What Drives Bank Wholesale Funding Spreads?
Empirical Evidence from Australia

A dissertation submitted by

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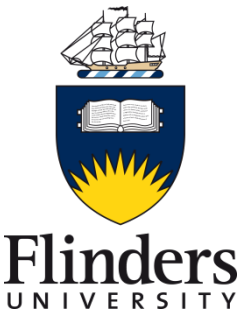

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ABSTRACT

Of the two funding options for banks (retail and wholesale), the Big Four banks in Australia have considerable proportions of their funding base made up of wholesale funding although, some lower tier banks (such as Bendigo/Adelaide Bank, Bank of Queensland, and Suncorp) had more than half of their funding base in wholesale leading up to the financial crisis.

Wholesale funding is funding accessed from domestic and international debt markets (i.e euro market, Asia, and the United States) and/or the domestic interbank markets. The majority of wholesale funding consists of long term bonds (term funding), securitisation and short term NCD's (negotiable certificate of deposits and Euro commercial paper) issued via domestic and international capital markets.

Wholesale funding is usually priced to the respective benchmark interest rate. In Australia this is the BBSW (bank bill swap rate), in Europe the LIBOR (London inter-bank offered rate) and in the US the USCP rate (US commercial paper rate). Each bank is charged a different margin above their respective benchmark interest rates based on variables such as credit ratings, size of the issue and maturity, and general economic conditions. In addition, debt issued offshore is hedged using cross currency swaps and interest rate swaps to hedge out exchange rate risk and interest rate risk. This adds a cost to the banks debt funding margins. The relative importance of these variables and the issues related to wholesale funding are empirical questions yet to be addressed.

The most common wholesale funding instrument is one where interest rate paid by a bank is a combination of the 90 day bank bill swap rate (90 day BBSW) and a margin (spread) above the BBSW. During the financial crisis, wholesale funding came under pressure around the world due in part to a reluctance of banks willing to invest in each other's negotiable certificate of deposits (NCD's) and other interbank funding instruments, fuelling the liquidity crisis. The aim of this research is two-fold. First it explores the size and scope of wholesale funding in Australia with particular reference to domestic wholesale funding. Second it examines the relative power of macro-economic variable factors in influencing the patterns of wholesale funding

spreads in order to address the research question “What drives bank wholesale funding spreads?: Empirical evidence from Australia”.

CERTIFICATION OF DISSERTATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

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Simon Cottrell

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ABBREVIATIONS

ABS: Asset Backed Securities
AIC: Akaike'nformation Criterion
ANZ: Australian New Zealand Bank
APRA: Australian Prudential Regulatory Authority
ARDL: Autoregressive Distributed Lag
ASX: Australian Securities Exchange
BBSW : Bank Bill Swap Rate
CBA: Commonwealth Bank of Australia
CDO : Collateralised Debt Obligation
CDS: Credit Default Swap
CGS : Commonwealth Government Securities
CUB: Credit Union & Building Societies
DMU: Decision Making Units
ECM : Empirical Estimates
ECP : Euro Commercial Paper
EFS: Efficient Structure
EMTN : European Medium Term Notes
EXR : Exchange Rate
FLR : Funding Liquidity Risk
HHI: Herfindahl-Hirshman Index
HQC: Hannan-Quinn Criterion
KPSS: Kwiatkowski, Phillips, Schmidt, and Shin
LIBOR: London Interbank Offered Rate
MBS: Mortgage Backed Securities
MLR: Market Liquidity Risk
NAB : National Australia Bank
NCD: Negotiable Certificate of Deposit
OIS: Overnight Index Swap
PP : Phillips–Perron
RBA: Reserve Bank of Australia
RMBS: Residential Mortgage Back Securities
RMP: Relative Market Power

