPMG (2013).

Even though banks in Australia hold higher levels of capital than the minimum requirement, due to the negative impact of the financial crisis in banking sectors and economies around the world, the Murray Inquiry recommends a further look at increasing the levels of capital in Australia (Treasury 2014). Furthermore, APRA also encourages bank to take a pro-active approach, which enhances the international reputation of Australian banks facilitating the access to overseas funding.

6.2.2 Capital and Excess Capital Assumptions

Based on the dynamic balance sheet assumption it is important to consider the future impact up to the full implementation of the new capital requirements. It also shows the impact of the change in transitional adjustments from well above regulatory minimums and in line with international standards in order for the bank to be able to attract foreign funds. Maintaining a higher capital level is important as, in Australia, based on the current level of excess capital that the four major banks hold in Australia and international capital comparisons, this thesis takes a proactive approach as the capital constraints in the BALM model were set at 4.8%, higher than the minimum Basel III capital requirements at all phases of implementation.

Table 6.2: Australian Major Banks, Capital Adequacy Ratio, quarter end

	Mar-15	Jun-15	Sep-15
Major banks	12.4%	12.9%	13.5%
Minimum Basel III Capital Regulatory Requirements (2015)	8.0%	8.0%	8.0%
Excess Capital Levels	4.4%	4.9%	5.5%

Source: APRA 2015.

6.2.3 International Capital Comparisons

As mentioned, Australian banks hold higher levels of capital than the minimum Basel requirement (APRA 2011). A recent study conducted by the APRA (2015a) *Information Paper: International Capital Comparison Study*, analysed the comparative capital adequacy position of Australia's four largest banks against global peers, using a range of measures of capital strength. The findings concluded that Australian major banks are well capitalised, and are 'in the top quartile of a group of 52 selected international banks' (APRA 2015a, p. 24). In this study the CET1 ratios rank similarly or lower than other measures of capital adequacy in Tier 1, total capital. Table 6.2 below shows the distribution of reported CET1 ratios (%).

Table 6.3: Distribution of Reported, Common Equity Tier 1 ratios (%)

	Basel QIS Group 1	Alternative peer list
Maximum	20.9	20.7
75th percentile	13.3	13.3
Median	11.6	18.8
25th percentile	10.2	10.6
Minimum	8.3	8.6

Source: APRA (2015a, p. 24).

This study confirms that the banking system is moving towards holding higher capital levels than the Basel III capital requirements, meaning that capital management is a critical component to the risk management, and the boards of directors need to play a fundamental role in effective capital management. Furthermore, the Financial System Inquiry (Treasury 2014, p. 217) highlighted that increased capital requirements reduce the likelihood of institutional failure (Littrell 2011b) and that these requirements gives a greater capital buffer to systemically important banks, whose collapse would cause significant damage to financial markets and the economy. Higher capital also helps ameliorate the effects generated by perceptions of an implicit guarantee.

The following sections will discussed the assumptions that underpin the BALM-B3 model constraints.

6.3 Measurement Issues and Assumptions for Basel III Capital Ratios Framework

The model used in this thesis implements Basel III regulatory capital requirements using a progressive approach to simulate the new capital requirements. This is done in order to determine common equity Tier 1 and additional common equity and capital conservation buffers.

6.3.1 Housing Loans Measurement and Assumptions

The variables used to test the impact of the proposed variation in Basel III for housing in this thesis are net loans and advances under different risk weights for housing mortgages (APRA 2012c). In agreement with current regulatory banking practice, the model allocates different risk weights according to the LVR (APRA 2014b), and whether the mortgages have adequate and APRA approved lender's mortgage insurance or not. Analysing the impact of risk-weighted assets is important because it: (i) provides common measures for a bank's risk; (ii) ensures that capital allocated to assets is commensurate with the risks; and (iii) potentially highlights where destabilizing asset bubbles are raising. This model application is used to analyse the impact of different weighting on housing loans and manage capital risk to determine how much extra capital the bank needs to hold in order to counteract higher risk weights in housing loans.

Table 6.4: Risk Weights for Residential Mortgages

LVR (%)	Standard eligible mortgage		Non-Standard eligible mortgage	
	Risk-weight (no mortgage insurance) %	Risk-weight(with at least 40% of the mortgage insured by an acceptable LMI) %	Risk-weight(no mortgage insurance) %	Risk-weight(with at least 40% of the mortgage insured by an acceptable LMI) %
0 - 60	35	35	50	35
60.01 - 80	35	35	75	50
80.01 - 90	50	35	100	75
90.01 - 100	75	50	100	75
> 100.01	100	75	100	100

Source: APRA (2013b, p. 29).

As the global financial crisis (GFC) demonstrated, the consequences of weak residential mortgage underwriting practices in one country can be transferred to other countries that are financially linked through securitisation of mortgages underwritten to weak standards. For this reason the Australian Financial Stability Board (2012) highlighted that authorised deposit-taking institution (ADIs) should ensure that they follow the new principles (these were particularly weak prior to the global financial crisis of 2007) including: '(i) effective verification of income and other financial information; (ii) reasonable debt service coverage; (iii) appropriate loan-to-value ratios; (iv) effective collateral management; and (v) prudent use of mortgage insurance' (FSB 2012, p. 1).

6.3.2 Risk Weight Scenarios Using LVR Ratio

In this thesis, APRA Basel III capital requirements regulations are implemented in the ALM model using a progressive approach (see Table 6.4). In order to assess the APRA Basel III capital requirements, a simulated risk weighted assets numerator value is used for calculating common equity Tier 1, together with additional common equity and the capital conservation buffer of APRA Basel III regulatory requirements. Furthermore, in order to calculate risk weighted asset values scenarios in residential mortgages, the data is separated according to APRA prudential requirements, which include the loan-to-valuation ratio (LVR) in four categories: loans approved LVR < 60%; loans approved LVR between 60%-80%; loans approved LVR between < 80%-90%; and loans approved LVR > 90%. The LVR ratio determines the risk weighted assets allocated, and therefore influences the amount of capital the bank must hold (APRA 2013b).

Collateralisation is an important dimension of mortgage underwriting standards. Read et al. (2014) found that high LVR ratio loans (above 90%) consistently perform worse

than those with a high proportion of initial equity, because the probability of entering arrears increases with the loan-to-valuation ratio (LVR) at origin. Their results clearly emphasize the importance of careful supervision when monitoring changes in lending standards that affect the loan-to-valuation ratio of loans at origin.

Read et al. (2014) noted that it is not necessary for regulators and supervisors to mandate caps in LVR, if they satisfy themselves that the underwriting standard are sufficiently prudent and unlikely to be eroded under competitive pressure. However, jurisdictions may consider imposing or incentivising limits on LVR ratios according to specific national circumstances. Their results also reinforce the importance of checking that supervisors carefully monitor any changes in lending standards that affect the LVR of loans at origination and rates of principal repayments thereafter

6.3.3 Risk Weight Asset Scenarios Based on Standard/Non-Standard Loans

The risk weight scenario is also determined by whether the mortgage loans are classified as standard eligible mortgages or non-standard eligible mortgages. APRA defines a standard eligible loan as a residential mortgage where the:

> *…ADI has prior to the loan approval and as part of the loan origination and approval process, documentation, assessed and verified the ability of the borrower to meet their repayment obligations, valued any residential offered as security; and established that any property offered as security for the loan is readily marketable. (APRA 2013b, p. 29)*

If the mortgage loan does not satisfy the standard eligible mortgage criteria it is considered as a non-standard eligible mortgage.

Since information of LVR ratios and standard and non-standard eligible mortgages are not disclosed by individual banks, in this thesis a proxy is used. Risk weight scenarios are calculated using aggregate data from APRA quarterly ADI Property Exposures (see Table 6.4). The data of major Australian banks' new housing loan approvals are used to calculate the aggregate mean percentage of LVR ratios and the mean aggregate standard and non-standard eligible mortgage percentages. These data are then used in combination with the ANZ housing loan data in order to simulate the LVR ratio and standard and non-standard eligible mortgages, thereby simulating risk weighted assets

data for the residential mortgages. This data is used in the ALM model to calculate the APRA Basel III capital requirements.

6.3.4 International Lenders' Mortgage Insurance Comparisons

The determination of the appropriate risk-weight is also determined by mortgage insurance that has been provided by an accepted APRA lender mortgage insurance (LMI) (see Table 6.4). Mortgage insurance paid by the borrower protects the mortgage lender in the event that the borrower cannot repay their loan. APRA requires that ADIs taking lenders' mortgage insurance to provide cover for all losses of up to 40% of the higher of either the original loan amount or the outstanding loan amount (APRA 2013b, p. 28). Lenders generally use mortgage insurance for loans that have originated with a loan-to-variation ratio of 80% or greater – given the higher risk profile of these loans.

Mortgage insurance is available in many jurisdictions, including Australia, Canada, Hong Kong, the Netherlands and United States. Structure of the mortgage insurance industry across these and other countries varies considerably, and is affected by the domestic regulatory landscape and the extent of government participation in each jurisdiction (refer to Table 6.5). In Australia, although lenders' mortgage insurance is not compulsory, it enhances credit support for mortgage loans, and despite larger deposit-taking institutions operating on the advanced approach to capital adequacy having quite limited capital incentives to do so, they still use insurance extensively for high LVR mortgages, given their credit risk transfer and other benefits.

As discussed previously, LMI is not compulsory in Australia, however to:

> *…qualify as a mortgage insurance by an acceptable LMI, for the purposes of the Level 1 regulatory capital, the LMI must be regulated by APRA; and for the purposes of the Level 2 regulatory capital, in the case of overseas subsidiaries of Australian ADIs, APRA will accept the host supervisor's requirements on what constitutes an acceptable LMI in those jurisdictions. (FSR 2013, p.31).*

Table 6.5: Mortgage Insurance, Selected Jurisdictions

	Australia	Canada	Hong Kong	New Zealand	The Netherlands	United Kingdom	United States
Extensive use of LMI	Yes	Yes	Yes	No	Yes	No	Yes
Government participation in LMI	No	Yes	Yes	Yes[a]	Yes[a]	No[b]	Yes[a]
Mortgages fully insured	Yes	Yes	No	Yes	Yes	No	No[c]
Mandatory for certain loans	No	Yes	Yes	No	No	No	Yes
Capital relief for insured loans	Yes[d]	Yes	Yes	Yes[d]	Yes	Yes	Yes

Notes: a. 'Socially targeted' mortgage insurance.
b. The UK Government plans to insure up to 15 per cent of certain mortgages from January 2014.
c. Only the government insurer's policies typically cover the whole mortgage.
d. Smaller lenders have lower capital requirements on insured mortgages.
Source: Financial Stability Review September (2013, p. 41) Reserve Bank of Australia.

The explicit incentive for Australian banks to use LMI has, to a significant extent, been reduced for banks approved to use internal models, because APRA requires a minimum 20% loss given the default assumption in these models, irrespective of LMI. This floor was imposed as a substitute for the limited downturn experience in Australia over the past few decades, which impacted on mortgage repayment defaults. For this reason, government financial support of the mortgage insurance industry is important for supporting social policy goals, for example by subsidising the provision of affordable housing credit for low-income households. However, these benefits must be balanced against potential cost, including cost to the taxpayer if the mortgage risk transferred from the financial sector is subsidised and therefore under-priced, which then leads to a distortion in lending towards housing credit, particularly higher-risk mortgages.

6.3.5 Limitations of Basel III Risk Weighted Assets Approach

The aim of Basel III framework is to strengthen capital ratios after the global financial crisis. While new regulations have focused on improving the numerator of capital ratios, not much attention has gone to the denominator (risk weighted assets). Le Lesle and Avramova (2012) noted that regulators, banks and market participants have all expressed doubts about the adequacy, consistency, transparency and comparability of capital holdings. Their research found that because markets tend to distrust capital

regulatory requirements due to the way risk weighted assets are measured, there could be a number of consequences including:

i) market participants may re-calculate bank's capital ratios;

ii) market participants could stop using risk-based capital ratios altogether and turn to the current leverage ratio;

iii) investors may require higher capital ratios to compensate for the low perceived reality of the denominator; and

iv) market participants could restrict lending to banks for which they have doubts about reported capital adequacy. (Le Lesle and Avramova 2012, p. 6)

As discussed in previous sections, APRA's framework has been used to calculate the risk weighted assets for home loans. However, it is important to note that there are differences in risk weighted assets within and across countries, and that harmonization and convergence of risk weighted assets practices may not be achievable, but that the focus should be on improving transparency as highlighted by Lesle and Avramora.

6.4 Implementation of the New Basel III Liquidity Regulatory Requirements

Originally, the Basel Committee provided discretion for supervisors to implement the LCR on a stage basis, commencing at 60% on 1 January 2015 and increasing by 10% increments until it reached 100% by 1st January 2019 (BIS 2008). However, the Australian Prudential Regulation Authority recommended that since the majority of large internationally active ADIs were already compliant with the new Basel III LCR, it would not exercise discretion by implementing the new liquidity requirements in stages, but instead require that all LCR for ADIs be 100% compliant by 1 January 2015 (APRA 2012b; APRA 2015, p.16). Therefore, in this thesis, the LCR goal in the new BALM goal model will be set at 100% in order to comply with regulatory requirements. The following sections will begin by discussing the assumptions that have been made to develop a methodology for analysing the impacts of the new Basel III liquidity requirements.

6.4.1 Liquidity Position in Australian Banks

The 2008 financial crisis revealed that a number of banks globally had not managed their liquidity risk prudently and therefore contributed to financial contagion. Banks assume liquidity risk – the risk of being unable to satisfy cash flow needs. This risk arises because banks engage in maturity transformation. The new Basel III LCR aims to promote stronger buffers against acute short-term liquidity stress. The Australian banking system's liquidity amounts to $450 billion (Debelle 2014) and the total stock of CGS and semis currently amounts to around $600 billion. If the banks attempt to meet their liquidity needs solely by holding only CGS and semis, banks would not be successful. Because the stock of public debt in Australia is relatively low, the banking system's overall liquidity needs to meet the LCR and exceed what the banks could reasonable holding in this assets.

6.5 Measuring Issues and Assumptions for Basel III Liquidity Framework

In order for banks to comply with the new Basel III liquidity covered ratio, is it important to have a clear understanding of the definition. The Basel Committee on Banking Supervision defines and calculates net cash outflow as:

i. The total expected cash outflow minus the expected cash inflows in the specified stress scenario for the subsequent 30-day calendar day.

ii. Total expected cash outflows are calculated by multiplying the outstanding balances of various categories or types of liabilities and off-balance sheet commitments by the rates at which they are expected to run off or be drawn down.

iii. Total cash inflows calculated by multiplying the outstanding balances of various categories of contractual receivables by the rates at which they are expected to flow in under the scenario up to an aggregate cap of 75% of total expected cash outflows. (BIS 2013, p. 20).

In order to calculate the LCR and implement it as a liquidity constraint in the new BALM goal management model, the following assumptions with respect to cash inflow and outflows are needed in order to calculate the net cash outflow, which will determine the amount of high quality liquid assets (HQLA) that the bank must hold in order to

comply with the new Basel III liquidity regulatory requirement (LCR). In order to calculate the required net cash outflow, cash inflow and outflow, data are required. The following paragraphs explain the assumptions used to calculate net cash outflow.

6.5.1 Assumption 1: Cash Inflow Proxy

On 30 January 2014, APRA released the Implementation of Basel III liquidity (APRA 2014c) framework in Australia explaining that the projected cash inflows from transactions with commitments to related-party entities should be no greater than 50% of projected outflows. This maximum limit is in addition to the general stipulation that cash inflows (from all sources) cannot be greater than 75% of cash outflows. Therefore, the cash inflows are forecasted here for 2016 and 2019 using the two-year (2014 and 2015) data published by ANZ (see Table 6.6).

6.5.2 Assumption 2: Cash outflow Proxy

Liquidity reforms in Australia outlined that the LCR information be presented as simply averages of daily observations over the previous quarter (APRA 2013a). Therefore, the cash outflows here are forecasted for 2016 and 2019 using the two-year (2014 and 2015) data published by ANZ (see Table 6.6).

Table 6.6: Actual and forecasted Net Cash Outflow

Cash flows modelled under stress scenario	2014 $b	2015 $b	2016 (Forecast) $b	2019 (Forecast) $b
Cash outflows	157.1	175.2	195	271
Cash inflows	22.4	24.4	26.5	34.4
Net Cash Outflow	134.7	150.8	168.5	236.7

Source: 2014 and 2015 values were obtained from ANZ Annual Reports (2015, p. 118) and forecasted data for 2016 and 2019 were calculated by the author.

6.5.3 Assumption 3: Net Cash Outflow

The BALM model uses the calculated cash outflow (based on assumption 1 and 2) to determine the amount of high quality liquid assets (HQLA) the bank must hold in order to comply with the new Basel III LCR requirement (see Chapter 5).

6.5.4 Liquidity Cover Ratio Assumptions

The new liquidity cover ratio requires banks to hold a minimum of 100% for the LCR (APRA 2014e). Since ANZ data for 2014 and 2015 show that the bank is holding 122% of LCR (ANZ 2015, p.118), this thesis makes the assumptions that the banks will pursue the LCR to be 122% (see Chapter 5).

6.6 Conclusion

This chapter has presented the current capital ratios in Australian banks compared with international capital, with particular emphasis on how these underpin the assumptions used in calculating the minimum capital and excess industry capital required for compliance with the Basel III framework and Australian industry standards. As both liquidity and capital assumptions have played a critical role in the development of the goal and constraints in the BALM model, challenges of the liquidity position in Australian banks and how the new Basel III liquidity framework has been used as a foundation for the construction of liquidity assumptions, has been explained. The following chapter will present an analysis of the impact of moving progressively to Basel III, using the methodology developed in Chapter 5, together with the capital and liquidity assumptions discussed in this chapter.

Chapter 7
The Impact of Moving Progressively to Basel III

7.1 Introduction

Building on assumptions used in calculating the minimum capital and excess industry capital required for compliance with the Basel III framework and Australian industry standards presented in Chapter 6, this chapter presents an analysis of the impact of moving progressively to Basel III. As both Basel III liquidity and capital requirements play a critical role in the development of the goals and constraints in the bank asset and liability management (BALM) model, the liquidity framework and construction of liquidity assumptions discussed in Chapter 6 are used to analyse the impacts of the new Basel III liquidity requirements, thereby answering the research questions discussed in Chapter 1. These include measurements of the impact of Basel III liquidity and capital regulatory requirements on financial performance (ROE and ROA), banking performance (II, IE and NII), and balance sheet structure.

As discussed in Chapter 3, the Basel Committee on Banking Supervision provides a forum to regulate banking supervisory recommendations presented in the Basel III framework. Due to the committee's objectives being to enhance the understandings of key supervisory issues and improve the quality of banking supervision, the main aim of their new regulatory requirements was to reduce the probability of any future financial crisis by ensuring that banks hold higher levels of liquidity and capital (APRA 2015b). These requirements included the introduction of a liquidity cover ratio (LCR) and an increase in minimum capital requirements equal to 15.5%. Building on these requirements, in 2016 APRA is proposing to introduce a capital conservation buffer equal to 2.5%. APRA is also recommending additional requirements for an enhanced board of oversight that includes an authorised deposit-taking institution (ADI) liquidity and capital risk management framework.

In order to analyse the impact of Basel III liquidity and capital regulatory requirements on ROE, ROA and NII and asset and liability management under forward looking scenarios in banking, two versions of the ALM model have been developed (see Chapter 5). Although both of these versions implement Basel liquidity and capital

regulatory requirements using mathematical constraints, BALM-B2 implements Basel II whereas BALM-B3 implements Basel III while taking into account the three regulatory phases (phase one 2015, phase two 2016, phase three 2018). As discussed in Chapter 4, the BALM model aims to ensure that the bank allocates resources efficiently for both sides of the balance sheet, therefore both models implemented the minimum and maximum allowed categories of assets and liabilities in the balance sheet based on historical data growth trends. They aim to allocate resources efficiently through the use of optimization to achieve financial goals, including ROE, ROA and NII.

Taking into account that the ASX Corporate Governance Council's recommendation Principle 7 (to recognise and manage risk) is the responsibility of the board of directors, both BALM-B2 and BALM-B3 models assume that the board of directors have only implemented risk management strategies that manage liquidity and solvency risk to comply with the new Basel III liquidity and capital regulatory requirements.