SCP: Structure Conduct Performance

SIC: Schwarz Information Criterion

VAR: Value at Risk

VEC: Vector Error Correction Model

VECM: Vector Error Correction

VIX: Volatility Index

WACC: Weighted Average Cost of capital

WBC: Westpac Bank Corporation

WF: Wholesale Funding

Chapter 1

Introduction and Outline of the Research

1.1 Introduction

One of the most visible impacts of globalisation has been the rapid increase in capital flows either in terms of foreign direct investment or portfolio investment. Responding to the changes in global environments, Australia rapidly liberalised its economy first by removing the exchange rate controls in 1983 followed by the opening of the banking and financial services to foreign competition. Within a 10 year period after liberalisation Australia's external debt holdings of equity and debt instruments increased to 10.6 percent of the Gross National Income (IMF, 2000). Similarly the reduction in the Australian's household saving rate and reduced share of savings flowing into deposits was complemented by banks owning an unusually high proportion of assets in the form of mortgages funded with the increased reliance by financial intermediaries on wholesale funding (WF) markets, particularly domestic and off-shore markets. As a result, foreign borrowing also accounted for 10 percent of the Australian Banks liabilities by the end of 1990's and has rapidly increased since then (Ryan and Thompson, 2007).

The post 1990s has seen further increase in activities in financial markets due to the diversity of available financial instruments such as WF and the range of investment options available. This has helped not only Australian firms in diversifying their capital raising activities through equity financing but has also allowed greater access to debt funding domestically and off-shore. Equity capital is raised either through transferring ownership by offering shares to offshore investors or through initial public offerings (IPOs). IPOs are when a company, for the first time, offers shares to the public and subsequently trades on the stock exchange. In contrast, financial intermediaries in particular, have resorted to relying on WF markets with rapid access to both domestic and off-shore funding markets to fund excess growth in credit markets. By 2009, the major four banks in Austalia: ANZ, Commowealth

Bank of Australia, National Australian Bank and Westpac (the Big Four) raised a record 30 percent of their funding liabilities from domestic and off-shore sources while foreign-owned banks in Australia recorded 41 percent. Interestingly, equity capital and securitisation funding accounted for less than 4 percent of the Big Four's total shareholders' equity and liabilities. This also indicates that the lower tier banks (regional and community banks) are less effective in participating in the WF market for bonds relative to the Big Four, and as such they are more active in the securitisation market or RMBS market (residential mortgage-backed securities). This implies the lower tier banks resort to a higher proportion of securitisation and short-term funding while the majors benefit from long-term funding and lower borrowing costs.

Chapter 1 is set out in nine sections. Section 1.2 provides background information on domestic and international WF markets and trends leading up to the 2007 financial crisis. In addition, it introduces the research question and justification to be addressed in this dissertation. Section 1.3 considers the motivation for the research and sectors of influence on WF spreads. The main contributions provided by the research are outlined in Section 1.4. Section 1.5 specifies some limitations of the research. Sections 1.6 and 1.7 provide the theoretical framework and prior literature on WF markets. Section 1.8 examines the development of hypotheses and research methodology. Section 1.9 outlines and summarises the framework of the seven chapters in the dissertation. Finally, Section 1.10 concludes this chapter with a review of the key points.

1.2 Background

The 2007 financial crisis that was triggered by an increase in loan defaults in the United States (US) subprime mortgage sector observed since late 2006, quickly spread across global WF markets. The spread resulted in an unexpected recession leading to capital flight sparking a liquidity crisis. In particular the financial crisis fuelled a major disruption in debt markets resulting in governments around the world responding to the crisis with fiscal stimulus programs and non-traditional expansive monetary policy mechanisms. This led to a transition of governments with significant budget surpluses to running large deficits, with government debt expanding to

finance fiscal stimulus packages as well as a series of large government-guaranteed bank-issued debt programs. For instance, over the period from December 2008 to December 2009, Australian government-guaranteed bank debt on issue rose from AUD8.6 billion to AUD133.8 billion, an increase of over 1,455 percent (AGGS, 2010). Significant increases in debt issuance will undoubtedly challenge the directions of capital flight and the relevance of the crowding out concept given in the economic literature.

The financial crisis and the recovery of wholesale debt markets raised a number of fundamental questions. One that has yet to be answered is what drives Australian wholesale bank funding spreads? Generally, each bank is charged a different margin above the respective benchmark interest rate BBSW (the bank bill swap rate) based on variables such as credit ratings, size of the issue and maturity and general economic conditions. The relative importance of these variables and the issues related to WF are fundamental empirical questions yet to be addressed.

To address the above question, this research adopts a novel approach that traces the WF, and their terms and conditions, in Australia as two components: domestic and off-shore WF, and examines the size and scope of the debt issued in Australia. Using information on the debt issued, the research examines the relative power of macroeconomic variable factors such as: AUD/USD exchange rate, the VIX (volatility index), the spread between the Australian Government 10-year yield over the US 10-year treasury yield, the Reserve Bank of Australia's cash rate, and the 90-day BBSW in influencing the patterns of WF spreads in order to address the research question "What drives bank WF spreads? "

Previous literature has focused on capital flight and crowding out as the main drivers of funding spreads. Moreover, there is an ongoing debate over the relationship between the capital flight in the financial markets and capital flight in the real economy. Similarly new research evidence is emerging on the role of banks' reliance on WF in the international transmission during the financial crisis suggesting liquidity played an important role in the transmission of the crisis. This research builds on that literature, with a focus on factors driving Australian bank funding spreads. It extends the extant economic literature on capital flight and liquidity crisis

literature by examining WF from the domestic perspective. To date, there is no available Australian research that attempts to ascertain how much bank WF spreads can be attributed to the aforementioned factors and how much is due to investor (both domestic and foreign) behaviour. The Australian institutional setting facilitates this approach and has the potential to provide important insights to WF that cannot be gleaned from overseas samples.

1.3 Motivation

The motivation for this research is to gain greater understanding of the behaviour of the WF markets and factors that drive bank WF spreads. This thesis contends that WF decisions of the banks are driven by underlying macroeconomic conditions. The WF activities of banks have received little attention from academic research not only because of the complexity and confidentiality of the transactions but also due to limited available information. Traditionally banks have financed their daily funding operations by driving demand deposits from customers. Historically this source of funding has been relatively cheap compared with others thus making them a superior form of financing despite their fragility (Diamond and Rajan, 2001). Moreover, banks have also relied on other traditional methods of raising funds such as CDs (certificates of deposits), overnight cash, and funding from the repo markets (repurchase agreements) which are considered as short-term options available for funding. The opening of new windows for banks to raise higher proportions of capital through wholesale debt markets, securitisation of lending portfolios (in particular mortgages) and more recently covered bonds, has provided banks with a reduced reliance on raising funds through traditional means. For instance during the decade beginning in 2000 the Australian domestic bond market grew from 10 percent to approximately 30 percent in 2010 (ABS, 2010). Furthermore, the funding mix of the four major banks in Australia indicates that by 2009, the percentage of domestic deposits (from transaction, savings and term accounts) declined to 53 percent while short-term and long-term capital rose to 26 percent of the total liabilities (RBA 2009). This has implications on overall funding costs, lending rates and interest margins, and thus the overall welfare of the economy. Rather than focussing on ‘a model’ of bond pricing, this research disaggregates WF arrangements into a model of

domestic funding to gain a clearer picture of the potential sources of spread determinants.

Figure 1.1 illustrates the drivers of WF spreads and sectors of influence. The primary driver for change is considered to be global and domestic reforms that lead to competition influencing the capital markets in which WF is considered a subset. The liberalisation of financial markets also leads to a change in investor behaviour with increased access to offshore debt and equity capital. The dynamic growth in technology and financial innovation (particularly the development of a competing range of financial instruments that could be used for managing risk in a global business environment) are also drivers of WF spreads. Figure 1.1 shows the inter-relationships between WF spreads and macro-economic variables. The directions and causalities of these variables are yet to be tested. Therefore, the research design will not preclude the possibilities of positive or negative drivers and causes. The empirical question of this thesis is:

What drives bank wholesale funding spreads?