In order to measure the impact of Basel III liquidity and capital regulatory requirements on financial performance of the bank (NII, ROE, and ROA), the base BALM-B2 model uses the 2013 balance sheet data while implementing Basel II regulatory requirements. BALM-B3 phase 1 uses the 2015 actual balance sheet data, while BALM-B3 phase 2 (2016) and BALM-B3 phase 3 (2019) uses the balance sheet data adjusted according to the bank's balance sheet growth trend. These growth trends are calculated using 2006 to 2015 balance sheet data and implementing Basel III regulatory requirements in accordance with APRA's regulatory implementation phases from 2014-2019 (see Table 7.1).

Table 7.1: Bank Asset and Liability Management Input Framework

Balance sheet variables	**Model Run: Basel II**	**Model Runs: Basel III Implementation Simulations**		
	BALM-B2	**BALM-B3 Phase 1**	**BALM-B3 Phase 2**	**BALM-B3 Phase 3**
	Using Basel II Framework in 2013	**Using Basel III Framework in 2015**	**Using Basel III Framework in 2016**	**Using Basel III Framework in 2019**
Assets, liabilities and equity	2013 actual data	2015 actual data	2016 forecasted data using 2006-2015 data	2019 forecasted data using 2006-2015 data
	Model run using actual 2013 data implementing Basel II liquidity and capital regulatory requirements.	Model run using actual 2015 data implementing Basel III liquidity and capital regulatory requirements.	Model run using estimated 2016 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements.	Model run using estimated 2019 data (projected from 2015) implementing Basel III liquidity and capital regulatory requirements.

BALM-B2 and BALM-B3 models are identical in terms of the types assets, liability and equity variables, but differ in terms of liquidity and capital regulatory policy constraints (see Chapter 4). By comparing these two models, the impact of simulated 2019 Basel III liquidity and capital regulatory requirements for assets, liability, equity and financial performance (NII, ROE and ROA), can be quantified.

The new Basel III regulatory requirements aim to strengthen the liquidity and capital position of banks, however changes in the regulatory environments has raised many questions for banks, regulators and investors. The risk and regulatory reform represented by Basel III needs to be examined in light of the impact it will have balance sheet restructuring, financial and banking performance. This chapter is divided into six sections: 1) analysis of the progressive implementation of the Basel III capital requirements, 2) analysis of the implementation of the liquidity regulatory requirements, and 3) analysis of the implementation of Basel III and the impact on the structure of the balance sheet.

7.2 Analysis of BALM Model Output for Capital Ratios

Due to industry trends, Australian banks hold levels of capital ratio ranging from 4.2% to 4.8% higher than the minimum capital regulatory requirements. Furthermore, the Murray Inquiry recommends that these levels of capital be further increased to strengthen the banking sector and protect it from financial contagion (FSI 2015). These trends and recommendations that were included in the development and implementation of Basel II and III APRA capital regulatory requirements are incorporated in the base line (BALM-B2) Model and modified BALM-B3 Model of this thesis. Therefore the capital goals and constraints in the model were higher than the minimum Basel III capital regulatory requirements (see Chapter 4).

In order to arrive at the optimal BALM output, various models were run to yield an optimal balance sheet structure, which was a lengthy process. The findings from this process highlighted that optimal outputs were only achieved using the banks' current capital ratio level rather than the minimum Basel II capital ratio requirements, because the bank's financial balance sheet data reflects higher capital ratio levels (see Chapter 6). Once these findings were implemented as goals and constraints in the BALM, optimal solutions were able to be obtained. It is the responsibility of the bank's board of

directors to ensure good corporate governance through compliance with Basel III capital regulatory requirements implemented within the new BALM model, giving capital goal compliance first priority over all other goals in the model. In analysing the Basel III capital regulatory requirement variables, the following sections will discuss the BALM output for the amount of capital in millions the banks needs to hold in order to comply with APRA Basel III capital regulatory requirements and the capital ratios.

Table 7.2 summarises the BALM Model outputs for the BALM-B2 Model and the BALM-B3 Model Phases One, Two, Three and Four, to indicate the amount of capital that the bank is required to hold at each phase in order to comply with the new APRA Basel III capital requirements. Outputs show that the Common Equity Tier 1 for BALM-B2 is $26,410 million and in BALM-B3 Phase Four it is $59,407 million (an increase of 124.94%). This table also shows that the output for additional Tier 1 capital has increased by 7.98%, which is an increase from $6,002 millionto $6,481 million. Tier 2 Ratio in BALM-B3 is equal to zero because is it not a Basel III capital regulatory requirement. The capital conservation buffer (CCB) output for BALM-B3 Phase Two is $2,740 million, whereas in BALM-B3 phase four it is $13,501 million (an increase of 393%). As a result, the amounts of total capital plus the CCB will increase from $36,614 to $79,389 (an increase of 116.83%). This means that the bank's solvency position will be much stronger, and therefore the corporate governance objective to reduce agency cost will be achieved.

Table 7.2: BALM-B2 and BALM-B3 Output for Basel II and III (Phase One, Two and Three) Capital Levels

APRA Basel capital regulatory requirements variables	BALM-B2 outputs: Applying APRA Basel II capital regulatory requirements (2012) A$m	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases							
		Phase One (2013) A$m	Change in percentage points	Phase Two (2015) A$m	Change in percentage points	Phase Three (2016) A$m	Change in percentage points	Phase Four (2019) A$m	Change in percentage points
Common Equity Tier 1 Capital (millions)	26,410	28,791	9.0%	38,586	46.10%	48,223	82.59%	59,407	124.94%
Additional Tier 1 Capital	6,002	6,401	6.6%	6,833	13.85%	5,261	-12.35%	6,481	7.98%
Tier 2 Capital Ratio Basel II only	4,202	6,190	47.3%	7,235	Not required	Not required	Not required	Not required	Not required
Capital Conservation Buffer (CCB)	Not required	Not required	Not required	Not required	Not required	2,740	Not required	13,501	393%
Total Capital + CCB	36,614	41,382	13.0%	52,654	43.81%	56,224	53.56%	79,389	116.83%

This indicates that under all phases, the board of directors needs to set policies that ensure the bank is able to increase its level of total capital and capital conservation buffer (CCB) in order to comply with Basel III capital regulatory requirements and minimize capital risk. These findings indicate that the policies implemented by the board of directors will result in the minimization of solvency risk. Therefore, results from the ALM model in this study confirm that the implementation of APRA Basel III can help reduce capital risk. This indicates that higher capital ratios can result in safer, stronger and more resilient banks, which can therefore borrow funds and raise capital more cheaply, reducing risk and potential magnitude of financial contagion.

Table 7.3: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) Capital Ratios

APRA Basel capital regulatory requirements variables	BALM-B2 outputs: Applying APRA Basel II capital regulatory requirements (2012) %	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases							
		Phase One (2013)	Change in percentage points	Phase Two (2015)	Change in percentage points	Phase Three (2016)	Change in percentage points	Phase Four (2019)	Change in percentage points
Common equity Tier 1 ratio	8.80%	8.40%	-40	9.60%	80	11.00%	220	11.00%	220
Additional Tier 1 ratio	2.00%	1.90%	-10	1.70%	-30	1.20%	-80	1.20%	-80
Tier 2 ratio	1.40%	1.80%	40	2.00%	60	Removed	Removed	Removed	Removed
Capital conservation buffer (CCB) ratio	Not Required	Not Required	Not Required	Not Required	Not Required	0.625%	Not Required	2.50%	250
Total capital + CCB ratio	12.20%	12.20%	0	13.30%	110	12.82%	62	14.70%	250
Minimum capital ratio requirements	8.00%	8.00%	0	8.00%	0	8.625%	62	10.50%	250
Excess capital ratio holdings	4.20%	4.20%	0	5.30%	110	4.20%	0	4.20%	0

Table 7.3 summarises the BALM-B2 and BALM-B3 Phases One, Two Three and Four, thus indicating the capital ratio and excess capital ratio the bank is required to hold at each phase in order to comply with the new APRA Basel III capital requirements and excess capital according to industry trends. The output shows that the common equity Tier 1 ratio increases by 220% – an increase from 8.49% to 11.00%. Due to changes in Basel III, the bank is not required to hold the Tier 2 ratio. The CCB ratio increased from 0.625% to 2.5%, so the total capital plus CCB and the required excess capital increased from 12.20% to 14.70%. Therefore, in this thesis an assumption is made that it is common practice for Australian banks to hold higher levels of capital of 4.20% (see Section 6.2.1 Capital Ratios in Australian Banks) higher than the minimum prudential capital requirements. Furthermore, international capital comparisons show that some banks are holding up to 20.9% capital (see Section 6.2.2). The APRA (2015a) *Information Paper: International Capital Comparison Study* confirms that the banking system is moving towards holding higher capital levels than the Basel III capital requirements.

The output of the BALMG-B2 and B3 model of optimal solutions confirms that regulatory compliance of capital levels exceed APRA's Basel II minimum prudential capital ratios, with total minimum common equity capital and minimum Tier 2 being equal to 12.2% in Basel II, and increasing to 14.70% in Basel III ,which is well above the minimum capital requirement for risk minimization. As illustrated in the Table 7.2 above, it is important implementation of good corporate governance ensures that the board of directors implement policies that ensure the bank complies with the new Basel III capital regulatory requirement of a minimum common equity ratio plus a conservation buffer of 2.5%, and the additional excess capital, therefore satisfying all stakeholders.

7.2.1 Basel III Capital Requirements: Impact on ROE

The previous section discussed that the bank is able to meet its capital regulatory requirements, and thereby reduce capital risk and satisfy social responsibilities. One of the research questions was to measure the impact of Basel III liquidity and capital regulatory requirement on financial performance (ROE and ROA), this section will discuss the BALM model output for ROE.

Table 7.4: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) ROE

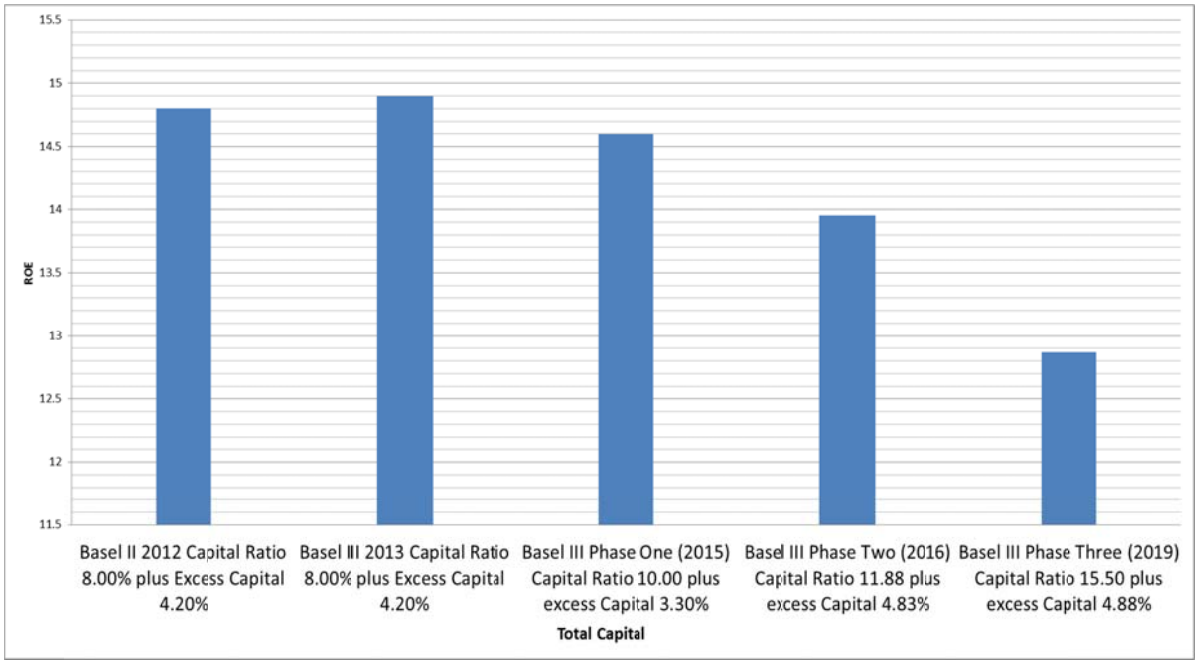
Financial performance ratio	BALM-B2 outputs: applying APRA Basel II capital regulatory requirements (2012) %	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases											
		Phase One (2013) %	Change in basis points	% change	Phase Two (2015) %	Change in basis points	% change	Phase Three (2016) %	Change in basis points	% change	Phase Four (2019) %	Change in basis points	Change in percentage points
ROE	14.8	**14.9**	10	0.7%	**14.6**	-20	-1.4%	**13.95**	-85	-6%	**12.87**	-193	-13%

Table 7.4 shows ROE for BALM-B2 is 14.8%, whereas in BALM-B3 Phase One it is 14.9%, (a decrease of 10 basis points), in Phase Two it is 14.6% (a decrease of 20 basis points), in Phase Three it is 13.95% (a reduction of 85 basis points) and in Phase Four 12.87 (a reduction of 193 basis points). These outputs indicate that, as the bank holds more capital, ROE falls from 14.8% to 12.87% – a reduction of 193 basis points. These results are due to the implementation of Basel III capital regulatory requirements that will result in a reduction of ROE, since ROE is measured by dividing NII by total capital. Therefore, the BALM output clearly demonstrates that there is an inverse relationship between higher levels of capital and NII. Hence, if capital (the denominator) increases but NII (the numerator) remains the same, this will cause ROE to fall. Therefore, given the new regulatory environment, although the bank needs to develop policies ensuring that NII increases by greater amounts to offset increases in capital regulatory requirements, it may also require increases in interest income and minimisation of interest expenses to achieve sustainable levels of ROE.

The results of this study show that there is an inverse relation between risk and return, which is in agreement with previous literature (Bushman and Smith 2000). Thus, the findings provide evidence that, although good corporate governance practices enhance the liquidity and capital position, they challenge financial performance (ROE). Therefore, these findings could be considered as an adjustment cost for the implementation of Basel III capital requirements.

The model output indicates that implementing higher risk weights for residential loans increases the amount of capital that the bank would need to hold. The benefit of holding higher levels of capital for housing loans is that it reduces the impact from possible housing bubbles, thereby reducing solvency risk. At the same time, however, it also negatively affects financial performance, particular ROE, as demonstrated in Figure 7.1. The BALM model output indicates that, as the bank has to hold more capital due to increases in the risk weight assets for home loans and the increase in the minimum capital ratio, the ROE falls from 14.8% to 12.87% – a reduction of 193 basis points as a consequence of changes in the Basel III capital requiring the bank to hold to increase capital from 12.20% to 14.70% more of capital.

Figure 7.1: BALM-B2 and B3 Model Output for Basel II and Basel III Capital and ROE



7.3 Analysis of BALM Model Output for Liquidity

The Basel Committee has stated that the only assets in the Australian jurisdiction that comply with the characteristics of high quality liquid assets (HQLA) are: balance held with the RBA, notes and coins; Commonwealth government securities (CGS); and semi-government securities (Semis) (APRA 2014a). This definition has been used in the measurement of HQLA. The liquidity variables used in this model have been selected because they are regulatory requirements for banks recommended by the Basel Committee for reducing liquidity risk. Additionally, the literature highlights that minimum liquidity holdings and minimum LCRs are useful indicators in measuring liquidity risk.

Table 7.5: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) Liquidity Requirements

APRA Basel capital regulatory requirements variables	BALM-B2 outputs: applying APRA Basel II capital regulatory requirements (2012) A$m	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases					
		Phase Two (2015) A$m	Change in Percentage Points	Phase Three (2016) A$m	Change in Percentage Points	Phase Four (2019) A$m	Change in Percentage Points
Level 1 assets	71,108	115,400	62%	215,000	202%	215,000	140%
Level 2 A + B asset	5,463	8,504	56%	11,946	119%	11,946	119%
total stock of high quality assets (HQLA)	76,571	123,904	62%	226,946	196%	226,946	196%
Internal residential mortgage backed securities	n/a	49,000	-	49,000	-	49,000	-
Alternative liquid assets (qualifying as collateral for the APRA Committed Liquidity Facility)	n/a	16,900	-	16,900	-	16,900	-
Net cash outflows	n/a	150,800	-	168,800	12%	236,600	57%
Liquidity coverage ratio (LCR)	Not required	125%	-	124%	-1%	123%	-1.6%

In the BALM goal model output for LCR, presented in Table 7.5 above, outputs for BALM-B2 were not required. However, using Basel III framework, the amount of total stock of high quality assets have been calculated. The output at each phase of APRA Basel III liquidity implementation shows that the bank's HQLA, increase from $76,571 million to $226,946 million, an increase of 196%. Table 7.4 also shows that the banks' LCR regulatory requirement is greater than 100% for all phases. These results assume that the internal residential mortgage backup securities and the alternative liquid assets (qualifying as collateral for the APA Committed Liquidity Facility remain constant. Data from Table 7.5 indicate that through the implementation of good corporate governance and taking into account that it is the responsibility of the board to ensure that the bank complies with the new LCR requirement, the banks is minimizing its liquidity risk. However, it is important to consider that the bank is relying on the LCF to meet any future shortage (Debelle 2012). The amounts remain the same, because the assumption is made that net cash outflow remain the same. However, higher levels of net cash outflow will mean the bank will have to hold higher levels of HQLA.

7.3.1Basel III Liquidity Requirements: Impact on ROA

The BALM model output shows that the implementation of good corporate governance means that the bank has higher levels of HQLA, which indicates the bank is managing its liquidity risk. However, taking into account that the bank is in a strong position to meet Basel III liquidity regulatory requirements in terms of achieving the target ROA, the output data indicates that the ROA has declined, confirming that lower risk may result in lower returns.

Table 7.6: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) for ROA

Financial performance ratio	BALM-B2 outputs: applying APRA Basel II capital regulatory requirements (2012)	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases											
		Phase One (2013) %	Change in basis points	% change	Phase Two (2015) %	Change in basis points	% change	Phase Three (2016) %	Change in basis points	% change	Phase Four (2019) %	Change in basis points	Change in percentage points
ROA	0.9	**0.91**	0.1	-0.09	**0.88**	0.06	-2.22%	**0.82**	0.03	-8.89%	**0.80**	0.08	-11.11%

Table 7.6 shows the output of ROA for BALM-B2 is 0.90, whereas in BALM-B3 Phase Four it is 0.80 (a reduction of 11.11%). The result of the indicate that the new liquidity regulatory requirements means the bank will have to restructure of the balance sheet by holding higher levels of quality liquid assets.

The Basel III LCR came into full effect in 2015, the output clearly highlights that the implementation of corporate governance the board of directors can ensure that the bank complies with the new regulatory requirements, however at the cost of a decline in ROA. Even though currently no public disclosure to the public is required here, APRA has indicated that in the future this data will be disclosed to the public. It is important to note that the bank is now facing extra pressure to hold not only higher levels of liquidity but also higher levels of capital. Chapter 7 will test the model under stress scenarios in order to test the impact on both ROA and ROE.

7.4 Impact of Basel III Liquidity and Capital Requirements on Balance Sheet Structure

As discussed in Chapter 2, prior studies on assets and liabilities have highlighted that goal programming for financial planning and portfolio selections help facilitate the efficient use of resources by determining the best values for a bank's balance sheet structure in which several goal objectives conflict (Kosmidou & Zopounidis 2001). The previous sections have discussed the impact of Basel III regulatory requirements on ROE and ROA. In this section, the BALM model output is analysed in order to measure the impact of Basel III liquidity and capital regulatory requirements on re-structuring the balance sheet.

In order to analyse the output of both BALM-B2 and BALM-B3 produced on all assets and liabilities, it is important to briefly review from which context the constraints in the ALM model originate. First, the BALM model uses financial accounting information in order to calculate average trends in growth for assets, liabilities and equity; then these growth trends were used to calculate the minimum and maximum constraints to be used in the BALM model. The testing of these strategies using a BALM model provides useful information that will facilitate the adjustment transition to meet all the new APRA Basel III liquidity and capital regulatory requirements, and measure this impact on the balance sheet structure. The following section provides the analysis and output of

the impact of Basel III liquidity and capital regulatory requirements on the structure of the balance sheet.

7.4.1 Impact of Basel III Liquidity and Capital Requirements on Assets Portfolio

The BALM model aims to ensure that the bank allocates resources efficiently for each balance sheet goal, including: cash liquid assets, trading securities, derivative financial instruments, available for sale assets, net loans and housing loans, shares (controlled entities) and other assets. The BALM model has implemented both minimum and maximum allowed categories of assets based on historical balance sheet data growth trends. Table 7.6 shows the output of BALM-B2 and BALM-B3, with the asset output based on: first priority – liquidity and capital goal; second priority – ROE, ROA and NII; and third priority – assets and liabilities. An analysis of the assets categories is outlined below.