The question will investigate whether there is an impact on banks' wholesale capital

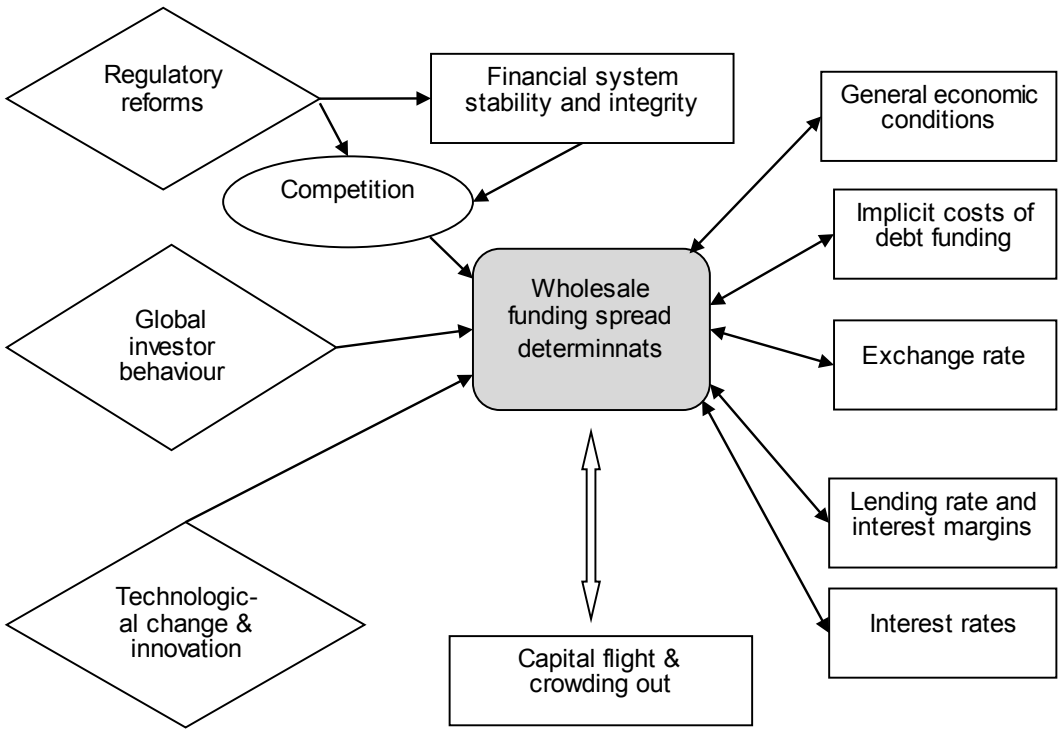


Figure 1.1: The drivers of WF spreads

raising activities of general economic variables such as the Volatility Index, exchange rate, the RBA's cash rate, the 10-year yield spread and the bank bill rate.

1.4 Contributions of the study

The four main contributions to this study are as follows:

i. greater understanding of the behaviour of WF markets by disaggregating the phenomenon into domestic markets from offshore components;

ii. the research design allows for behavioural influences on funding contract terms and conditions and market benchmarks in the explanation of pricing strategies and is not restricted to behavioural explanations of bond pricing;

iii. enhancing understanding of long term capital raising by the Australian banks through fixed and floating rate mechanisms, and the supply and demand factors associated with them; and

iv. analysis of the extant economic and finance theories to identify causes and consequences of capital markets using WF as a proxy measure of capital flows.

1.5 Delimitation of the scope

The focus of this research is on explaining observed behaviour of the Australian Banks in dealing with WF markets during 2000-2010. As such, it does not attempt to predict which of the sample banks will experience higher or lower levels of funding spreads by taking their position of advantage. Further, it does not attempt to explain participation of non-banking financial institutions and other corporates due to the complexity of the focus of research question. An examination of participation by non-bank institutions in the WF markets is relatively more dependent on a variety of other factors such as industry segment, credit rating, relative exposure to the equity market and key measures of value (i.e. price earnings ratio; P/E, price to book value ratio; P/B, and growth forecast of P/E), income (dividend yields, and their stability), and risk (measured by market and industry β). Similarly, the capital raising activities of the non-bank corporates are dependent on geographical interests and they are far

more active in funding capital via equity markets. Therefore, the results of this research are not expected to be generalisable to the non-bank corporate sector.

The Australian institutional setting for the WF market has some important differences to other capital markets. These differences and their relevance to this research will be discussed in the next section. While it is expected that the results of this study will have explanatory power for wholesale markets with similar institutional settings, where fixed and variable price mechanism are applied, the results will not be generalisable to all capital markets. It is, however, expected that the results of this study will provide useful insights that can be investigated in dissimilar institutional settings. Similarly, this research does not contest the theories related to bond pricing, fiscal consequences of budget surplus or deficit, and Balance of Payment positions which have been dealt with adequately in the literature.

1.6 Theoretical framework

Although there is no direct literature related to this study, theories underpinning this research stem from the literature related to crowding out, deficits, capital flows, interest rate and risks associated with WF. As outlined in Figure 1.1, the growth of wholesale capital markets can be attributed to the reforms (in both global and domestic market environments) promoting competition and the stability and integrity of the financial system and technology driven innovation leading to improved information arbitrage combined with growth in investor confidence.

1.7 The application of prior literature and theories to the wholesale funding market

Capital markets, interest rates, exchange rate, liquidity risk, market risk, crowding out and capital flows have received a tremendous amount of attention from researchers. This will be further investigated in Chapter 4. The processes of reforms coupled with investor behaviour and technological innovation (as identified in Figure 1.1) based on competition and market efficiency theories, have led to almost perfect information arbitrage and innovation in the capital markets. The development of WF markets can be considered as one of these innovations although there is on-

going debate on the bright and dark sides of WF particularly after the recent financial crisis.

One of the most important highlights in the literature was the risk involved in banks having unimpeded access to WF; particularly liquidity risk. Sharma (2004) described the liquidity risk in terms of adverse liquidity outcomes that arise from a combination of an external or non-liquidity trigger event and an internal vulnerability. He further describes the liquidly outcomes as: the inability to pay liabilities; or realising a market loss as a result of the premature; or forced sale of assets to raise liquidity; or a loss of business opportunity/franchise due to a lack of liquidity. The prevalence of these possible outcomes points to the strong correlation between market risk and liquidity risk. As for the banks, they are of systemic importance as any of the said outcomes may lead to a disruption of the entire financial system. Thus, any study of the WF market adopts the body of knowledge already available in the literature such as that of Raddatz (2010), which looked at liquidity and the wholesale funds in the transmission of the US subprime crisis.

1.8 Development of hypotheses and research methodology

A unique Australian model of the WF market is required to assess the potential contribution from disaggregating market activities into domestic and offshore components. The models developed in this study are based on the extant literature related to economic and financial market theories and empirical investigations. Results from testing the WF market models will be compared to prior research to identify potential sample period issues or disparities caused by differences in variable measurement.

The relevant variables considered are based on the prior literature and include the AUD/USD exchange rate, the bank bill rate, the Volatility Index (VIX), cash rate and the spread between the 5-year Australian Government bond and the 5-year US Treasury bond. The variables may also comprise a set of dummy variables to control economic shocks. The variables selected are usually significantly associated with WF in the Australian institutional setting. Some of the variables selected may have been

previously untested but in those cases an appropriate rationale or statistical reasoning will be provided.

A set of 5 hypotheses is developed in this thesis. The first hypothesis relates WF spreads and the Australian dollar exchange rate with the US dollar (AUD/USD) and is an indirect exchange rate that states the amount of USD required to purchase one AUD. Specifically, does a fluctuating exchange rate drive Australian bank WF spreads?

> **$H0_1$** Wholesale funding spreads of Australian banks are influenced by the movement of the official exchange rate.

The second hypothesis tests whether the 90-day bank bill rate has any effect on WF spreads. The Australian bank bill rate, known as the Bank Bill Swap Rate (BBSW), is an independent and transparent benchmark borrowing interest rate set at approximately 10 am daily in Sydney. Banks typically price their funding requirements to the 90-day BBSW.