Table 7.7: BALM-B2 and B3 Output for Balance Sheet Assets

APRA Basel capital regulatory requirements variables	BALM-B2 outputs: applying APRA Basel II capital regulatory requirements (2012) A$m	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases							
		Phase One (2013) A$m	Change in Percentage Points	Phase Two (2015) A$m	Change in Percentage Points	Phase There (2016) A$m	Change in Percentage Points	Phase Four (2019) A$m	Change in Percentage Points
Cash-liquid assets	36,578	51,025	39%	84,789	132%	95,321	161%	128,581	252%
Trading securities 1	24,102	21,205	-12%	21,451	-11%	20,112	-17%	26,310	9%
Trading securities 2	16,500	20,083	22%	30,611	86%	39,679	140%	86,419	424%
Derivative financial institutions	45,531	43,688	-4%	85,625	88%	99,479	118%	155,988	243%
Available for sale assets 1	13,390	16,067	20%	25,012	87%	29,644	121%	35,134	162%
Available for sale assets 2	7,172	12,071	68%	18,655	160%	19,854	177%	23,932	234%
Net loans 1	200,860	219,685	9%	257,701	28%	277,140	38%	335,034	67%
Net loans 2	17,103	24,702	44%	24,702	44%	27,417	60%	37,485	119%
Net loans 3: Housing loans	230,706	253,277	10%	300,468	30%	326,933	42%	412,243	79%
Shares (controlled entities) & other assets	16,418	19,959	22%	22,089	35%	21,869	33%	21,221	29%
Total assets	608,360	681,762	12%	871,103	43%	957,448	57%	1,262,347	108%

As shown in Table 7.7 above, the output for trading securities 1, net loans and advances 1 and 2, shares (controlled entities), and others assets increases are based on the assets policy constraints implemented on the basis of the average balance sheet growth trend, meaning they were significantly affected. However, the implementation of Basel III liquidity and capital regulatory constraints has influenced the ways in which the bank allocates its assets. The largest change in the assets portfolio corresponds to the trading securities 2, which increased from $16,500 in BALM-B2, to $86,419 in BALM-B3 – an increase of 424%, while cash-liquid assets increased from $36,578 in BALM-B2 to $128,581 in BALM-B3 – an increase of 252%. These increases were aimed to meet the new liquidity regulatory requirements for banks to hold higher levels of liquidity. These outputs show that since implementation of the Basel III LCR, the bank has been required to hold higher levels of liquidity, meaning that the bank has re-structured its balance sheet in order to comply with the new liquidity regulatory requirements.

Derivative financial instruments, including swaps, forwards, futures and options contracts and agreements increased from $45,531 in BALM-B2 to $155,988 in BALM-B3 – an increase of 243%, this increase can be considered as the banks' balance sheet risk management derivatives into hedging relationships in order to minimise market and credit risk, including income statements volatility.

7.4.2 Net Loans and Advances 3: Housing Loans

Table 7.7 shows the output for BALM-B2 and BALM-B3 in which the output is based on first priority – liquidity and capital goal, second priority – ROE, ROA and NII and third priority – assets and liabilities goals. The output for housing loans show that net loans for housing increased from $230,706 million in BALM-B2 Model to $412,243 million in BALM-B3 Phase Three (an increase of 79%). These results show that the bank has increased its mortgage loan portfolio in order to increase interest income. This lending growth means that the bank will need to hold even more capital by increasing its risk weighted assets for mortgage loans in order to comply with the new Basel III framework requirements. However, this additional increase in capital will have a negative impact on ROE (see Section 6.4.1).

It is important to note that in this study the average growth trend of home loans has been used to calculate the forecasted home mortgage loans amount, which is used in

combination with the new APRA Basel III capital risk weighted assets approach to calculate the forecasted risk weighted assets in balance sheet assets for the bank (refer to Chapter 5). The forecasted risk weighted assets was then used to calculate the amount of required capital ratio based on Basel III capital regulatory requirements. Therefore, in order to forecast the risk weighted assets, the outputs of BALM-B3 are based on the aforementioned assumptions.

On the 20 July 2001, APRA announced an increase in the amount of capital required for Australian residential mortgage exposures by ADIs accredited to use the internal ratings-based (IRB) approach to credit risk (APRA 2015d, p. 1). This means that the weight for residential mortgage exposures, measured across all IRB banks, are now at a minimum of at least 25%. However, as the banks continue to have a range of risk weights for individual mortgage exposures and portfolio segments, further changes to the minimum risk weights are still subject to change due to the risk weight for mortgages largely being determined by the Basel Committee. As a result, APRA's decision to target the lower end of the range primarily reflects the interim nature of the measure and uncertainty over the ultimate outcome of the Basel Committee's review of the global capital adequacy framework.

In this thesis, the model has used a minimum of 35% minimum, as recommended by the Basel Committee (BIS 2011), and for the following reasons outlined by APRA aimed at increasing the IRB mortgage risk weights in order to:

> *…Address a recommendation of the FSI that APRA narrow the difference between average mortgage risk weights for ADIs using IRB risk weight model and those using standard risk weight;*
> *Align with the direction of work being undertaken by the Basel Committee; and*
> *Have the effect of enhancing the resilience of IRB-accredited ADIs and the broader financial system.* (APRA 2015e, p. 1)

This is an important move because it will improve the bank's position relative to its international peers, and contribute to closing the gap to the fourth quartile. The BALM output based on a 35% minimum (IRB) is analysed below.

This implies that by holding more capital there will be an increase in cost, which will inevitably be borne by shareholders and investors in the form of lower earnings per share and downward pressure on dividends. However, there are some issues that need to be looked at, including the bank's responses to APRA's new capital requirements. These include increasing the bank's costs on mortgage loans, higher interest on mortgage loans, and extra fees and charges for obtaining these loans. The macroeconomic implications of holding higher capital are that consumers will bear the cost, which will put extra pressure on households and increase the probability of credit defaults. This may ultimately have a negative impact on the bank's interest income. Another implication of charging higher interest on mortgage loans is that housing affordability will further decline in Australia.

Due to the high chance of a housing bubble increasing loan defaults, the Murray Report (Treasury 2014) warns that risk weighted assets are expected to increase further in the foreseeable future. As a result, the board of directors will need to enhance their risk management framework for housing loans in order to alleviate the possible negative impacts that these increases may have on NII, ROE and ROA. The new regulatory environment also means that the cost of finance will further increase the impact on shareholders, investors and society. This will be investigated in Chapter 9.

7.4.3 Impact of Basel III Liquidity and Capital Requirements on Liability Portfolio

The bank ALM model ensures that the bank allocates resources efficiently for each balance sheet liability goal including: deposits to other financial institutions, deposits and other borrowings, derivative financial instruments, payables and other liabilities, provisions, other liabilities and total liability growth. The model implements both minimum and maximum allowed liability categories based on historical data growth trends, while allocating resources efficiently using optimisation to achieve the financial goals of ROE, ROA and NII. These include growth trends expected for each type of ANZ bank liability through analysis of the model output for a balance sheet structure based on Basel III liquidity and capital regulatory requirements.

As seen in Table 7.8 below, the goal programing output shows that the bank strategy policy constraints were achieved. Furthermore, the implementation of Basel III impacts on the structure of the balance sheet whereas certain asset and liability variables do not

differ significantly from those of the actual bank strategy, which differs from the Basel III phase scenarios. This indicates that APRA Basel III liquidity and capital regulatory constraints positively impact on the structure and quality of the bank's balance sheet.

Table 7.8: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) for Balance Sheet Liabilities

APRA Basel CAPITAL REGULATORY REQUIREMENTS VARIABLES	BALM-B2 outputs: Applying APRA Basel II capital regulatory requirements (2012) A$m	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases							
		Phase One (2013) A$m	Change in percentage points	Phase Two (2015) A$m	Change in percentage points	Phase Three (2016) A$m	Change in percentage points	Phase Four (2019) A$m	Change in percentage points
Deposits and other borrowings	426,388	474,633	11%	577,045	35.33%	645,922	51.49%	905,924	112.46%
Borrowing corporations' debt 1	1,273	1,347	6%	1,276	0.24%	1,032	-18.93%	675	-46.98%
Derivative financial instruments	52,639	47,509	-10%	81,270	54.39%	92,988	76.65%	139,290	164.61%
Payables, other liabilities	10,109	9,059	-10%	10,332	2.21%	10,230	1.20%	10,196	0.86%
Provisions	1,201	1,228	2%	1,074	-10.57%	1,088	-9.41%	1,130	-5.91%
Other liabilities	77,050	84,978	10%	109,297	41.85%	116,183	50.79%	132,257	71.65%
Total liabilities	568,660	618,754	9%	780,294	37.22%	867,443	52.54%	1,189,472	109.17%

Table 7.8 shows the output of BALM-B2 and BALM-B3 in which the output is based on: first priority – liquidity and capital goal; second priority – ROE, ROA and NII; and third priority – assets and liabilities constraints. This table shows that the implementation of Basel III liquidity and capital regulatory constraints have influenced the ways in which the bank allocates its liabilities portfolio. The next section will analyse the liability portfolios in detail.

As shown in Table 7.8 above, the outputs for deposits and other borrowings BALM-B2 are $426,388 and for BALM-B3 are $905,924 (an increase of 112.46%), which will help to raise sufficient funds to meet the new APRA Basel III liquidity regulatory requirements and the banks objectives. However, corporations' debt declined from $1,273 in BALM-B2 to $675 in BALM-B3 (a decrease of 49.89%). This reduction is due to the high interest cost for this type of debt, and while it is important for the bank to raise funds, changes in the regulatory requirements will increase cost forcing banks to pursue cost reduction strategies.

Table 7.8 shows the output for derivative financial instruments increased from $52,639 in BALM-B2 to $139,290 in BALM-B3, an increase of 164.61%. This increase can be considered as the banks' balance sheet risk management derivatives into hedging relationships in order to minimise market and credit risk, including income statements volatility.

7.5 Impact of Basel III Liquidity and Capital Requirements on Net Interest Income

Brezeanu et al. (2011) argue that risk management strategies contribute to value maximization and creation. Furthermore, one of the corporate governance objectives is to enhance financial performance (Greuning and Bratanovic 2009; Bessis 2010; Love 2010). The model in this thesis includes an additional measure that was used in the finance literature, net interest income (Sounders and Cornett 2011). This measure has been widely used in the finance literature. Lileikeene's (2008) research used NII, as it takes into account the change in the net interest income value subject to change interest rate. Corporate governance banking efficiency performance policy in the ALM model aimed at minimising interest expense and consequently increasing net interest income.

Table 7.9: BALM-B2 and B3 Output for Basel II and III (Phase One, Two and Three) for Banking Performance

APRA Basel capital regulatory requirements variables	BALM-B2 outputs: Applying APRA Basel II capital regulatory requirements (2012) A$m	BALM-B3 outputs: Applying APRA Basel III capital regulatory requirements using progressive implementation phases							
		Phase One (2013) A$m	Percentage change	Phase Two (2015) A$m	Percentage change	Phase Three (2016) A$m	Percentage change	Phase Four (2019) A$m	Percentage change
Interest income	34,311	32,479	-5%	33,517	-2.31%	36,434	6.19%	46,083	34.31%
Interest expense	20,019	17,135	-14%	16,004	-20.06%	17,556	-12.30%	23,447	17.12%
Net interest income	14,293	15,344	7%	17,513	22.53%	18,787	31.44%	22,636	58.37%

In analysing the banking performance ratios, Table 7.9 summarises the BALM model outputs for the amount of interest income, interest expense and net interest income. These outputs show that the interest income for BALM-B2 is $34.311 million, whereas in BALM-B3 Phase Four it is $48.028 million (an increase of 34.31%). This increase was driven by the bank's asset allocations given the banks' balance sheet growth trend, meaning that the objectives of the balance sheet structure to secure and optimize interest income can be achieved. Interest expense for BALM-B2 is $20.019 million, whereas in BALM-B3 Phase Four it is $23.447 million (an increase of 34.31%). This increase was also due to the bank's liability portfolio given the banks' balance sheet growth trend. Since the growth for interest income was greater than the interest expense NII for BALM-B2 is $14,293 million, whereas in BALM-B3 Phase Four it is $22,636 million (an increase of 58.37%).

This output indicates that the new Basel III liquidity and capital regulatory requirements have not had a negative impact on net interest income for the bank. However, the new APRA Basel III regulatory requirements do have a negative impact on ROE and ROA as shown in Section 7.4.1.

7.6 Summary and Key Findings

The recent financial crisis highlighted that even though banks were regulated and used accepted corporate governance principles within a Basel II framework, many failed to successfully manage their liquidity and capital challenges without costly government bailouts leading to financial contagion. For this reason, the International Basel Committee introduced a new Basel III liquidity and capital regulatory framework aimed at strengthening the stability of these financial institutions. However, in this thesis, the integrated BALM model has been used in conjunction with the new Basel III framework to further strengthen corporate governance practice and more fully safeguard the financial position of a specific bank against contagion. In this way, the satisfaction of its investors and other stakeholders can be further ensured. In doing so, it is hoped that the social costs of the type of bank failure seen during the global financial crisis will be avoided.

The 2008 global financial crisis highlighted the importance of proper prudential and regulatory practices in commercial banks, and the economic and social costs that can be

incurred if such practices are not being followed. Partly in response to this experience, the global community is adopting the third generation of liquidity and capital requirements developed by the Basel Committee on Banking Supervision (the Basel III standards).

In Australia, the banks are being required by APRA to fully implement the Basel III standards by 2019. The Australian banks weathered the recent financial crisis well, with some government support. Nevertheless, high quality bank governance, and in particular the effective implementation of these new requirements, is important in the national interest, but may have significant financial costs to the banks themselves. While both the banks and the regulatory authorities presumably model these changes in considerable detail, there is little work in the public domain assessing the impact of Basel III on the banks themselves and on broader issues of governance.

This study develops a goal programming model of one large Australian bank, (ANZ) to examine the implications of a progressive move to Basel III on key financial variables (the level of additional capital required, the level of profitability, and the return on assets and on equity), to undertake a preliminary stress testing analysis of the bank after implementation of Basel III and to consider some of the governance and policy response issues involved. Some of the key conclusions in terms of measuring the impact of Basel III on key variables are as follows.

Required additional capital. For the bank under study, the increase in Tier 1 as a result of implementing Basel III is about $32,997 million or 124.94%. This estimate assumes that the bank retains the current level of over-provision of capital. Taking account of the new capital conservation buffer required by Basel III, the total increase in capital is $42,775million or 116.83%.

Impact on return on equity. In terms of return on equity, the model measures the ratio of net interest to equity (ROE) as non-interest income and costs are not modelled. This overstates the true return on equity, as it excludes both non-interest income and the costs of earning income. Reflecting the big increase in equity capital and the implied reallocation of assets, ROE falls sharply as a result of implementing BASEL III, falling by 13% from 14.8% to 12.87%.

Impact on return on assets. Moving to Basel III does not necessarily imply a major increase in the bank's overall asset base, but does imply a significant restructuring of that base. Thus while the return on assets (here again defined as net interest income to total assets, ROA), the drop is not nearly as large as for ROE. ROA is estimated to fall by 11% as a result of implementing Basel III, from 0.90% to 0.80%.

Higher liquidity levels. The banks were required to implement the Basel III LCR in 2015, and it is estimated that this requires an increase of $85,800 million or 57% in liquid assets held by the bank.

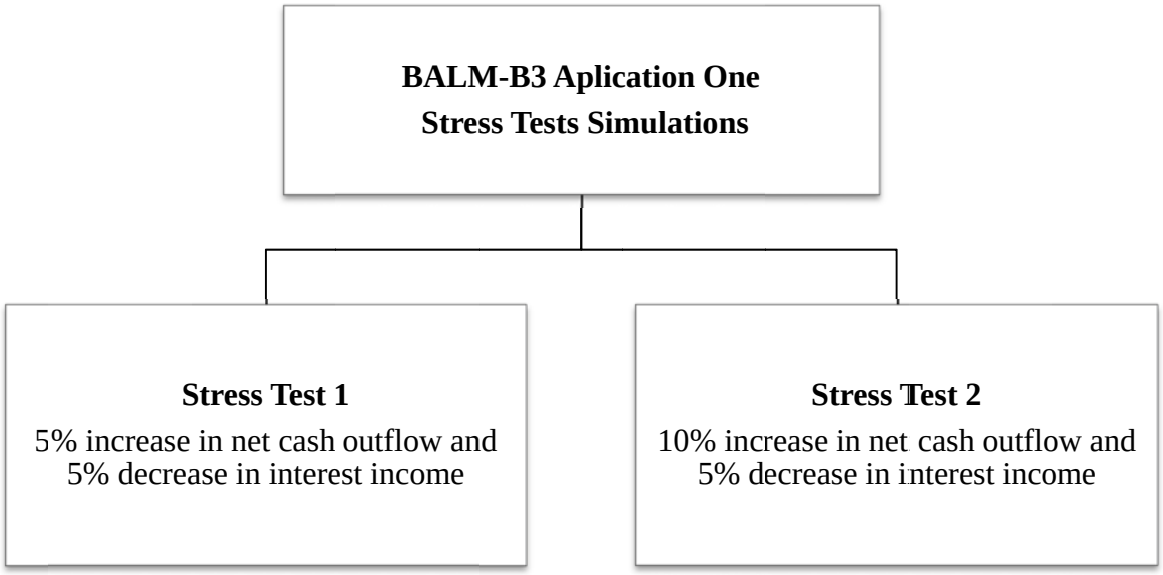
The results of this study confirm that good corporate governance practices in banks can promote the enhancement of liquidity and capital risk management by ensuring that the bank not only complies with the new liquidity and capital regulatory requirements, but also increases its capital requirements to industry standards. The implications of these findings are that in order to comply with the new Basel III regulatory requirements (assuming average balance sheet growth trends and no changes to interest rate policy), ROE, ROA and NII *must* decline. The following chapter will present an analysis of these implications under two stress scenarios that include the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII). The first scenario presents a 5% increase in net cash outflow (NCO) and a 5% decrease in interest income, and the second scenario presents a 10% increase in net cash outflow and a 10% decrease in interest income.

Chapter 8
Stress Test Simulations under Basel III

8.1 Introduction

Building on the capital assumptions used for calculating the minimum capital and excess industry capital required for compliance with the Basel III framework and Australian industry standards (Chapter 6), this chapter presents the BALM-B3 Phase Three model (assuming that Basel III has been fully implemented) to test two stress scenarios: an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%; and an increase of 10% in net cash outflow and a decrease in interest income of 10% (see Figure 8.1). These two scenarios are analysed by comparing the BALM-B2 and BALM-B3 models under normal economic conditions in order to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII) under stress scenarios and thereby answer Research Question 2 outlined in Chapter 1.

Figure 8.1: BALM-B3 Stress Test Simulation Applications



The recent financial crisis has highlighted that the uncertainty in market conditions can change overnight, creating challenges for firms, banks and governments around the world (Greuning and Bratanovic 2009). This uncertainty can lead to loan defaults and unanticipated cash outflows without sufficient inflow to meet demand. The economic uncertainty should encourage the banks' boards of directors and managers to conduct stress tests in order to assess the quality of their balance sheets in times of crisis scenarios (Johannes 2014).

Rodger (2015) in the RBA research discussion paper "Credit Losses at Australian Banks: 1980-2013", highlighted that when credit risk materialises and borrowers fail to make repayments, banks are forced to recognise the reduction in current and future cash inflows. This means that:

> *…credit losses can be large enough to reduce a bank's profitability and can affect capital. In extreme cases, credit losses can be large enough to reduce a bank's capital ratio below regulatory requirements or minimum levels at which other private sector entities are willing to deal with a bank, so can cause banks to fail. (p. 1)*

This implies that by holding more capital there will be an increase in cost, which will inevitably be borne by shareholders and investors in the form of lower earnings per share and downward pressure on dividends. However, there are some issues that need to be looked at, including the bank's responses to APRA's new capital requirements. These include increasing the bank's costs on mortgage loans, higher interest on mortgage loans, and extra fees and charges for obtaining these loans. The macroeconomic implications of holding more capital are that consumers will bear the cost, which will put extra pressure on households and increase the probability of credit defaults. This may ultimately have a negative impact on the bank's interest income. As discussed previously, one of the implications of charging higher interest on mortgage loans, is that housing affordability will further decline in Australia. The cost of holding higher levels of capital include lower ROE and ROA and higher weighted funding costs. Banking institutions will increase lending rates to cover the increase of holding higher levels of equity and GDP will grow more slowly than would have otherwise been the case.

Managing and achieving the two important corporate governance objectives of risk minimization and profit maximization is a challenging task, due to the interrelation between risk and return. Previous studies have emphasized the importance of the role of corporate governance in setting risk policy. For example, Ganguin and Bilardello (2005) suggested that risk appetite should be set by the board of directors. Once risk tolerance is set, banks should conduct stress testing in order to take a proactive approach to managing risk. However, Byres (2014) point out that Australian banks need to improve stress testing methodologies.

As discussed in the previous chapter, although the new Basel III regulatory requirements aim to strengthen the liquidity and capital position of banks, changes in the regulatory environments have raised many questions for banks, regulators and investors. Even though Australian banks are subject to the current APRA Basel III liquidity and capital regulatory requirements, there is still a high level of regulatory uncertainty, particularly due to possible changes to the risk weighted assets housing loan measures requiring banks to hold higher levels of capital. This chapter aims to address these issues by answering the research questions presented in Chapter 1.

This chapter is divided into five sections: 1) explanation and justification of the two crisis scenarios; 2) sensitivity analysis: capital position under stress test; 3) sensitivity analysis: liquidity position under stress test; 4) stress testing scenarios and their impacts on ROE and ROA; 5) stress testing scenarios and their impacts on Net interest income; and 6) summary and key findings.

8.2 Basel III Stress Test Simulations

The financial instability of recent years has put the spotlight on risk management. The traditional value at risk (VaR) measures are not being considered as sufficient for managing financial risk under current risk scenarios. Therefore this thesis considers stress testing as a key method for analysing and quantifying the impact on NII. ROE and ROA to gain useful information that will help enhance transparency into the forward looking balance sheet structures under stress scenarios for the bank. The objective is to assess resilience of the bank under adverse economic conditions. And to take a pro-active approach to avoid corporate failure or collapse this model will be used to analyse and quantify the financial position of the bank in terms of meeting and

measuring the following: the Basel III liquidity and capital requirements; impacts of financial performance (ROE and ROA); of the followings impacts on banking performance (II, IE and NII); and impacts on the balance sheet structure. The thesis considers the two following crisis scenarios.

8.2.1 Stress Test 1: 5% Simulation Scenario

Stress Test 1 is calculated using risk weighted assets (RWA) and the liquidity cover ratio (LCR) assumption used in the BALM-B3 model. The first test considers the impact of a decrease in interest income (II) by 5% and increase in net cash outflow by 5%. The model is then run to test whether the bank is able to meet its liquidity requirements and capital requirements, then compared with the BALM-B3. This is to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII) under stress scenarios.

8.2.2 Stress Test 2: 10% Simulation Scenario

Stress Test 2 is also calculated using the risk weighted assets and liquidity cover ratio (LCR) assumption as foundation to calculate a decrease in interest income (II) of 10% and an increase in net cash outflow by 10%. The model is then run to test whether the bank is able to meet its liquidity requirements and capital requirements, then it is compared with the BALM-B3 model. This is to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA) and banking performance (NII) under the stress scenarios.

8.2.3 Crisis Scenario Assumptions

As discussed previously, the BALM-B3 model was used to conduct both crisis scenarios. The assumptions used to construct the stress tests are the same ones used for the BALM-B3 model, including, the average eight-year balance sheet growth and Basel III liquidity and capital regulatory requirements with the exception of changes in interest income decline and of net cash outflows. Furthermore, it was assumed that the bank would maintain the same business mix of geographical, operations and product strategies. The following sections will analyse the BALM-B3 model output for Basel III capital regulatory requirements under stress scenarios.

8.3 Sensitivity Analysis: Capital Position Under Stress Tests

In order to answer the first research question aimed at analysing and quantifying the financial position of the bank during two crisis scenarios, goal programing was used. This modelling approach was used not only because it models more accurately using goals rather than one explicit objective function to be maximized or minimized, but also due to its flexibility in obtaining an optimal solution under various goals and constraints. The goal programing formulation for the BALM-B3 model (see Chapter 5) conducted two stress test simulations, giving: first priority to liquidity and capital goal, second priority to ROE, ROA and NII, and third priority to assets and liabilities. In this case, the objective function of the BALM-B3 models for both stress tests is to minimize deviations from the pre-specified goals defined by multiple objective functions of the problem. The deviation variables are represented as either d+ or d-, to indicate both positive and negative deviations from the goals. The objective of goal programming is to reach a satisfactory level of multiple objectives whenever it is not possible to achieve every goal to the full extent, so that the decision makers may come as close as possible to reaching their goals. Therefore, output of the model solution can be considered as the banks' optimal capital requirements under different scenarios using the APRA Basel III framework.

Table 8.1: BALM-B3 Stress Test Simulations Output for Capital Requirements

APRA Basel III capital regulatory requirements variables	BALM-B3 output: (APRA Basel III fully implemented) A$m	BALM-B3 application 1: Stress test simulation outputs			
		Stress Test 1 (5% increase in net cash outflow & 5% decrease in interest income) A$m	Percentage change	Stress Test 2 (10% increase in net cash outflow & 10% decrease in interest income) A$m	Percentage change
Common Equity Tier 1 capital (millions)	62,108	62,108	0.00%	64,160	3.30%
Additional Tier 1 capital	9,721	9,721	0.00%	9,721	0.00%
Capital conservation buffer (CCB) (millions)	13,502	11,101	-17.78%	8,700	-35.57%
Total capital + CCB	85,331	82,930	-2.81%	82,581	-3.22%

Table 8.1 summarises the BALM-B3 Phase Three and BALM-B3 stress simulation outputs to measure and quantify the impact of a decrease in interest income and the increase in net cash outflow which would affect the amount of capital required. This first scenario (5% decrease in interest income) reduces NII by 5.26% (see Table 8.5). As a result the bank would be required to use $2,401 million of its capital conservation buffer (CCB). These results indicate that the CCB ratio is reduced from $13,502 million

to $11,101 million reduction and the CCB ratio from 2.5% to 2.07% (see Table 8.2) is required to cover interest income loss of 5%. While second scenario (10% decrease in interest income) caused NII to decrease by 10.52%, meaning that the bank would be required to use $4,802 million of CCB (reduction from $13,503 to $8,700 in the CCB) and thereby reduce its CCB ratio from 2.5% to 1.65% to cover its interest income losses (Table 8.2).

These outputs show that the new APRA Basel III capital requirements are useful during stress periods, as in both scenarios the bank did not have to use any of its common equity tier capital or its additional Tier 1 capital. However, this study shows that in order to continue to comply with APRA Basel III, the board of directors needs to set policies to ensure the bank is able to increase the level of total capital and CCB to minimize capital risk.

Table 8.2: BALM-B3 and B3 Stress Test Simulations output for APRA Basel III Capital Ratios

APRA Basel III capital regulatory requirements variables	BALM-B3 output: APRA Basel III fully implemented %	BALM-B3 Application 1: Stress Test Simulation Outputs			
		Stress Test 1 (5% increase in net cash outflow & 5% decrease in interest income) %	Change in percentage points	Stress Test 2 (10% increase in net cash outflow & 10% decrease in interest income) %	Change in percentage points
Common Equity Tier1 ratio	11.00%	11.00%	0.00%	11.00%	0.00%
Additional Tier 1 ratio	1.20%	1.20%	0.00%	1.20%	0.00%
Capital conservation buffer (CCB) ratio	2.50%	**2.07%**	-0.43%	**1.65%**	-0.85%
Total capital + CCB ratio	14.70%	14.27%	-0.43%	13.85%	-0.85%
Minimum capital ratio requirements	10.50%	10.50%	0.00%	10.50%	0.00%
Excess capital ratio holdings	4.20%	3.77%	-0.43%	3.35%	-0.85%

In Table 8.2, the BALM output shows the capital ratio for the BALM-B3 Phase Four and BALM-B3 stress test simulation outputs. The output shows that the bank did not have to use any of its Common Equity Tier 1 and additional Tier 1 capital, as it was able to use 0.43% of its CCB to cover the interest income losses and still be in a strong capital position. Even though existing literature produces conflicting results regarding the effect of capital on bank performance during normal and crisis periods, the thesis findings show that the new Basel III capital requirements enhance the financial stability position and help the bank during a crisis. Similar findings have been recorded in the literature, for example as stated in Berger and Bouwman (2011), capital helps banks of all sizes during a banking crisis.

These outputs demonstrate that the board of directors achieved Goal 1: Corporate governance regulatory policy aims to manage financial risk by implementing APRA Basel III capital regulatory constraints and therefore minimize solvency risk by regulatory compliance; and banks will still be able to hold excess capital equal to 3.77% in crisis Scenario One and 3.35 % in crisis Scenario Two. In the following section, the liquidity position of the bank will be discussed.

8.4 Sensitivity Analysis: Liquidity Position

Table 8.3 summarises the BALM-B3 and stress test simulation outputs (forward looking – assuming that Basel III has been fully implemented) in terms of the amount of high quality liquid assets level 1, level 2A and B and the total stock of high quality assets. Even though there are many corporate governance responses to an increase in net cash outflow, including using high quality liquid assets (HQLA) level 2, or even using derivatives, this thesis has chosen to use HQLA level 1 (cash-liquid assets) to respond to a sudden increase in net cash outflows. In the first stress test scenario, assuming Basel III is fully implemented and if there a decline in interest income of 5% and an increase of net cash outflows by 5%, the bank would need to use $1,830 million (a reduction from $215,000 to $203,170 in Level 1 Assets) of its stock of high quality liquid assets (5.50% of Level 1 Assets) in order to meet its liquidity needs during a liquidity crisis of an increase in net cash outflow of 5%. This means that the liquidity cover ratio (LCR) falls from 123% to 113%, but still meets the regulatory minimum of 100%. For crisis Scenario Two, assuming a decline in interest income of 10% and decline in net cash outflow of 10%, the bank would need to use $23,6602 million ($215,000–191,340) of its stock of HQLA (11.00% of Level 1 Assets) in order to meet its liquidity needs during a liquidity crisis due to an increase of net cash outflow of 10%, and the liquidity cover ratio falls from 123% in BALM-B3 Phase Three to 103% for crisis Scenario Two, but still meets the regulatory minimum of 100% which includes the use of the APRA Committed Liquidity Facility (CLF) equal to 16,900. However, it is important to note that the banking system’s contingent use of the CLF will decrease in 2016 from 2015, as the banks have made adjustments to lower their net cash outflows (Debelle 2015).

Table 8.3: BALM-B3 and B3 Stress Test Simulation Outputs for APRA Basel III Liquidity Regulatory Requirements

APRA Basel III liquidity regulatory requirements variables (millions)	BALM-B3 Output: (APRA Basel III fully implemented) A$m	BALM-B3 Application 1: Stress test simulation outputs			
		Stress Test 1 (5% increase in net cash outflow & 5% decrease in interest income) A$m	Change in percentage	Stress Test 2 (10% increase in net cash outflow & 10% decrease in interest income) A$m	Change in percentage
Level 1 assets	215,000	**203,170**	-5.50%	**191,340**	-11.00%
Level 2 A + B assets	11,945	11,946	0.01%	11,946	0.01%
Total stock of high quality assets (HQLA)	226,945	215,116	-5.21%	203,286	-10.42%
Internal residential mortgage backed securities	49,000	49,000	-	49,000	-
Alternative liquid assets (qualifying as collateral for the APRA Committed Liquidity Facility) (a)	16,900	16,900	-	16,900	-
Net cash outflows	236,600	248,430	5.00%	260,260	10.00%
Liquidity coverage ratio (LCR)	123%	113%	-8.13%	103%	-16.26%

Note: a) The liquidity of the Australian banking system on the 'payment of a 15 basis point fee, banks will be able to obtain a commitment from the Reserve bank to provide liquidity against a broad range of assets under repurchase agreements' (Debelle 2014, p.1).

The above BALM model outputs under both crisis scenarios show that by complying with the new APRA Basel III liquidity requirements, the bank will have sufficient liquidity to deal with crisis scenarios and still have sufficient high quality assets. However, in order to continue compliance with the new liquidity requirements, the bank will be required to hold higher levels of liquid assets by increasing them in their balance sheet and/or increasing the use of the new APRA Committed Liquidity Facility if necessary. Both crisis scenario outputs provide useful information to the board of directors, which are ultimately responsible for the sound and prudential management of bank liquidity under normal and stress conditions. These results will also help in the development of contingency plans and strategies that address liquidity short falls in normal and emergency situations. The next section will analyse the impact of holding higher total quality liquid assets on ROA.

8.5 Stress Testing Scenarios and Their Impacts on ROE and ROA

Table 8.4 shows that when interest income falls by 5% and NCO increases by 5%, ROE decrease from 12.87% in BALM-B3 to 10.74% in Stress Test 1 (a reduction of 213 basis points) and decrease to 8.50% in Stress Test 2 (a reduction of 437 basis points). These findings suggest that under both crisis scenario simulations ROE declines.

Table 8.4: BALM-B3 and Stress Test Simulation Outputs for ROE and ROA

Financial performance ratio	BALM-B3 output: (APRA Basel III fully implemented) %	BALM-B3 Application 1 Stress Test Simulation Outputs					
		Stress Test 1 (5% increase in net cash outflow & 5% decrease in interest income) %	Change in percentage points	% change	Stress Test 2 (10% increase in net cash outflow & 10% decrease in interest income) %	Change in percentage points	% change
ROE	**12.87%**	**10.74%**	-213	-16.6%	**8.50%**	-437	-34.0%
ROA	**0.80%**	**0.68%**	-12	-15.0%	**0.55%**	-25	-31.3%

Table 8.4 also shows that when interest income falls by 5% and net cash outflow increases by 5%, ROA decrease from 0.80% in the BALM-B3 model to 0.68% in Stress Test 1 (a reduction of 15 basis points) and decreases to 0.55% in Stress Test 2 (a reduction of 25 basis points). Even though ROE and ROA declined under both stress scenarios, new Basel III liquidity and capital requirements meant that the bank was already in a much stronger liquidity and capital position, and was therefore in a better position to survive during both crisis scenarios.

8.6 Stress Testing Scenarios and Their Impacts on Net Interest Income

In analysing the banking performance ratios, Table 8.5 summarises the BALM-B3 model outputs of both stress test scenarios for interest income, interest expense and net interest income.

The BALM-B3 output shows that NII for Stress Test 1 declined from $46,083 million to $43,658 million (a decline of 5.26%), while for Stress Test 2 it declined to $41,234 million (a decline of 10.52%). These outputs indicate that under both stress scenarios NII falls, however these results shows that under a Basel II framework, the bank would have been in a vulnerable position as interest expense would have increased due to the bank's lower levels of liquidity and capital. Conversely, under the new Basel III liquidity and capital regulatory requirements, the bank would be able to rely on its liquidity (see Section 8.4) and capital (see Section 8.5), and therefore be in a much stronger position to manage financial stability given unforeseen and unavoidable stress scenarios.

Table 8.5: BALM-B3 and Stress Test Simulation Outputs for Banking Performance

Banking performance	BALM-B3 output: (APRA Basel III fully implemented) A$m	BALM-B3 Application 1: Stress Test simulation outputs			
		Stress Test 1 (5% increase in net cash outflow & 5% decrease in interest income) A$m	Percentage change	Stress Test 2 (10% increase in net cash outflow & 10% decrease in interest income) A$m	Percentage change
Interest income	46,083	43,658	-5.26%	41,234	-10.52%
Interest expense	23,447	223,438	852.95%	23,441	-0.03%
Net interest income	22,636	20,221	-10.67%	17,793	-21.40%

8.7 Summary and Key Findings

As the role of the board of directors is to manage the relationship between risk and return more prudently than any other institution, this thesis has implemented good corporate governance principal 7 (see Chapter 3) in a BALM model to ensure that an Australian bank has complied with the new APRA Basel III capital regulatory requirements for minimizing financial risk and the probability of future costly financial crises. The BALM goal model output has demonstrated that the implementation of good corporate governance can assist the bank in managing liquidity and capital risk, therefore fulfilling its fiduciary duty to both shareholders and the wider society. The microeconomic implications of these findings are that banks implementing APRA Basel III capital requirements will be in a stronger position to withstand any future external financial shocks. Therefore it can be assumed that the macroeconomic implications of these findings are that if Australian banks are in a strong financial position, by applying the new APRA Basel III regulatory framework, the likelihood of financial contagion and its associated negative economic and social consequences will be reduced.

The goal programming model was first used to examine the implications of a progressive move to Basel III on key financial variables (ROE, ROA and NII). Furthermore, it was also used to examine the implications of two stress scenarios: the first scenario showed an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%, and the second scenario showed an increase of 10% in net cash outflow and a decrease in interest income of 10%. These stress test scenarios have been used to assist in the development of governance and policy responses to the challenges faced by the bank. Key conclusions of these two scenarios are as follows.

Required additional capital. In this first scenario (5% decrease in interest income) caused NII to decrease by 10.67%, as a result that the bank would be required to use $11,830 million of its CCB. These results indicate that the CCB ratio needs to be reduced from 2.5% to 2.07% in order to cover interest income loss of 5%. The second scenario (10% decrease in interest income) caused NII to decrease by 10.52%, meaning that the bank would be required to use $23.660 million (0.89%) of its CCB and thereby reduce its CCB ratio from 2.5% to 1.65% in order to cover its interest income losses. These outputs show that the new APRA Basel III capital requirements are useful during stress periods, as in both scenarios the bank did not have to use any of its common equity tier capital or its additional Tier 1 capital. However, in order to continue to comply with APRA Basel III, the bank will be required to increase its CCB buffer during periods of recovery in order meet the minimum regulatory requirement.

Impact on net interest return on equity. The BALM model has shown that under the first stress scenario, ROE will fall by 213 basis points (a decrease from 12.87% to 10.74%) as a result of a 5% decrease in interest income. In the second stress scenario, ROE will fall by 437 basis points (a decrease from 12.87% to 8.50%) as a result of a 10% decrease in interest income. In terms of return on equity, net interest to equity (ROE) as non-interest income and costs were not modelled in either crisis scenario.

Impact on return on assets. In crisis Scenario One, the ROA is estimated to fall by 12 basis points (from 0.80% to 0.68%) as a result of an increase of 5% of NCO and a decrease in interest income. For crisis Scenario Two ROA fell by 25 basis points (a reduction from 0.80% to 0.55%) as a result of an increase of 10% net cash outflow and a decrease of 10% of interest income.

Higher liquidity levels. As the bank was required to implement the Basel III liquidity cover ratio in 2015, in the first scenario (an increase in NCO of 5%) the bank will use 5.50% of high quality liquid assets equal to $11,830 million in order to meet the increase of net cash outflow of 5%. In the second scenario the bank will use 11.00% of high quality liquid assets equal to $23,660 million in order to meet the increase of 10% net cash outflow. The findings from this study also show the bank still is able to meet the regulatory minimum of 100% which includes the use of APRA Committed Liquidity Facility (CLF) equal to 16,900.

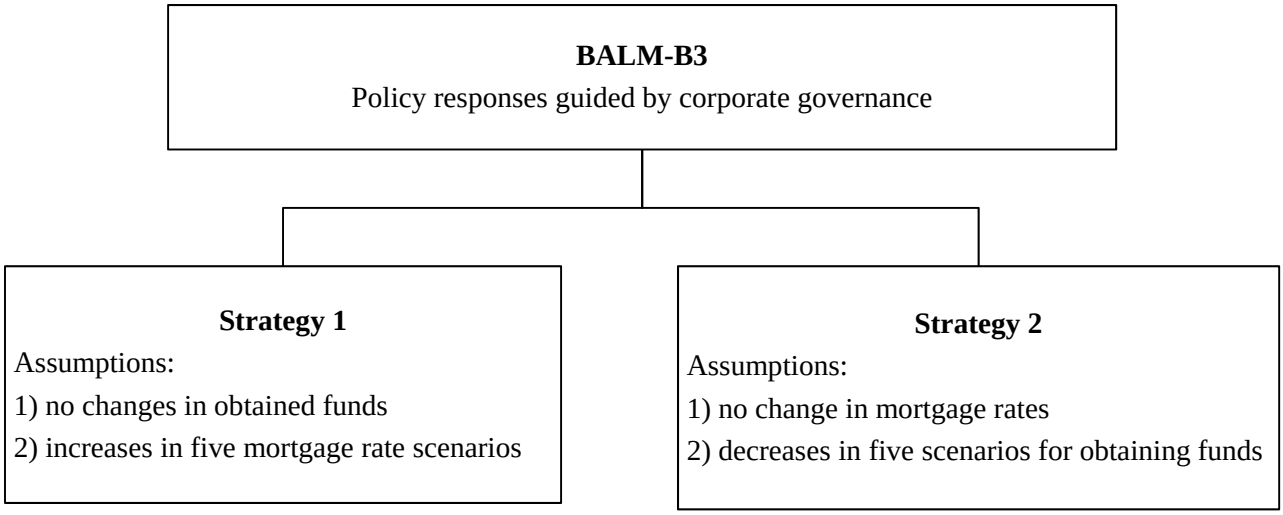
In this chapter, two stress test scenarios were analysed by comparing the BALM-B2 and BALM-B3 models under normal economic conditions in order to assess the impact of Basel III liquidity and capital on financial performance (ROE and ROA), and banking performance (NII) under stress scenarios In the next chapter, three proposed corporate governance responses will be tested using BALM-B3 model in order answer the research questions outlined in Chapter 1.