> **$H0_2$** Wholesale funding spreads of Australian banks are influenced by the bank bill rate.

The third hypothesis examines if there is any significant relationship between WF spreads and the VIX. The VIX is a measure of market risk commonly referred to as "the investors' fear gauge". The index represents market expectations of near term volatility. It is calculated using the implied volatility of call and put options trading on the S&P 500 index, an index representing the United States top 500 industrial companies based on market capitalisation.

> **$H0_3$** Wholesale funding spreads of Australian banks are influenced by the Volatility Index (VIX) which represents market volatility.

The fourth hypothesis analyses if there is any significance relationship between the cash rate gap (CASHRGAP) and WF spreads. The CASHRGAP is the 10-year historical difference between the Australian cash rate set by The Reserve Bank of

Australia and the federal funds rate set by The Federal Reserve in the United States. The rate denotes the interbank interest rate financial institutions charge each other to borrow and lend on uncollateralised funds, usually on an overnight basis. Within the respective countries, the rates are used by monetary authorities to influence macro-economic factors in particular employment, economic growth and price stability.

> **$H0_4$** Wholesale funding spreads of Australian banks are influenced by the Cash Gap which is the difference between the domestic cash rate and the foreign interest rate.

The final hypothesis examines any significance between the bond yield gap (BONDGAP) and WF spreads. The BONDGAP is the 10-year historical difference between Australian 5-year Government bond yields and 5-year United States Treasury bond yields. A treasury bond is a debt security issued by a national government usually in the country's own sovereign currency to fund government spending. The yield on a bond is determined by the market. When the price of a bond falls, this drives yields in the opposite direction and the yield increases and *vice versa* for an increase in bond prices.

> **$H0_5$** wholesale funding spreads of Australian Banks are influenced by the Bond Gap which is the difference between the domestic 5-year domestic Government bond yield and the foreign Government bond yield.

The above hypotheses are the main focus of this research. Testing and derivation of results will be carried out in Chapter 6.

1.9 Thesis structure

This chapter introduced the size and scope of the WF market and identified the research question. Chapter 1 has also provided four main contributions to research on WF markets and identified the delimitations of the research. The applicability of theories relevant to this thesis is assessed in the context of the Australian institutional setting. The preliminary models for investigation of the relevant questions and

related hypotheses are then presented. The final sections outline the research methods.

The next chapter reviews the domestic and international WF market and analyses the factors leading to the development of WF markets, including structure, conduct and performance, and provides an overview of the size and scope of WF, focusing on Australian banks.

Chapter 3 presents a practical overview of the bond issuance process employed by the Big Four Australian banks. Specifically, this chapter details the analysis, procedures and capabilities required for successful wholesale debt issuance from an Australian perspective and covers the factors leading to the expansion of WF markets, including their structure, conduct and performance, and provides an overview of the size and scope of WF markets in Australia.

Chapter 4 explores the theoretical and empirical literature on WF markets, reviews the research available on WF markets, and develops a sound framework for analysing the research questions. In addition, Chapter 4 examines empirical evidence and industry practices and their implication for the size and scope, as well as the growth of WF markets.

Chapter 5 draws conclusions from an extensive overview of the WF market literature from Chapters 2 and 3 in order to specify a basis or justification for the research questions addressed in this dissertation. This chapter extends this literature mainly to provide a justification for the research questions and the research methodology adopted to analyse those questions.

Chapter 6 provides a comprehensive overview of testing carried out prior to model specification, the model estimation and results derived, and provides a synthesis of the model specification based on content covered in the previous chapters. Furthermore, the chapter explains the model estimation process and presents the empirical results.

The final chapter presents conclusions of the research, summarising the research findings, contributions, implications and potential directions for future research.

1.10 Conclusion

This chapter introduced background evidence on WF markets and the research question and justification to be addressed in the dissertation. Chapter 1 explored the motivation for research and sectors of influence on WF spreads, outlined the main contributions provided by the research, and specified limitations of the research. Furthermore, a theoretical framework and prior literature on WF markets was examined. Finally, the hypotheses and research methodology was developed.

Chapter 2

The Wholesale Funding Market: Size and Shape

2.1 Introduction

As outlined in Chapter 1, the ability to access the global WF market has changed the traditional asset and liability management practices of the Australian banking industry. This chapter gives a comprehensive overview of the WF market from global and Australian perspectives. It covers the factors leading to the development of WF markets, including structure, conduct and performance, and provides an overview of the size and scope of WF, focusing on Australian banks.

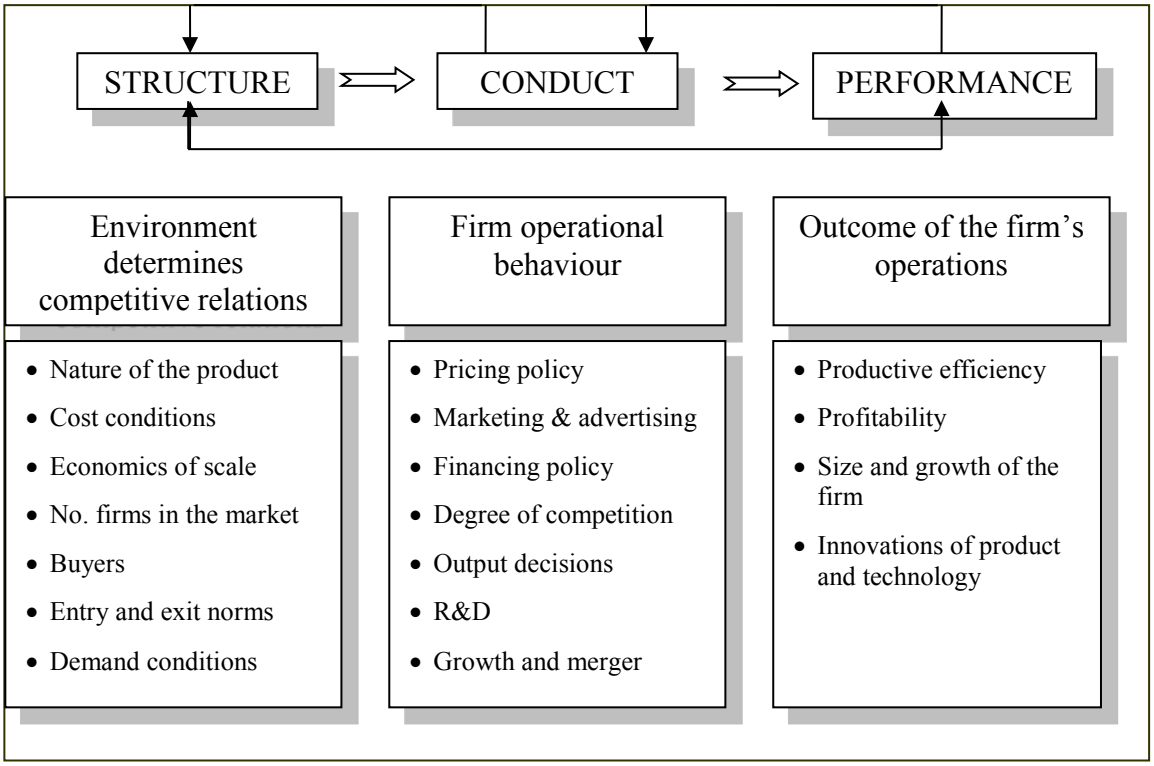
Literature on banking and financial institutions highlights three strategies that may lead to create competition in liberalised markets (Lloyd-Williams, Molyneux and Thornton, 1994). The first is to encourage mergers so that banks can capture market share and increase the size and scale of their business. Accordingly, three factors contribute to merger moves: creating larger banks; deterring potential hostile acquisitions and takeovers; and making the financial market (banking) more efficient. The second strategy focuses on banks taking measures to improve their own operating performance by improving administrative scale and technical efficiencies. The third strategy is of relevance to this study and involves banks sharing common resources such as ATM and branch networks. Recent developments in the financial services industry show that the concept of sharing can be extended to other areas as well. For instance, banks now heavily rely on outsourcing resources such as IT, call centres and, in some special cases, skilled fund managers. Similarly, banks of sufficient size and scale now have the ability to attract excess capital available in global WF markets. This has also provided a convenient alternative to traditional deposit mobilisation (encouraging savings). Furthermore, access to global markets has the potential to undermine the effectiveness of the monetary policy mechanism in managing the money supply through setting interest rates for overnight cash. The availability of offshore funding will potentially give an alternative to the