Chapter 9
Possible Corporate Governance Policy Responses to the Implementation of Basel III Regulatory Requirements

9.1 Introduction

Findings that Basel III liquidity and capital regulatory requirements cause return on equity (ROE), return on assets (ROA) and net interest income (NII), to fall (see Chapter 7), have resulted in the need for banks to re-examine their approaches to managing risk while enhancing performance. By examining two simulated crisis scenarios that are part of good corporate governance (see Chapter 8), an investigation of further possible corporate governance strategic responses has been made. However, these strategies may need to include an increase in interest rates, a reduction of interest rate expenses and operational costs, and additional funds obtained from shareholders in order to enhance financial performance. As raising interest rates and reducing interest rate expenses are the most significant variables affecting net interest income (NII), return on equity (ROE), and return on assets (ROA), these two corporate governance strategies will be tested in this chapter. This will be done through: 1) increasing interest in mortgage loans (simulating five possible increases in interest rates for mortgage loans: 10 basis points (bps), 30bps, 50bps, 70bps and 100bps), while assuming no change in rates of obtained funds; and 2) assuming no change in mortgage rates and simulating five decrease scenarios of obtained funds (simulating five possible decreases in interest rates for obtaining funds loans: 5bps, 10bps, 15bps, 20bp; and 25bps) (see Figure 9.1).

Figure 9.1: BALM-B3 Corporate Governance Responses



The possible policy responses guided by corporate governance implemented in the BALM-B3 model are based on the assumptions used for calculating the minimum capital and excess industry capital required to comply with the Basel III framework and Australian industry standards. The liquidity assumptions presented in Chapter 6 are also used to develop and implement goals and constraints in the BALM-B3 model for all three strategic applications, thereby answering Research Question 3 outlined in Chapter 1.

Increases in mortgage rates reveal crucial information on banks' willingness to lend, and go hand in hand with the amount of lending. The BIS working paper 'Higher Bank Capital Requirements and Mortgage Pricing: Evidence from the Countercyclical Capital Buffer (CCB)' maintains that higher capital requirements apply to both new and existing mortgage stocks on banks' balance sheets, apparently seeking to pass on the extra cost of previously issued mortgages to new customers (Basten & Koch 2015).

The Murray Report (Treasury 2014) warns that risk weighted assets are expected to increase further in the foreseeable future due to changes in APRA Basel III capital requirements and the probability of a housing bubble causing increases in loan defaults. In this situation, the board of directors will need to enhance their risk management framework for housing loans to alleviate possible negative impacts on NII, ROE and ROA. The new regulatory environment also means that the cost of finance will further

increase, which could affect shareholders, investors and society. Therefore, the question that the board of directors needs to ask is ‘what is the optimal level of interest that the bank should change in order to maximise ROE and ROA in the current environment?’ while still providing consumers with a competitive interest on mortgage loans.

The role of the board of directors is to maintain strong liquidity and adequate levels of capital to enhance ROA and ROA. As highlighted by Shleifer and Vishny (1997), the main purpose of the corporate governance role is to provide reassurance to the shareholders that managers will achieve results which are in the best interest of shareholders. The policy responses guided by corporate governance were simulated to determine the impact of changes in interest rate strategies on NII, ROE, ROA, based on the assumption of a dynamic forward-looking balance sheet. As discussed previously, the BALM-B3 model was used to conduct both crisis scenarios and also to construct the three possible corporate governance strategic applications. The assumptions used to construct the strategies are the same ones used for the BALM-B3 model, including the average eight-year balance sheet growth and Basel III liquidity and capital regulatory requirements, with the exception of changes in interest rates for mortgage loans and interest rates for obtaining funds. Furthermore, it was assumed that the bank would maintain the same business mix of geographical, operations and product strategies. The following sections will analyse the BAML-B3 model output for Basel III capital regulatory requirements for all three corporate governance applications. Based on these assumptions, the following sections will analyse the financial performance measure outputs under all possible interest rate strategies.

9.1.1 Mortgage Loan Interest Rate Increases

On 20 July 2015, the Australian Prudential Regulation Authority (APRA) announced its proposal that authorised deposit-taking institutions (ADIs) accredited to use the internal ratings based (IRB) approach to credit risk increase the amount of capital required for their Australian residential mortgage exposures. APRA made this decision for the following reasons:

- to address the recommendation of FSI that APRA narrow the difference between average mortgage risk weights for ADIs using IRB risk weights models and standard risk weights;
- to align with the direction being undertaken by the Basel Committee; and

- to enhance the resilience of IRB-accredited ADIs and the broader financial system (APRA 2015e, p. 1).

The increase in risk weighted assets means that banks need to find ways to meet regulatory requirements, while at the same time maintain an adequate level of return for shareholders. Interestingly, at the time of submitting this thesis, banks are already starting to implement the corporate governance strategies proposed in this chapter. The APRA announcement triggered an immediate response by all major Australian banks, with media announcements that banks are passing on the cost of holding higher levels of capital to their consumers. As warned by Peter King (Westpac CFO), 'The cost of holding higher capital will inevitably be borne by customers and shareholders' (Janda 2015).

Table 9.1: Increased Interest Rates for Home Loans and Residential Investments

Home loans and residential investment property variable rates increases in response to APRA announcement		
Four major banks in Australia	**Date of announcement**	**Basis Points Increases**
Wespac	14 October 2015	20
Commonwealth Bank	22 October 2015	15
ANZ	23[r] October 2015	17
NAB	24[t] October 2015	18

Source: Websites of the four major Australian banks (October 2015).

As shown in Table 9.1 above, in response to the new APRA requirements, Westpac was the first to post the announcement of an increase in its home loan variable rates and residential investment property loan variable rates by 20 basis points (bps) on 14 October 2015 (Westpac 2015). Westpac also announced that it had raised its ordinary equity by $3.5 billion, which further increased costs of providing mortgages. Westpac's reasons for increasing home and residential investment property loan variable rates (even though the Reserve Bank of Australia (RBA) had not made any announcement on rates) were that these adjustments not only reflected the recent changes to regulatory requirements, but also the impact of current market conditions, the funding of wholesale and deposit costs, ensuring attractive returns for shareholders, and creation of a competitive position to obtain mortgage and deposit customers.

Following Westpac's announcement, on 22 October 2015, the Commonwealth Bank released a statement on its website that it was increasing its home loans by 15 basis points to 'partially' offset the costs associated with recent changes required by APRA. In this way, the Commonwealth Bank raised $5.1billion to strengthen their capital

position. On 23 October 2015, ANZ posted an increase of 17 basis points in home loans on its website. Then, on 23 October 2015, NAB announced an increase of 18 basis points on its home loans to strengthen its capital position, raising $5.5 billion to begin to address the expected changes to required capital.

At the time of submitting this thesis, banks were already starting to implement the proposed corporate governance strategies. The corporate governance recommended strategies used in this thesis are fully supported by the recent announcements made by all four major banks in Australia. Even though the RBA has not yet made any announcement on rate changes, the four major banks have independently raised their interest rates on mortgage loans in order to enhance profitability and cover increases in costs resulting from changes in regulatory requirements. One major implication to consumers is that there is no clear indication of how much more the interest rates on mortgage loans are likely to increase due to changes in the regulatory environment.

The three proposed corporate governance strategies discussed above have used the BALM-B3 model to implement constraints, which allow the bank to meet its APRA Basel III capital regulatory requirements for Common Equity Tier 1, Additional Tier 1 and the capital conservation buffer (see Table 4.1). By incorporating these constraints, additional capital was raised assuming that 51.8% comes from ordinary share capital, 48.12% from reserve earnings and the remaining from preference share capital and minority interest (see Chapter 5).

9.1.2 Online Savings Account Rates Reductions

As discussed in the previous section, the possible corporate governance responses recommended in this thesis are to: 1) increase interest in mortgage loans; and 2) reduce interest in obtaining funds, using two combinations (Strategies 1 and 2). Following the decision to increase interest rates on mortgage loans, three of the four major banks reduced base rates on deposits in November 2015. ANZ Bank reduced its base rate on the online saver account by 0.2 percentage points, NAB reduced its base rate on the iSaver account by 0.1 percentage points and Westpac Bank reduced its base rate on the eSaver account by 0.21 percentage points (Yeates 2015). The decision to reduce rates was made based on regulatory changes. Even though these reductions may appear fairly small, banks are under pressure to widen the interest rate margin.

9.2 Impact of Corporate Governance Policy Strategy on Basel III Capital Regulatory Requirements

In analysing the impact of corporate governance policy strategies on Basel III capital requirements for the bank, the BALM-B3 model implemented and complied with Basel III capital the bank is required to hold. Outputs for Common Equity Tier 1 ratio is 11.88%, Additional Tier 1 ratio is 6% and CCB ratio is 2.5%. This means that these strategies had no impact on the ability of the bank to meet its capital regulatory requirements and has maintained an excess of 4.88% capital holdings, assuming these increases are obtained from 51.8% ordinary shares and 48.12 reserve earning (see Chapter 5).

9.3 Impact of Corporate Governance Policy Strategy on Basel III Liquidity Regulatory Requirements

In analysing the impact of corporate governance policy strategies on Basel III liquidity requirements for the bank, the BALM-B3 model implemented and complied with Basel III liquidity requirements the bank is required to hold. These outputs show that under all three strategies the bank is holding a total of $226,946 million in high quality liquid assets (HQLA), and the liquid coverage ratio (LCR) remains at the same level of 123% with the use of the APRA Committed Liquidity Facility equal to $16,900. This data highlights that the strategies have no impact on the ability of the bank to meet the liquidity regulatory requirements. The following sections will analyse and quantify the impact of each strategy on NII.

9.4 Impact of Corporate Governance on Net Interest Income

In analysing possible outcomes of the three proposed corporate governance strategies dealing with the challenges banks face when implementing Basel III liquidity and capital requirements, Table 9.2 below summarises the BALM-B3 model outputs for net interest income. In BALM-B3 Strategy 1, outputs show that by simulating five possible interest rates for mortgage loans and assuming no change in interest rates on liabilities, NII can increase from 1.8% to 18.2% depending on how much the interest rate on mortgage increases. For example, if the board of directors chooses to increase mortgage interest rates by 100 basis point, NII can increase from $22,636 million to $26.759 million. In Strategy 2, the BALM-B3 model shows that by simulating five possible decrease scenarios for obtaining funds, NII could increase from 2.0% to 10% depending

on the reduction in interest for obtaining funds. These results show that if the board of directors implement any of the two possible policies, the bank can enhance NII. However, even though both strategies increases NII, the board of directors will need to consider all associated risks and implications.

Table 9.2: BALM-B3 Application 2: Corporate Governance Outputs for Banking Performance

Banking performance ($ millions)	BALM-B2 output: (APRA Basel II) 2012 A$m	BALM-B3 output: (APRA Basel III fully implemented) projected 2019 A$m	Strategy 1					Strategy 2				
			Assuming no change in rates of obtained funds and mortgage rate of 6.20% using five increased bps scenarios A$m					Assuming no change in mortgage rate and simulating five decrease scenarios for obtained fund: A$m				
			10 bsp	30 bsp	50 bsp	70 bsp	100 bsp	5 bsp	10 bsp	15 bsp	20 bsp	25 bsp
Interest income	34,311	46,083	46,495	47,320	48,144	48,969	50,206	46,083	46,083	46,083	46,083	46,083
Percentage change from BALM-B3			0.9%	2.7%	4.5%	6.3%	8.9%	0.0%	0.0%	0.0%	0.0%	0.0%
Interest expense	20,019	23,447	23,447	23,447	23,447	23,447	23,447	22,994	22,541	22,088	21,635	21,182
Percentage change from BALM-B3			0.00%	0.00%	0.00%	0.00%	0.00%	-1.9%	-3.9%	-5.8%	-7.7%	-9.7%
Net interest income	14,293	22,636	23,048	23,873	24,697	25,522	26,759	23,089	23,542	23,995	24,448	24,901
Percentage change from BALM-B3			1.8%	5.5%	9.1%	12.7%	18.2%	2.0%	4.0%	6.0%	8.0%	10.0%

9.5 Impact of Corporate Governance on ROE and ROA

The BALM-B2 and BALM-B3 model outputs given in Table 9.5 below summarise both ROE and ROA for the three corporate governance strategic applications, each with five outputs. In Strategy 1, there is no change in the interest rates for obtaining funds on liabilities, which are simulated with five possible interest rates for mortgage loans. Here the outputs for ROE ratios are: 1) 13.23%, 2) 13.95%, 3) 14.68%, 4) 15.40% and 5) 16.50%; which indicates that when the bank increases interest mortgage rates by 10 basis points to 100 basis points, ROE ratios will increase by: 1) 36 bps, 2) 108 bps, 3) 181 bps, 4) 253 bps and 5) 363 bps, respectively.

In Strategy 2, the BALM-B3 model shows that by simulating five possible interest rates reduction for obtaining funds, ROE ratios will be: 1) 13.26%, 2) 13.67%, 3) 14%, 4) 14.46% and 5) 14.86%. This means that when the bank reduces interest expense by 5 basis points to 25 basis points, ROE ratios will increase by: 1) 39 bps, 2) 80 bps, 3) 113 bps, 4) 159 bps and 5) 199 bps, respectively. These finding indicate that if the banks is aiming to earn pre-Basel III ROE levels, the board of directors would have to develop strategies to obtain funds at 25 basis points lower and increase interest on mortgage loans by at least 100 basis points.

Table 9.3 also summarises the two strategic applications for corporate governance, each with five outputs. In this case, output of ROA for the BALM-B2 and BALM-B3 model in Strategy 1 shows that by simulating five possible interest rates for mortgage loans and assuming interest rates on liabilities remain the same, ROA ratios are: 1) 0.83%, 2) 0.87%, 3) 0.92%, 4) 0.96% and 5) 1.03%. This indicates that when the bank increases interest mortgage rates by 10 basis points to 100 basis points, ROA can increase by 1) 3 bps, 2) 7 bps, 3) 12 bps, 4) 16 bps and 5) 23 bps, respectively. In Strategy 2, ROA ratios are 1) 0.83%, 2) 0.85%, 3) 0.88%, 4) 0.90% and 5) 93%. This indicates that when the bank reduces interest expense by obtaining funds at lower interest rates ranging from 5 basis points to 25 basis points, ROA will increase by: 1) 6 bps, 2) 10 bps, 3) 14 bps, 4) 18 bps and 5) 24 bps. In Strategy 3, ROA ratios will be: 1) 0.83%, 2) 0.85, 3) 0.88%, 4) 90% and 5) 93%. Therefore by reducing interest rates, ROA ratios could increase by: 1) 3 bps, 2) 5 bps, 3) 8 bps, 4) 10 bps and 5) 13 bps.

Table 9.3: BALM-B3 Application 2: Corporate Governance Outputs for ROE and ROA

Financial performance ratios ($ millions)	BALM-B2 output: (APRA Basel II) 2012	BALM-B3 output: (APRA Basel III fully implemented)	Strategy 1					Strategy 2				
			Assuming no change in rates of obtained funds and mortgage rate of 6.20% using five increased bps scenarios					Assuming funds are obtained lower rate of 10bps and mortgage rate of 6.20% using five increased bps scenarios				
			10 bsp	30 bsp	50 bsp	70 bsp	100 bsp	5 bsp	10 bsp	15 bsp	20 bsp	25 bsp
ROE	14.80	12.87	13.23	13.95	14.68	15.40	16.50	13.26	13.67	14.00	14.46	14.86
Bps change form BALM-B3			0.36	1.08	1.81	2.53	3.63	0.39	0.80	1.13	1.59	1.99
ROA	0.90	0.80	0.83	0.87	0.92	0.96	1.03	0.83	0.85	0.88	0.90	0.93
Bps change form BALM-B3			0.03	0.07	0.12	0.16	0.23	0.03	0.05	0.08	0.10	0.13

In conclusion, both policy responses guided by corporate governance, found that each 10 basis points (bsp) increase in mortgage rates can increase return on equity by 36 bsp and increase return on assets by 3 bsp. The second response found that when funds are obtained at 5 bsp lower than the base case, the bank can increase return on equity by an average of 40 bsp and increase return on assets by 3 bsp, given the Basel III regulatory requirements and current practices of holding excess capital and liquidity. While the bank thus has options to attempt to restore profitability, these practices will be constrained by market pressures. Although this study confirms that the introduction of Basel III liquidity and capital requirements leads to a strengthening of the quality of the banks' balance sheet under both normal economic conditions and stress scenarios, it does so at the cost of a significant deterioration in financial performance. However, at the same time it suggests that the above proposed policy responses could help restore bank profitability close to pre-Basel III levels.

9.6 Implications of the Proposed Corporate Governance Strategies

Results for all three BALM-B3 strategies show that by raising interest rates on mortgages (at competitive rates), both ROE and ROA can increase while meeting Basel III regulatory requirements. Even though Strategy 1 can yield improvements in financial performance, Strategy 2 reveals that the bank is better able to enhance its financial performance by increasing the gap between interest rates on mortgage loans (interest income) and interest rates paid on funds (interest expense). However, both strategies can be regarded as risky, as increasing mortgage rates could lead to losing market share, while obtaining funds at lower rates can result in challenges to bank stability. As a result, the board of directors will need to manage risks for wholesale funding, cross currency, off-balance sheet liquidity, intra-groups funding, intra-day liquidity funding and net cash outflow (Greuning & Bratanovic 2009). Therefore, even though these possible corporate governance strategies pose risks for the bank, the main findings of this study have shown that the bank's liquidity and capital position facilitates long-term sustainability under all economic conditions under the challenging new APRA Basel III liquidity and capital requirements.

In conclusion, this thesis has found that the fully implemented Basel III liquidity and capital requirements would enhance the liquidity and capital position of the bank, but causes ROE to fall sharply by 193 basis points (13%) and a reduction in ROA of 10

basis points (11.11%). Results from the stress test shows that a stronger capital and liquidity position will be able to assist the bank during a stress scenario, and results of the two possible policy responses guided by corporate governance strategic show that the bank can increase ROE from 36 basis points to 199 basis points and increase ROA from 3 basis points to 13 basis points – while at the same time complying with the new Basel III regulatory requirements.

9.7 Contribution to Knowledge

Despite the large body of theoretical and empirical research into corporate governance, financial accounting information, risk management, financial planning, and asset and liability management, no other studies have developed a comprehensive asset and liability management model that incorporates corporate governance, risk management and financial planning within an Australian setting, and measured the impact of Basel III liquidity and capital regulatory requirements on NII, ROE and ROA. However, research in this area is important because it addresses current issues of corporate governance and risk management inefficiencies that could lead to potential loss to all stakeholders. At the micro and macro level, positive relationships exist between good corporate governance and risk management, yet risk is inherit and omnipresent and 'you cannot get away from it' (Frame 2003, p. 2). Corporate governance mechanisms play a crucial role in mitigating risk, due to the fact that many corporations are run by people with personal agendas in an imperfect world.

This study addresses limitations in the multi-dimensional nature of corporate governance from a risk management and asset and liability management perspective. It presents a new multi-dimensional bank asset and liability management (BALM) model that progressively implements Basel III liquidity and capital requirements under corporate governance risk management policy constraints using the ALM Goal Programming Model of Kosmidou and Zopounidis (2004) as a foundation. The new BALM model measures and quantifies the impacts that APRA Basel III liquidity and capital regulatory requirements have on financial performance (ROE and ROA), banking performance (II, IE and NII) and balance sheet structure. The outcomes provide the board of directors with useful information that can enhance transparency in a forward looking balance sheet that helps provide resilience to the bank under the new regulatory environments. Further simulations of stress tests were conducted to examine

the worst scenarios, such as increases in net cash outflow and decreases in interest income scenarios have been used to measure and quantify impacts on financial and banking performance. The BALM model was also used to analyse and quantify possible strategic responses to the new challenges faced by banks when holding higher liquidity and capital requirements. As this is the first attempt undertaken in an Australian context, using the ANZ Bank as a case study, this thesis makes a particularly significant contribution towards an integrative approach for asset and liability management under the new APRA Basel III framework.

9.8 Limitations of the Study

One limitation of this study is that the BALM-B3 outputs use forecasted balance sheet data to run the model for 2016 and 2019, although the forecasted data provides useful information, there could be market shocks that could impact the bank's performance. Another limitation of this study is that only one bank (Wespac) released publically available data on bank cash outflows for 30-day periods. This meant that assumptions had to be made in order to calculate the LCR of ANZ to implement liquidity constraints in the new BALM goal management model. These assumptions were also used to determine the amount of HQLA that the bank would need to hold to comply with the new Basel III LCR. Although these assumptions were tested and found to be reliable when comparing the assumed ANZ data with the disclosed Westpac Group data, results may have been even more accurate if the ANZ data had been made publically available. Another limitation is that although the abuse of off-balance sheet accounting was a major cause of the 2008 financial crisis, this thesis has not focused on managing this kind of risk using derivatives due to lack of available data.

9.9 Implications for Further Research

After considering some of the limitations mentioned in the previous section, an evaluation of off-balance sheet items in the BALM model could provide more detailed information for shareholders, investors, regulators and academic researchers. In order to analyse and quantity financial and banking performance, the BALM model developed in this study could also be used as a framework for further research into managing financial risk in derivatives, liquidity gaps, exchange risk, domestic and foreign credit risk, and non-interest income and expenses. Another possible direction to pursue in future research is analysis of the net stable funding ratio (NSFR) using the BALM

model as a framework. Another interesting extension for future research is to use the BALM model to analyse and quantify the impact of Basel III liquidity and capital regulatory requirements on financial performance from banking, insurance or other industry perspective.

9.10 Bank Capital and Liquidity Study: Key Conclusions

The global financial crisis highlighted again the importance of proper prudential and regulatory practices in commercial banks, and the economic and social costs that can be incurred if such practices are not being followed. Partly in response to this experience, the global community is adopting the third generation of liquidity and capital requirements developed by the Basel Committee on Banking (the Basel III standards).

In Australia, the banks are being required by the Australian Prudential Regulatory Authority to progressively implement the Basel III standards by 2019. The Australian banks weathered the recent financial crisis well, with government support. Nevertheless, high quality bank governance, and in particular the effective implementation of these new requirements, is important in the national interest, but may have significant financial costs to the banks themselves. While both the banks and the regulatory authorities presumably model these changes in considerable detail, there is little work in the public domain assessing the impact of Basel III on the banks themselves and on the broader issues of governance.

This study develops a goal programming model of one large Australian bank to examine the implications of a progressive move to Basel III on key financial variables (the level of additional capital required, the level of profitability and the return on assets and on equity), to undertake a preliminary stress testing analysis of the bank after implementation of Basel III and to consider some of the governance and policy response issues involved. The main modelling undertaken is used to study the impact of the implementation of Basel III by imposing this change on a base case which otherwise maintains current trends, practices and corporate governance settings out to 2019. This final chapter examined possible policy responses available to the banks, guided by corporate governance, to offset some of the effects of implementing the Basel III requirements.

9.10.1 The Impact of Implementing Basel III

The bank asset and liability goal programming model was used to examine the implications of a progressive move to Basel III on key financial variables, including net interest income (NII), return on equity (ROE), and return on assets (ROA). As expected, the introduction of Basel III liquidity and capital requirements leads to a strengthening of the quality of the banks' balance sheet, as the banks' total capital increases by 28.8% relative to the base case, taking account of the new capital conservation buffer required by Basel III. This large increase in capital is mainly attributed to two factors. The first is the capital ratio effect (made up of the new Basel III capital requirements which increase the minimum capital requirements from 8.0% to 10.5% of risk weighted assets). The second is the risk weighted asset effect, arising from the increase of 6.9% in risk weighted assets, relative to the base case, due to required adjustments to the weights for mortgage loans in the new Basel III framework. Together these require an increase in required capital of $16,286 million or 26.4% of the total base case capital. It is also assumed that the bank continues to hold excess capital of 4.2%, over the minimum capital requirements, in line with existing bank corporate governance policy for retaining levels of over-provision of capital. This means that additional capital of $1,462 million needs to be held to maintain the 4.2% buffer on the higher level of risk weighted assets. This results in the bank being well capitalised and therefore in a stronger position to protect all stakeholders' interests while fulfilling corporate governance objectives for managing risk.

However, when comparing the 2019 Basel III output with the 2019 Basel II, the results show that even though the quality of the banks' balance sheet has improved due to stronger liquidity and capital position, it causes return on equity to fall sharply by 452 basis points (26%) and reduces return on assets by 4 basis points (4.8%) (see Diagram 9.1). These results raise serious challenges for the board of directors in managing the new regulatory requirements and their impact on the bank financial performance.

9.10.2 Stress Testing after Implementing Basel III

The bank asset and liability goal programming model was also used to examine the implications of two stress scenarios; first scenario was an increase of 5% in net cash outflow (NCO) and a decrease in interest income of 5%, and the second scenario was an increase of 10% in net cash outflow and a decrease in interest income of 10%. The

results of the first stress test show that net interest income decreased by 5.26%, as a result that the bank would be required to use 17.78% of the capital conservation buffer in order to cover the loss in interest income. The results of the second stress test show that net interest income decreased by 10.52%, meaning that the bank would be required to use 35.57% of the capital conservation buffer in order to cover the loss in interest income. These findings indicate that the new APRA Basel III capital requirements are useful during stress periods, as in both scenarios the bank only used a proportion of its capital conservation buffer and did not have to use any other type of capital (common equity tier capital or its additional Tier 1 capital). However, in order to continue to comply with APRA Basel III, the bank will be required to increase its capital conservation buffer during periods of recovery in order meet the minimum regulatory requirement.

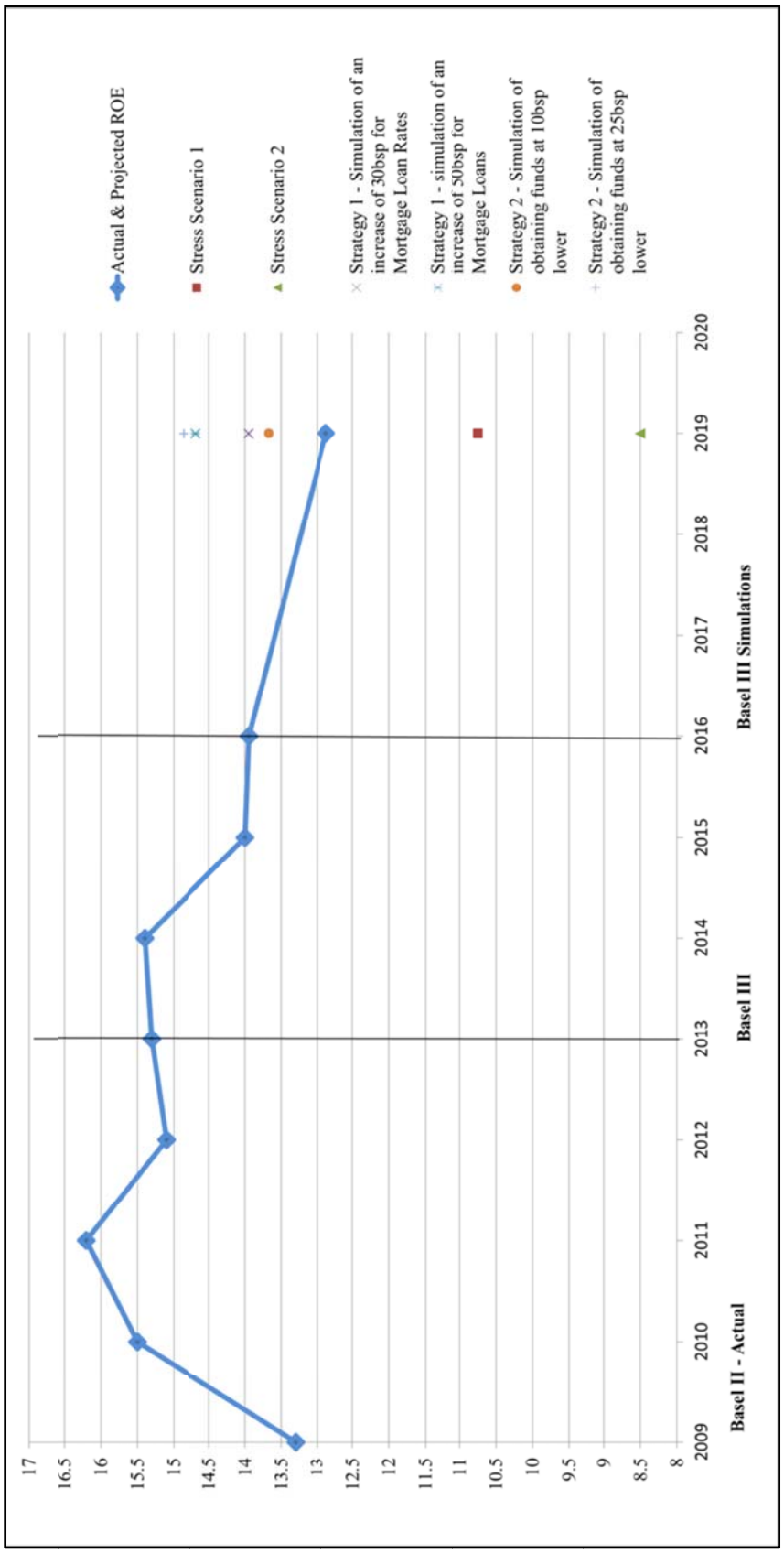
As the bank was required to implement the Basel III liquidity cover ratio (LCF) in 2015, in the first scenario the bank will be required to use 5.21% of high quality liquid assets (reducing the LCF to 113%) in order to meet the increase of net cash outflow of 5%. In the second scenario the bank will be required to use 10.42% of high quality liquid assets (reducing the LCF to 103%) in order to meet the increase of 10% net cash outflow. This results show that under both scenarios the banks' liquidity cover ratio is greater than 100% (including the use of the APRA Committed Liquidity Facility equal to 16,900), this means that under Basel III the bank is in a much stronger liquidity positon to be able to absorb any unforeseen shocks.

Based on the assumption that Basel III is fully implemented and using a forward-looking 2019 forecasted balance sheet data, the stress tests found that under scenario one, return on equity would fall by 213 basis points (a decrease from 12.87% to 10.74%), and under scenario two it would fall by 437 basis points (a decrease from 12.87% to 8.50%) (see Diagram 9.1). The stress tests also found that under scenario one return on assets would fall by 12 basis points (from 0.80% to 0.68%) and under scenario two it would fall by 25 basis points (a reduction from 0.80% to 0.55%). Even though both return on equity and return on assets fall under both stress scenarios, the tests indicate that the bank has sufficient liquidity and capital if the economy were to deteriorate more sharply than anticipated.

9.10.3Analysis of Potential Responses

Using a forward looking balance sheet measured at increasing trend rates and assuming Basel III is fully implemented, the bank asset and liability goal programming model was used to examine possible policy responses guided by corporate governance through: 1) mortgage rates policy – increasing net interest margins by simulates the relative impacts of five possible increases in interest rates for mortgage loans; and 2) obtaining funds rates policy – increasing net interest margins by simulates the relative impacts of five possible decrease in interest in obtaining funds. Sensitivity analysis of the two simulated corporate governance strategic responses show that the bank can increase return on equity from 36 basis points to 363 basis points and increase return on assets from 3 basis points to 23 basis points (see Figure 9.2). Depending on the chosen strategy – while at the same time complying with the new Basel III regulatory requirements and the present practice of holding excess capital and liquidity. Basel III provides boards of directors with several challenges and the proposed strategies may pose a risk to the bank, but despite these challenges, these simulated possible policy responses guided by corporate governance show that the bank can enhance profitability to pre-Basel III levels. The main findings of this study show that the implementation of the new Basel III regulatory requirements enhances the bank's liquidity and capital position resulting in a higher quality balance sheet that facilitates long-term sustainability at the cost of lower return on equity and assets, but the banks have options to restore profitability, partly at the expense of consumers.

Figure 9.2: Actual and Simulated ROE Output for Stress Test and Policy Responses



References

Abdullah, H. and B. Valentine (2009). 'Fundamental and ethics theories of corporate governance.' Middle Eastern Finance and Economics (4): 88-96.

Adrian, T. and H. Shin (2008). 'Liquidity and financial cycles.' BIS Working Papers No. 256, Monetary and Economic Department, Bank for International Settlements, Basel, Switzerland. Viewed, http://www.bis.org/publ/work256.pdf

Admary , A. and M. Hellwig (2013). *The Bankers' New Clothes: What's Wrong with Banking and What To Do About It*. Princeton University Press, Woosdstock, Oxfordshire.

Aebi, V., G. Sabaco, M. Schmid (2012). 'Risk management, corporate governance, and bank performance in the financial crisis.' Journal of Banking and Finance 36(12): 3213-3226.

Alchlan, A. (1950). 'Uncertainty, evolution, and economic theory.' Journal of Political Economy 58(3): 2011-221.

Anthony, R.B. (1960) 'The trouble with profit maximization.' Harvard Business Review 38: 126-34.

ANZ (2006). '2006 Concise Annual Report: Part 1.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2006). '2006 Concise Annual Report: Part 2.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2007). '2007 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2008). '2008 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2009). '2009 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2010). '2010 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2011). '2011 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2012). '2012 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2013). '2013 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2014). '2014 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-archive

ANZ (2015). '2015 Annual Report.' Melbourne. Viewed https://www.shareholder.anz.com/pages/annual-report-and-shareholder-review

ASX Corporate Governance Council (2012). 'Corporate Governance Principles and Recommendations with 2010 Amendments.' 2nd edn. Sydney. Viewed, http://www.asx.com.au/documents/asx-compliance/cg_principles_recommendations_with_2010_amendments.pdf

Australia Prudential Regulation Authority (2009). 'APRA's Prudential Approach to ADI Liquidity Risk.' Discussion Paper, Sydney, September. Viewed, http://www.apra.gov.au/adi/Documents/ADI_DP_PALR_092009_v5.pdf

Australia Prudential Regulation Authority (2011). 'Basel III Impact and Implications for Australia.' Sydney.

Australia Prudential Regulation Authority (2012a). 'Implementing Basel III Capital Reforms in Australia.' Regulation Impact Statement, Sydney, September. Viewed, http://www.apra.gov.au/Policy/Documents/September-2012-Basel-III-capital-regulation-impact-statement.pdf

Australia Prudential Regulation Authority (2012b). 'Implementing Basel III Capital Reforms in Australia – Counterparty Credit Risk and Other Measures.' Discussion Paper, Sydney, August. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/APRA_Discussionpaper_BASEL3_CCR_FINAL_2.pdf

Australia Prudential Regulation Authority (2012c). 'Prudential Practice Guide, APG 112 – Standardised Approach to Credit Risk.' Sydney, August. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/ADI_PPG_APG112_AUG2012_FINAL.pdf

Australia Prudential Regulation Authority (2012d). 'Response to Submissions II, Implementing Basel III capital reforms in Australia.' Sydney, September. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/120928-Basel-III-capital-response-paper.pdf

Australian Prudential Regulation Authority (2012e). 'Prudential Standard APS 111 Draft Capital Adequate: Measure of Capital.' Sydney, March. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/APS111_30_March_2012.pdf

Australia Prudential Regulation Authority (2013a). 'Implementing Basel III Liquidity Reforms in Australia.' Discussion Paper, Sydney, May. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/Implementing%20Basel%20III%20liquidity%20reforms%20in%20Australia%20-%20May.pdf

Australia Prudential Regulation Authority (2013b). 'Prudential Standard APS 112, Capital Adequacy: Standardised Approach to Credit Risk.' Sydney, January. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/Basel-III-Prudential-Standard-APS-112-(January-2013).pdf

Australia Prudential Regulation Authority (2014a). 'Prudential Practice Guide APG 210 – Liquidity.' Sydney, January. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/Prudential-Practice-Guide-APG-210-liquidity-(January-2014).pdf

Australia Prudential Regulation Authority (2014b). 'Prudential Practice Guide APG 223 – Residential Mortgage Lending'. Sydney, November. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/20141103-APG-223.pdf

Australia Prudential Regulation Authority (2014c). 'Prudential Standard APS 210, Liquidity.' Sydney, January. Viewed, http://www.apra.gov.au/adi/Documents/Prudential-Standard-APS-210-Liquidity-(January-2014).pdf

Australia Prudential Regulation Authority (2015a). 'Information Paper, International Capital Comparison Study.' Sydney, July. Viewed, http://www.apra.gov.au/adi/PrudentialFramework/Documents/150710-International-capital-comparison-information-paper.pdf

Australia Prudential Regulation Authority (2015b). 'Prudential Practice Guide, CPG 220 – Risk Management.' Sydney, January. Viewed, http://www.apra.gov.au/CrossIndustry/Documents/Prudential-Practice-Guide-CPG-220-Risk-Management-January-2015.pdf

Australia Prudential Regulation Authority (2015c). 'Prudential Practice Guide, CPG 220 – Risk Management.' Sydney. Viewed, http://www.apra.gov.au/CrossIndustry/Documents/Prudential-Practice-Guide-CPG-220-Risk-Management-January-2015.pdf

Australia Prudential Regulation Authority (2015d). 'Sound Lending Standings and Adequate Capital: Preconditions for Long-term Success.' Presented at the COBA CEI and Director Forum, Australia Prudential Regulation Authority, Sydney, 13 May 2015. Viewed, http://www.apra.gov.au/Speeches/Documents/04%20Sound%20lending%20standards%20and%20adequate%20capital%20-%20preconditions%20for%20long%20term%20success%20-%20COBA%20-%2013%20May%202015.pdf

Australia Prudential Regulation Authority (APRA) (2015e). 'APRA increases capital adequacy requirements for residential mortgage exposures under the internal ratings-based approach.' Media release 20 July, Viewed, http://www.apra.gov.au/mediareleases/pages/15_19.aspx

Australian Prudential Regulation Authority (APRA) (2015f). 'Prudential Standard CPS Risk Management .' Media release January, Viewed, ttp://www.apra.gov.au/CrossIndustry/Documents/Prudential-Standard-CPS-220-Risk-Management-January-2015.pdf

Banerjee, S. (2013). 'Corporate governance principles, policies and practices: a review of related literature.' International Journal of Arts Commerce and Literature 1(8): 2320-4370.

Bank for International Settlements (2008). 'Principles for Sound Liquidity Risk Management Supervision.' Basel Committee on Banking Supervision, BIS, Basel, Switzerland, September. Viewed http://www.bis.org/publ/bcbs144.pdf

Bank for International Settlements (2009a). 'Findings on the interaction of market and credit risk.' Basel Committee on Banking Supervision, BIS, Switzerland, May, Viewed, http://www.bis.org/publ/bcbs_wp16.pdf

Bank for International Settlements (2009b). 'Issues in the Governance of Central Banks'. Basel Committee on Banking Supervision, BIS Switzerland, May, Viewed, http://www.bis.org/publ/othp04.htm

Bank for International Settlements (2011). 'Basel III: A Global Regulatory Framework for more Resilient Banks and Banking Systems.' Basel Committee on Banking Supervision, BIS, Basel, Switzerland, June 2011 rev. Viewed, http://www.bis.org/publ/bcbs189.htm

Bank for International Settlements (2011a). 'Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems.' BASEL Committee on Banking Supervision, BIS, Basel, Switzerland, June.

Bank for International Settlements (2011b). 'Liquidity Transfer Pricing: A Guide to Better Practice.' Basel, Switzerland. Viewed, http://www.bis.org/fsi/fsipapers10.htm

Bank for International Settlements (2012). 'Principles for financial market infrastructure'. Committee on Payments and Settlement Systems, Technical Committee of the International Organization of Securities Commissions, BIS Basel Switzerland, April. Viewed, 'http://www.bis.org/cpmi/publ/d101a.pdf

Bank for International Settlements (2016). 'Basel III Monitoring Report.' Basel Committee on Banking Supervision, BIS, Basel, Switzerland, March. Viewed, http://www.bis.org/bcbs/publ/d354.htm

Basten, C. and C. Koch (2015). 'Higher Bank Capital Requirements and Mortgage Pricing: Evidence from the Countercyclical Capital Buffer.' Working Papers No. 511, Bank for International Settlements, Basel, Switzerland. Viewed, http://www.bis.org/publ/work511.htm

Baston, R. G. (1989). 'Financial planning using goal programing.' Long Range Planning 22: 112-120.

Beckerman, W. (2011). *Economics as Applied Ethics: Value Judgements in Welfare Economics*. New York, Palgrave Macmillan.

Bessis, J. (2010). *Risk Management in Banking*. Hoboken, NJ, Wiley.

Bilston, T. and D. Rodgers (2013). 'A Model for Stress Testing Household Lending in Australia.' Australia Reserve Bank Bulletin, December: 27-38. Viewed, http://www.rba.gov.au/publications/bulletin/2013/dec/4.html

Bilston, T., R. Johnson, M. Read (2015). 'Stress Testing the Australian Household Sector Using the Hilda Survey.' Research Discussion Paper, Reserve Bank of Australia, Sydney. Viewed, http://www.rba.gov.au/publications/rdp/2015/pdf/rdp2015-01.pdf

Black, R., K. Brown, J. Moloney (2003). 'Asset and liability management: what does the future the future have in store.' Balance Sheet 11(2): 32-38.

Booth, G. (1972). 'Programing bank portfolios under uncertainty: an extension.' Journal of Bank Research 2: 28-40.

Borio, B., M. Dremann, K. Tsatsarnis (2012) 'Stress-Testing Macro Stress Testing: does it live up to expectations'. Basel Committee on Banking Supervision, BIS, Basel, Switzerland, September. Viewed, http://www.bis.org/publ/work369.pdf

Bradley, S. P. and D. B. Crane (1972). 'A dynamic model for bond portfolio management.' Management Science 19: 139-151.

Brealy, R. and S. Myers (1997). *Principles of Corporate Finance*. New York, Prentice-Hall.

Brodt, A. I. (1978). 'Dynamic balance sheet management model for a Canadian charted bank.' Journal of Banking and Finance 2(3): 221-241.

Brown, P., W. Beekes., and P. Verhoeven (2011). 'Corporate governance, accounting and finance: a review.' Accounting and Finance 51(1) 96-172.

Bunea, M. (2013). 'The corporate governance impact on banking performance increase.' Cross-Cultural Management Journal 15(3): 51-59.

Bushman, T. M. and A. J. Smith (2001). 'Financial accounting information and corporate governance.' Journal of Accounting and Economics 32(1-3): 237-333.

Byres, W. (2014). 'Seeking Strength in Adversity: Lessons from APRA's 2014 Stress Test on Australia's Largest Banks.' AB +F Randstad Leaders Lecture Series, Australia Prudential Regulation Authority, Sydney. Viewed, http://www.apra.gov.au/Speeches/Documents/Byres%20-%20ABF%20Randstad%20Leaders%20Lecture%20Series%202014%20-%207%20November%202014%20(2).pdf

Carino, D. R., T. Kent., D. H. Myers., C. Stacy., M. Sylvanus., A. L. Turner., K. Watanabe., W. T. Ziemba (1994). 'The Russell-Yasuda Kasai model: an asset/liability model for Japanese Insurance company using multistage stochastic programing.' Interfaces 24(1): 29-49.

Chambers, D. and A. Charnes (1961). 'Inter-temporal analysis and optimization of bank portfolio.' Management Science 7: 393-410.

Charnes, A. and W. W. Cooper (1977). 'Goal programing and multiple objectives optimization (Part1).' European Journal of Operational Research 1(1): 3954.

Charnes, A. and S. C. Littlechild (1968). 'Intertemporal bank asset choice with stochastic dependence.' Systems Research Memorandum (188). Viewed, http://www.dtic.mil/cgi-bin/GetTRDoc?Location=U2&doc=GetTRDoc.pdf&AD=AD0672581

Charnes, A. and S. Thore (1966). 'Planning for liquidity in financial institutions: the chance constrained method.' Journal of Finance 21(4): 649-674.

Choong, K. K. (2009). *Issues in Accounting and Finance Research: Quantitative Approach Perspective*. Melbourne, uniPrint.

Chorafas, D. (2007). *Risk Accounting and Risk Management for Accountants*. Elsevier.

Chung, H. K., J, Elder., J. Kim (2010). 'Corporate governance and liquidity.' Journal of Financial and Quantitative Analysis 45(2): 265-291. Viewed, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1142975

Clarke, T. (2004). *Theories of Corporate Governance, the Philosophical Foundations of Corporate Governance.* New York, Routledge.

Cohen, K. J. and F. S. Hammer (1967). 'Linear programing and optimal bank asset management decisions.' Journal of Finance 22: 42-61.

Cohen, K. J. and S. Thore (1970). 'Programming bank portfolios under uncertainty.' Journal of Bank Research 2(2): 28-40.

Collier, P. M. (2009). *Fundamentals of risk Management for Accountants and Managers: Tools and Techniques*, Oxford, Butterworth-Heinemann.

Colm, K. (1997). 'The Wallis Inquiry: An Assessment.' *Economic and Labour Relations Review* 8(2): 308-317.

Committee of Sponsoring Organisations of the Treadway Commission (1992). 'Integrated Control – Integrated Framework.' Jersey City, NJ, American Institute of Certified Public Accountants.

Committee of Sponsoring Organisations of the Treadway Commission (2004a). 'Enterprise Risk Management – Integrated Framework: Application Technique.' New York, American Institute of Certified Public Accountants.

Committee of Sponsoring Organisations of the Treadway Commission (2004b). 'Enterprise Risk Management – Integrated Framework: Executive Summary Framework'.' New York, American Institute of Certified Public Accountants.

Cortez, A. (2011). *Winning at Risk: Strategies to Go Beyond Basel*. Hoboke, NJ, Wiley Finance.

Crane, B. (1971). 'A stochastic programing model for commercial bank bond portfolio management.' Journal of Finance Quantitative Analysis 6: 955-976.

Cyert, R. M. and J. G. March (1963). *A Behaviour Theory of the Firm*. New Jersey, Prentice Hall.

Damghani, K, Taghavifard, M, and Moghaddam (2009). 'Decision making under uncertainty and risky situations.' Society of Actuaries. Viewed, https://scholar.google.com.au/scholar?hl=en&as_sdt=0,5&q=%E2%80%98Decision+making+Under+Uncertain+and+Risky+Situations,+Society+of+Actuaries

Debelle, G. (2010). 'RBA: Speech on Risk and Uncertainty.' Presentation at Risk Australia Conference. Sydney, 31 August 2010, Viewed, http://www.rba.gov.au/speeches/2010/sp-ag-310810.html

Debelle, G. (2012). 'Presentation on the Regulatory Reforms and their Implications for Financial Markets, Funding Costs and Monetary Policy.' Address to the Financial Services Institute of Australia, Adelaide, September 2012. Viewed, http://www.rba.gov.au/speeches/2012/sp-ag-180912.html

Debelle, G. (2014). 'Liquidity.' Speech at the 27th Australasian Finance and Banking Conference, UNSW Business School, Sydney, 16 December 2014. Viewed, http://www.rba.gov.au/speeches/2014/sp-ag-161214.html

Debelle, G. (2015). 'Some Effects of the New Liquidity Regime'. Speech at the 28th Australian Finance and Banking Conference, Australia, Sydney, 16 December 2015.

DeFond, M. and K. R. Subramanyam (1998). 'Auditor changes and discretionary accruals.' Journal of Accounting and Economics 25(1): 35-67.

Dowd, K. (2014) 'Math Gone Mad: Regulatory Risk Modelling by the Federal Reserve'. The Cato Institute, Policy Analysis, Number 754.

Dowd, K., M. Hutchinson., S Ashby. and K.M. Hinchcliffe (2011). 'Capital Inadequacies: The Dismal Failure of the Basel Regime of Capital Regulation'. The Cato Institute, Policy Analysis, No 681, July.

Drehmann, M., and K. Nikolau (2010). 'Funding Liquidity Risk: Definition and Measurement'. Bank of International Settlements Working Papers, No 315 July. Viewed, http://www.bis.org/publ/work316.pdf

Edey, M and B. Gray (1996) 'The Evolving Structure of the Australian Financial System'. Viewed, http://www.rba.gov.au/publications/confs/1996/pdf/edey-gray.pdf

Edey, M. (2011). 'Base III and Beyond.' Presentation at the Basel III Conference 2011. Sydney, 24 March 2011. Viewed, http://www.bis.org/review/r110325b.pdf

Edey, M. (2015). 'The Risk Environment and the Property Sector'. Presentation at the Australian Property Institute's Queensland Property Conference, Gold Coast, 6 November 2015. Viewed, http://www.rba.gov.au/speeches/2015/sp-ag-2015-11-06.html

Edey, M. (2016). 'The Evolving Risk Environment'. Presentation at the Australian Shareholders Association (ASA) Investor Forum, Sydney, 18 February 2016. Viewed, http://www.rba.gov.au/speeches/2016/sp-ag-2016-02-18.html

Eppen, G. D. and E. F. Fama (1971). 'Asset cash balance and dynamic portfolio problems.' Management Science 17: 311-319.

Epps, R. and S. Cereola (2008). 'Do institutional shareholder services (ISS) corporate governance ratings reflect a company's operating performance?' Critic Perspectives on Accounting 19: 1138-1148.

European Banking Authority (2014). 'Results of 2014 EU-wide stress test.' London. Viewed, Viewed, http://www.eba.europa.eu/documents/10180/851779/2014%20EU-wide%20ST-aggregate%20results.pdf

Fama, E. (1980). 'Agency problem and the theory of the firm.' Journal of Political Economy 88(2): 288-307.

Fama, E. and M. Jensen (1983). 'Separation of ownership and control.' Journal of Law and Economics. 26: 301-325.

Fama, E. F. and K. R. French (2002). 'Testing trade-off and pecking order predictions about dividends and debt.' The Review of Financial Studies 15(1): 1-33.

Financial Crisis Inquiry Commission (2011). 'The Financial Crisis Inquiry Report'. Washington, DC: U.S. Government Printing Office. Viewed, https://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf

Feltham, G., J. Hughes., D. Simunic (1991). 'Empirical assessment of the impact of auditor quality on the valuation of new issues.' Journal of Accounting and Economics 14(4): 375-399.

Fielitz, D. and A. Loeffler (1979). 'A linear programing model for commercial bank liquidity management.' Financial Management 8(3): 44-50.

Financial Stability Board (2012). 'FSB Principle for Sound Residential Mortgage Underwriting Practices.' Basel, Switzerland. Viewed, http://www.fsb.org/wp-content/uploads/r_120418.pdf?page_moved=1

Frame, JD (2003), 'Managing risk in organizations: a guide for managers, Jossey-Bass, San, Francisco, CA, USA.

Francis, J., D. Philbrick., K. Schipper (1994). 'Shareholder litigation and corporate disclosure.' Journal of Accounting Research 32(2): 137-164.

Freeman, RE. (1984). *Strategic Management: A Stakeholder Approach*. Boston, Pitman Publishing.

Freeman, R., Wikcks, A., B. Parmar (2004). 'Stakeholder theory and corporate objective revisited.' Organization Science 15(3): 364-369.

Ganguin, B. and J. Bilardello (2005). *Fundamental of Corporate Credit Analysis*. McGraw-Hill, New York.

Gass, S. I. (1987). 'The setting of weights in linear goal-programming problems.' Computers and Operations Research 14(3): 227-230.

Grant, J. (2011). 'Liquidity transfer pricing: a guide to better practice.' Working Paper, Australia Prudential Regulation Authority, Sydney. Viewed, http://www.apra.gov.au/AboutAPRA/Documents/Liquidity-Transfer-Pricing-A-Guide-to-Better-Practice-22Mar11.pdf

Greuning, H. V. and S. B. Bratanovic (2009). *Analyzing and Managing Banking Risk: A Framework for Assessing Corporate Governance and Financial Risk*. Herndon, VA, World Bank Publications.

Gup, B. E. (2007). *Corporate Governance in Banking: A Global Perspective*. Cheltenham, Edward Elgar.

Gupta, U. G. and W. Collins (1997). 'The impact of information systems on the efficiency of banks: an empirical investigation.' Industrial Management and Data Systems 97(1). Viewed, http://www.emeraldinsight.com/doi/abs/10.1108/02635579710161296

Hadi, Z. A. and S. F. Abdul (2011). 'Corporate governance and performance of banking firms: evidence from Asian emerging markets.' Advances in Financial Economics 12: 49-74. Viewed http://www.emeraldinsight.com/doi/abs/10.1016/S1569-3732(07)12003-X

Hannan, E. L. (1980). 'Non-dominance in goal programming.' INFOR 18(4): 300-309.

Hannan, E. L. (1985). 'An assessment of some criticisms of goal programming.' Computers and Operations Research 12(6): 525-541.

Harrald, J., J. Leotta, R. Wallace., E. Wendel (1978). 'A note on the limitations of goal programming as observed in resource allocation for marine environmental protection.' Naval Research Logistics Quarterly 25(4): 733-739.

Hart, O. (1995). 'Corporate governance: some theory and implications.' The Economic Journal 105(430): 678-689. Viewed, http://www.ppge.ufrgs.br/giacomo/arquivos/gov-corp/hart-1995.pdf

Hartmann-Wendels, T., p. Grundke., W. Spork (2003). 'Basel II and the effects on the banking sector.' In M. Frenkel et al. (eds), *Risk Management*, Springer Berlin Heidelberg, pp. 3-24. Viewed, http://link.springer.com/chapter/10.1007/3-540-26993-2_1

Hirschey, M. (2009). *Managerial Economics*, Mason, Ohio, Thomson South-Western.

Hoening, T (2013). 'Basel III Capital: A well-Intended Illusion' International Association of Depositors Insurers 2013 Research Conference Basel, Switzerland. Viewed, https://www.fdic.gov/news/news/speeches/spapr0913.pdf

Holmstrom, B. (1979). 'Moral hazard and observability.' The Bell Journal of Economics 10: 74-91.

Ho, T. and S. B Lee. (2004). *The Oxford Guide to Financial Modelling: Applications for Capital Markets, Corporate Finance, Risk Management, and Financial Institutions.* Oxford University Press. Viewed, https://ideas.repec.org/b/oxp/obooks/9780195169621.html

Hoening, T. M. (2013), Basel III Capital: A well-Intended Illusion ----- International Association of Deposit Insurers 2013 Research Conference Basel, Switzerland . --- http://www.asbaweb.org/E-News/enews-34/Contr/5%20Cont.pdf

Holmstom, B and J. Tirole (1998). ''Liquidity and Public Supply Liquidity", Journal of Political Economy, 106, 1-40. Viewed, http://isites.harvard.edu/fs/docs/icb.topic1002789.files/Week%209%20-%20October%2025%20and%2027/Holmstrom-Private%20and%20public%20supply%20of%20liquidity.pdf

Janda, M. (2015) 'Banks ward that APRA move on home loans will push up mortgage costs'. ABC News, July 20, 2015. Viewed, http://www.abc.net.au/news/2015-07-20/apra-increases-mortgage-risk-weights-for-major-banks/6632680

Ignizio, J, P, and T. Cavalier (1976). 'An approach to the capital budgeting problem with multiple objectives.' *The Engineering Economist* 21(4): 259-272.

Ijiri, Y. (1965). *Management Goals and Accounting for Control*. Chicago, Rand-McNally.

Jensen, M. and W. Mecklin (1976). 'Theory of firm: managerial behaviour, agency cost and ownership structure.' Journal of Financial Economics 3: 305-350.

Johannes, W. (2014). *Bank Management and Control: Strategy, Capital and Risk Management*, New York, Springer.

Kalirajan, K. P. and R. T. Shand (1992). 'Causality between technical and allocative efficiencies an empirical testing.' Journal of Economic Studies 19(2): 3-17.

Kallberg, J. G., R. W. White., W. T. Ziemba (1992). 'Short Term Financial Planning under Uncertainty.' Management Science 28: 670-682.

Kapan, T. and C. Minoiu (2013). 'Balance sheet and bank lending during the global financial crisis.' International Monetary Fund Working Paper, International Monetary Fund, Washington DC. Viewed, https://www.imf.org/external/pubs/ft/wp/2013/wp13102.pdf

King, P.,and H.Tarbert (2011) Banking Financial Services: Policy Report Volume 30 Number 5 May http://www.weil.com/~/media/files/pdfs/Basel_III_May_2011.pdf

Knight, F. H. (1921). *Risk, Uncertainty and Profit*. Boston, Mass., Hart.

Komar, R. (1971). 'Developing a liquidity management model.' Journal of Bank Research Spring: 38-53.

Korhonen, A. (1987). 'A Dynamic Bank Portfolio Planning Model with Scenarios, Multiple Goals and Changing Priorities'. European Journal of Operational Research 30(1):13-23

Korhonen, P. and J. Wallenius (1998). 'A Pareto race.' Naval Research Logistics 35: 615-623.

Kosmidou, K. and C. Zopounidis (2001). 'Bank asset liability management techniques: an overview.' In Zopounidis C., P. M. Pardalos, G. Baourakis (eds.), *Fuzzy Sets in Management and Economics*. World Scientific Publishers, pp. 255-268.

Kosmidou, K. and C. Zopounidis (2004). *Goal Programing Techniques for Banks Asset Liability Management*. Heidelberg, Springer.

KPMG (2013) 'Major Australian Banks Full Year Results' Financial Institutions Performance Summary. Viewed, https://home.kpmg.com/au/en/home/industries/banking-capital-markets.html

Kusy, I. M. and T. W. Ziemba (1986). 'A bank and liability management model.' Operations Research 34(3): 356-376.

Kvanli, A. H. (1980). 'Financial planning using goal programming-OMEGA.' The International Journal of Management Science 8(2): 207-218.

Lange, H., A. Saunders, M. Cornett (2007). *Financial Institutions Management*, Sydney, McGraw Hill Australia.

Lange, HP., A. Saunders., M. Cornett (2015). *Financial Institutions Management: A Risk Management Approach*. North Ryde, NSW: Mcgraw Hill.

Laugh, I. (2015). 'Risk Management and Governance: A Prudential Regulator Perspective.' Australia Prudential Regulation Authority, Sydney. Viewed, http://www.apra.gov.au/Speeches/Documents/Macquarie%20Risk%20Day%202015%20-%20Risk%20Culture,%20Governance%20and%20Financial%20Literacy%2013%20March%202015%20final%20for%20publication.pdf

Lee, S. M. and D. L. Chesser (1980). 'Goal programming for portfolio selection.' The Journal of Portfolio Management 6: 22-26.

Lee, S. M. and A. J. Lerro (1973). 'Optimizing the portfolio selection for mutual funds.' Journal of Finance 28: 1086-1101.

Levary, R and S. Seits (1990). *Quantitative Methods for Capital Budgeting*. Cincinnati Ohio, South-Western Publishing Co.

Lifson, K. A. and B. R. Blackman (1973). 'Simulation and optimization models for asset deployment and funds sources balancing profit liquidity and growth.' Journal of Bank Research 4(3): 239-255.

Lin, T. and D. O'Leary (1993). 'Goal programming applications in financial management.' Advances in Mathematical Programming and Financial Planning 3: 211-229. Viewed, https://msbfile03.usc.edu/digitalmeasures/doleary/intellcont/goal-programming-applications-in-financial-management-1.pdf

Littrell, C. (2011a). 'What are the costs of Australian Basel III Implementation, what are the benefits.' Presented at the Annual Australian Financial Services Conference of UBS, Australia Prudential Regulation Authority, Sydney, 23 June 2011. Viewed, http://www.apra.gov.au/Speeches/Documents/Charles-Littrell-Speech-to-UBS-23-June-2011-final-2-2.pdf

Littrell, C. (2011b). 'APRA's Basel III implementation rational and impacts.' Presented at the APRA Financial Workshop, Australia Prudential Regulation Authority, Sydney, 23 November 2011.

Liu, B. and X. Chen (2015). 'Uncertain multiobjective programming and uncertain goal programming'. Journal of Uncertainty Analysis and Applications 3(10). DOI: 10.1186/s40467-015-0036-6. Viewed, http://orsc.edu.cn/online/131020.pdf

Love, I. (2010). 'Corporate governance and performance around the world: what we know and what we don't.' World Bank Research Observer 26(1): 42-70.

Lowe, P. (2015). 'Remarks at FINSIA Regulators Panel', Speech at the FINSIA Regulators Pane, Financial Services Institute of Australasia, Sydney, 5 November 2015. Viewed, http://www.rba.gov.au/speeches/2015/sp-dg-2015-11-05.html

Markowitz, H. M. (1959). 'Portfolio election under certainty: the continuous time case.' Review of Economics and Statistics 3: 373-413.

McGrath, M. and C. Viney (1997). *Financial Institutions Instruments and Markets*. Sydney, McGraw Hill.

McTaggart, D., Findlay, C, and Parkin, M.. (2007). *Economics*. Frenchs Forest, N.S.W., Pearson Education Australia

Merton, R. C. (1969). 'Lifetime portfolio selection under certainty: the continuous time case.' Review of Economics and Statistics 3: 373-413.

Merton, R. C. (1990). *Continuous-Time Finance*, Blackwell Publishers.

Min, H. and J. Storbeck (1991). 'On the origin and persistence of misconception in goal programming.' Journal of the Operations Research Society 42(1): 301-312.

Moeller, R. (2007). 'COSO enterprise risk management: understanding the new integrated ERM framework.' Hobokoen, NJ, John Wiley and Sons Inc.

Moosa, I.A. (2011). 'Basel II as a casualty of the global financial crisis', Viewed, http://link.springer.com/article/10.1057%2Fjbr.2010.2#page-1

Mullineux, A. (2007a). 'The corporate governance of banks.' Journal of Financial Regulation and Compliance 14(4): 375-382.

Mullineux, A. (2007b). 'Financial sector convergence and corporate governance.' Journal of Financial Regulation and Compliance 15(1): pp.8-19.

Mulvey, J. M. and H. Vladimirou (1992). 'Stochastic network programing for financial planning problems.' Management Science 38: 1642-1663.

Mulvey, J.M., and H. Vladimirou. (1992). 'Stochastic Network Programming for Financial Planning Problems'. Applied Numerical Mathematics 38:1643-1664

Mulvey, J. M. and W. T. Ziemba (1998). 'Asset and liability management systems for long-term investors: discussion of the issues.' In W.T. Ziemba and J. M. Mulvey (eds), *Worldwide Asset and Liability Modeling*. London, Cambridge University Press, 3-38.

OECD (2004). *OECD Principles of Corporate Governance*. Paris, Organization for Economic Co-operation and Development.

OECD (2014). Risk Management and Corporate Governance, Corporate Governance, OECD Publishing. Viewed, http://www.oecd.org/daf/ca/risk-management-corporate-governance.pdf

Ogden, S. and R. Watson (1999). 'Corporate performance and stakeholder management: balancing shareholder and customer interest in the U.K. privatized water industry.' Academy of Management Journal 42(5): 526-538.

Olafsson, S. (2002). 'Simulation Optimization.' In WSC '02 Proceedings of the 34th conference on Winter Simulation: Exploring New Frontiers, Winter Simulation Conference, pp. 79-84. Viewed, http://dl.acm.org/citation.cfm?id=1030467

Padberg, M. W. (1995). *Linear Optimization and Extensions*. New York, Springer.

Palepu, K. (1986). 'Predicting takeover targets: a methodological and empirical analysis.' Journal of Financial Economics 46(2): 165-197.

Pindyck, R and D. Rubinfeld (2005) Microeconomics, Pearson Prentice Hall, Upper Saddle River, NJ.

Pogue, G. A. and R. N. Bussard (1972). 'Linear programing modeling for short-term financial planning under uncertainty.' Sloan Management Review 13: 69-98.

Press, G. and J. Weintrop (1990). 'Accounting-based constraints in public and private debt arrangements: their association with leverage and impact on accounting choice.' Journal of Accounting and Economics 12(1-3): 65-95.

Pyle, D. H. (1971). 'On the theory of financial intermediation.' Journal of Finance 26: 737-747.

Ragsdale, C. T. (2012). *Spreadsheet Modeling and Decision Analysis: A Decision Analysis*. Mason, OH South-Western Cengage Learning.

Read, M., C. Stewart., G. La Cava (2014). 'Mortgage-related Financial Difficulties: Evidence from Australian Micro-Level Data.' Research Discussion Paper, Reserve Bank of Australia, Sydney. Viewed, http://www.rba.gov.au/publications/rdp/2014/pdf/rdp2014-13.pdf

Rechner, P. and D. Dalton (1991). 'CEO duality and organisational performance: longitudinal study.' Strategic Management Journal 12: 155-160.

Reserve Bank of Australia (2013). 'Financial Stability Review.' Sydney, September. Viewed, http://www.rba.gov.au/publications/fsr/2011/sep/

Reserve Bank of Australia (2015). 'The Basel III Liquidity Reforms in Australia' Reserve Bank of Australia March Publications. Viewed, http://www.rba.gov.au/publications/fsr/boxes/2015/mar/a.pdf

Rezaee, Z. (2009). *Corporate Governance and Ethics*, Hoboken, NJ: John Wiley and Sons.

Roberson, M. (1972). 'A bank asset management model.' In S. Eilon and T.R. Fowkes (eds). *Applications of Management Science in Banking and Finance*. Epping, Essex, Gower Press, pp. 149-158.

Rogers, D. (2015). 'Credit Losses at Australian Banks: 1980-2013.' RDP 2015-06, Research Bank of Australia, Sydney. Viewed, http://www.rba.gov.au/publications/rdp/2015/pdf/rdp2015-06.pdf

Rosenthal, R. E. (1983). 'Principles of multi-objective optimization.' Decision Science 16(2): 133-152.

Samuelson, P. (1969). 'Lifetime portfolio selection by dynamic stochastic programing.' Review of Economics and Statistics 51(3): 239-246.

Saunders, A. and C. M. Millon (2011). *Financial Institutions Management: A Risk Management Approach*. New York: Mcgraw Hill.

Seshadri, S., A. Khanna, F. Harche, R. Wyle. (1999). 'A method for strategic asset and liability management with an application to the federal home loan bank of New York.' Operations Research 47(3): 345-360. Viewed: https://www.researchgate.net/publication/238836825_A_Method_for_Strategic_Asset-Liability_Management_with_an_Application_to_the_Federal_Home_Loan_Bank_of_New_York

Sharma, J. K., D.K. Sharma., J.O. Adeyeye (1995). 'Optimal portfolio selection: a goal programing approach.' Indian Journal of Finance and Research 7(2): 67-76.

Skinner, D. (1994). 'Why firms voluntarily disclose bad news.' Journal of Accounting Research 32: 38-60.

Smith, C. and R. Stulz, (1985). 'The determinants of firms' hedging policies.' *The Journal of Financial and Quantitative Analysis* 20(4): 391-405.

Sorge, M. (2004). 'Stress-testing financial systems: an overview of current methodologies.' Working Papers No. 165, Monetary and Economic Department, Bank for International Settlements, Basel, Switzerland.

Sounders, A. and M. M. Cornett (2011). Financial Institutions Management: A Risk Management Approach. New York, McGraw-Hill.

Stiglitz, J. E. (2010). *Freefall: America, Free Markets, and the Sinking of the World Economy*. New York, W.W. Norton.

Sweeney, A. (1994). 'Debt-covenant violates and managers' accounting.' Journal of Accounting and Economics 17(3): 281-308.

Tangen. S. (2004). 'Performance measurement: from philosophy to practice'. International Journal of Productivity and Performance Management, Vol.53 Iss: 8, p.726-737.

Tektas, A., E. Ozkan-Gunay, G. Gunay (2005). 'Asset and liability management in financial crisis.' The Journal of Risk Finance 6(2): 135-149.

Treasury (2014). 'Financial System Inquiry: Final Report.' Commonwealth of Australia, Canberra. Viewed, http://fsi.gov.au/files/2014/12/FSI_Final_Report_Consolidated20141210.pdf

Tutuncu, R. H. (2003). 'Optimization in Finance. Research Reports on Mathematical and Computing Sciences.' Research Reports on Mathematical and Computing Sciences, Series B: Operations Research Department of Mathematical and Computing Sciences, Tokyo Institute of Technology. Viewed, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.61.2925&rep=rep1&type=pdf

Uzan, M. (2012). *The Financial System Under Stress*, Taylor and Francis.

Valentine (1991). 'What the Campbell Committee Expected.' Presentation at Reserve Bank Conference The Deregulation of Financial Intermediaries, Sydney, 20-21 June 1991. Viewed http://www.rba.gov.au/publications/confs/1991/

Wallis Inquiry (1997). *Wallis Report. Financial System Inquiry Final Report*. AGPS, Canberra.

Wolf, C. R. (1969). ‘A model for selecting commercial bank government security portfolio.’ Review of Economics and Statistics 51(1): 40-52.

Xu, T., Grove, H., Schaberl, P. (2013). ‘Corporate governance: a risk management approach.’ Corporate Ownership and Control 10(2).

Zeleny, M. (1982). *Multiple Criteria Decision Making*. New York, McGraw-Hill.

Appendix 1
Ten Core Principles Released by the ASX Corporate Council Government

Principle 1: Lay solid foundations for management and
Principle 2: Structure the board to add value
Principle 3: Promote ethical and responsible decision-making
Principle 4: Safeguard integrity in financial reporting
Principle 5: Make timely and balanced disclosure
Principle 6: Respect the rights of shareholders
Principle 7: Recognise and manage risk
Principle 8: Remunerate fairly and responsibly

Source: ASX Corporate Governance Council (2012)..

Appendix 2
Risks faced by Financial Intermediaries

Lange et al. (2007 p.13) describe risks faced by financial intermediaries.

1. **Interest rate risk:**
   The risk incurred by a financial institution when the maturity of its assets and liabilities are mismatched.
2. **Market risk:**
   The risk incurred from assets and liabilities in a financial institutions trading book due to the changes in interest rates, exchange rates and other prices.
3. **Credit risk:**
   The risk that promised cash flow from loans and securities held by financial Institutions may not be paid in full.
4. **Off-balance-sheet risk:**
   The risk incurred by a financial institution as a result of activities related to its contingent assets and liabilities held off the balance sheet.
5. **Technology risk:**
   The risk incurred by a financial institution when its technological investments do not produce anticipated cost savings.
6. **Operational risk:**
   The risk that existing technology, auditing, monitoring and other support systems may malfunction or break down
7. **Foreign exchange risk:**
   The risk that exchange rate changes can affect the value of financial institution assets and liabilities denominated in non-domestic currencies.
8. **Country or sovereign risk:**
   The risk that payments to foreign lenders or investors may be interrupted because of restrictions, intervention or interference from foreign government.
9. **Liquidity risk: (see also appendix 3)**
   The risk that sudden surge in liability withdrawals may require a financial institution to liquidate assets in a very short period of time and at less than fair market prices.
10. **Insolvency risk:**
    The risk that a financial institution may not have enough capital to offset a sudden decline in the value of its assets.

Note: BIS (2009) highlighted even though market and credit risks have often been treated as if they are unrelated sources of risks: the risk types have been measured separately, managed separately, and economic capital against each risk type has been assessed separately, that liquidity conditions interact with market risk and credit risk through the horizon over which assets can be liquidated, deteriorating market liquidity often forces banks to lengthen the horizon over which they can execute their risk management strategies (BIS 2009, p.1).

Appendix 3
Liquidity Risk

Liquidity is the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses (Greunning and Bratanovic 2009). Liquidity risk can be given many interpretations. For example, according to Drehmann and Nikolau (2010) liquidity risk can be classified as the ability to settle obligations, with immediacy and liquidity risk defined as the risk that a counterparty (participant or other entity) will have sufficient funds to meet financial obligations as and when expected. Similarly, the Australian Prudential Regulation Authority defines liquidity risk as "the risk that an institution has insufficient liquidity to meet its obligations as they fall due - is critical to the continued operation of an ADI and to the stability of the financial system as a whole (APRA 2009, p.9).

According to the Bank for International Settlements (2012), liquidity risk includes the risk that a seller of an asset will not receive payment when due, and the seller may have to borrow or liquidate assets to complete other payments. It also includes:

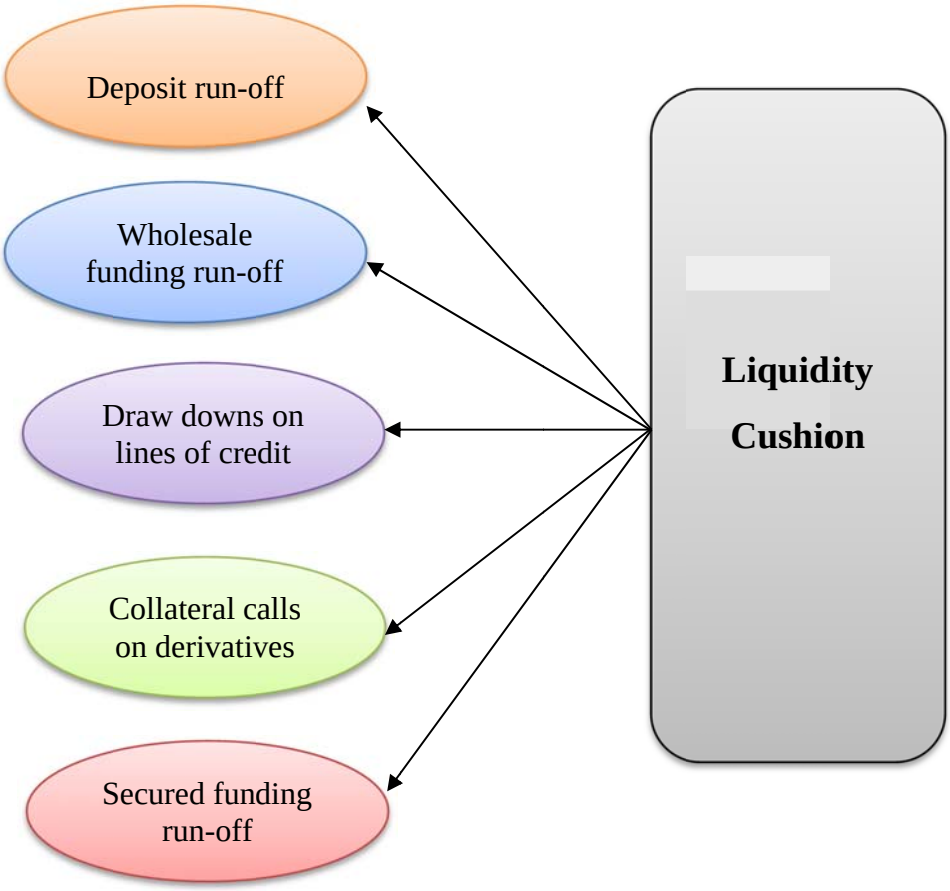
> *the risk that a buyer of an asset will not receive delivery when due, and the buyer may have to borrow the asset in order complete its own delivery obligation. Thus, both parties to a financial transaction are potentially exposed to liquidity risk on the settlement date. Liquidity problems have the potential to create systemic problems, particularly if they occur when markets are closed or illiquid or when assets prices are changing rapidly, or if they create concerns about solvency. Liquidity risk can also arise from other sources, such as the failure or the inability of settlement banks, nostro agents, custodian banks, liquidity providers, and linked FMIs to perform as expected (BIS 2012, p.25)*

In order to make banks more self-sufficient and stable over a longer period and reduce the burden of central banks having to act as the lender of last resort (including potential implications of moral hazard resulting from these actions), the BCBS introduced two fundamental Principal for the management of liquidity risk: 1) a Liquidity Cover Ratio (LCR) developed to ensure that banks have sufficient high quality liquid assets to meet their daily net cumulative cash outflows during an idiosyncratic shock for a period of one calendar month; and 2) a net stable funding ratio (NTFR), aimed at reducing banks'

structural liquidity risk by encountering the use of long-term funding of assets and other business activities. Both of these new regulatory requirements aim to ensure that the banks hold high quality liquid assets as insurance against a range of liquidity stress scenarios (Grant 2011). Taking into account liquidity definitions used by academics and practitioners, liquidity risk mainly arises because revenues and outlays are not synchronised, regardless of unexpected funding outflows (see Appendix 4). Therefore, this thesis focuses on the management and implementation of the new Basel III Liquidity Cover Ratio from a forward looking regulatory perspective of whether the bank would be in a position to fund liquidity from a point-in-time and binary concept, as banks are either able to settle obligations or not.

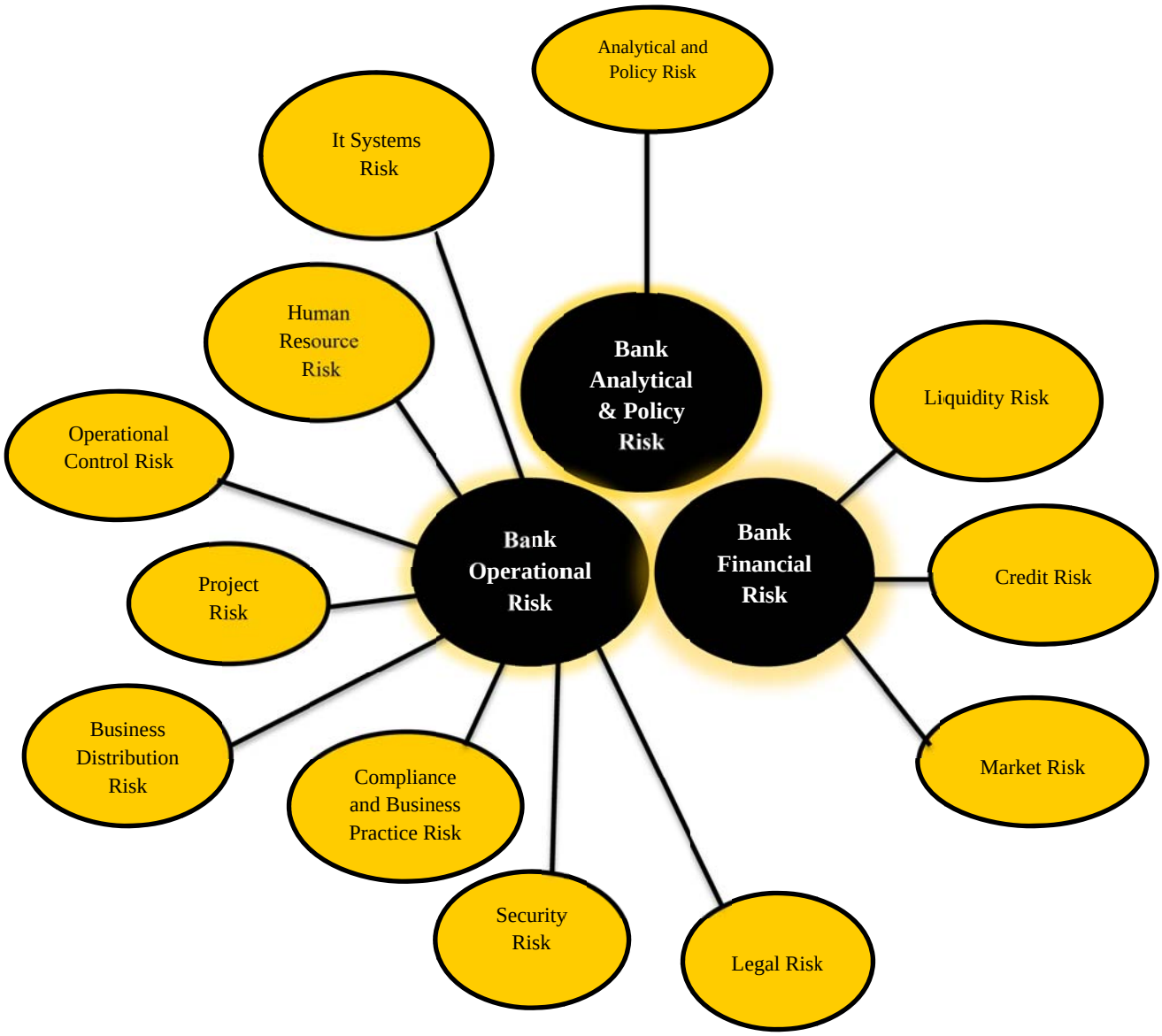
Appendix 4
Ten Financial Risks

Grant (2011 p.32) described the unexpected funding outflows and the need for a liquidity cushion.



Source: Grant (2011).

Appendix 5
Risk Categorisation Model



Source: BIS (2009b).