banks to reduce their reliance on the Reserve Bank. On the other hand, from an investment point of view, the WF market will also provide an alternative investment platform to domestic investors. Therefore it is important to examine the growth of WF activities.

This chapter consists of eight sections including the introduction. The next section introduces the Structure-Conduct-Performance (SCP) to be used to explore the behaviour of the WF market. Section 2.2 initially reviews the application of the framework to the banking industry and then examines its usefulness in exploring WF markets. The next three sections deal with the structure, conduct and performance of the WF market. Accordingly, Section 2.3 reviews market concentration, forms of products/instruments, factors affecting entry into the market, and syndication/conglomeration aspects. Similarly, Section 2.4 is an overview of the conduct of the markets in terms of margin (spread) determination, issuing strategies (such as secured, subordinated, callable and non-callable bonds), innovations in the markets (such as securitisation, hybrid capital and contingent capital), and BASEL and APRA implications for WF. Section 2.5 evaluates the performance of the markets by reviewing historical information (such as trade volumes, data on deals and prices), net interest margins (deposit versus non-deposit) and bank use of WF pre and post financial crisis. The penultimate section examines the case for access to WF by Australian banks. The final section summarises the chapter. It is important to note that the contents covered in this chapter are built on in the next chapter, which covers the process aspect of WF.

2.2 The behaviour of wholesale funding markets

In the literature, the behaviour of the banking industry (and financial markets) has been examined using both structural and non-structural approaches. Structural approaches follow traditional industrial organisation theory by encompassing the efficient-structure (EFS) hypothesis and the structure-conduct-performance (SCP) hypothesis (Figure 2.1 illustrates the basic compartments of the theory behind structural approaches). Structural approaches assume that market concentration weakens market competition due to collusive behaviour among firms. In contrast, non-structural approaches consider that factors other than market structure and



concentration may affect competitive behaviour, such as barriers to entry/exit and the

Source: Seelanatha, 2009

Figure 2.1: The structure-conduct-performance theory

general contestability of the market (Panzar and Rosse, 1987; Rosse and Panzar, 1977). Most of the non-structural approaches are built on the context of the new empirical industrial organisation (NEIO) literature.

2.2.1 EFS hypothesis versus SCP hypothesis

The EFS hypothesis stresses that aggressive behaviour of efficient firms in the market may lead to an increase in those firms' size and market share. This allows efficient firms to concentrate on earning higher profits while further enhancing their market share. This means firms can maximise profits either by maintaining their present level of price and firm size, or by reducing price and expanding the firm size (Lloyd-Williams, Molyneux and Thornton, 1994). Berger and Hannan (1989) stated that firms in markets that have a large dispersion of efficiency create an unequal market share and a high level of concentration. Accordingly, the EFS hypothesis states that the positive relationship between profit and concentration results in lower cost achieved through superior operational management and an efficient production

process (Goldberg and Rai, 1996). Thus, proponents of the EFS hypothesis argue that differences in efficiencies between decision-making units (DMUs) within markets create high levels of concentration. The high concentration ratio in the market creates greater than average efficiency in these markets, yielding a positive profit–concentration relationship (Berger and Hannan, 1989).

As mentioned previously, deregulation and globalisation, have changed the nature of competition in the banking and other financial services industries. The improved level of competition has forced financial institutions to be more efficient. As explained in the EFS hypothesis, there is no need to encourage mergers in the banking industry, since efficient banks can improve their market share by providing more cost-effective financial services while weak ones will either exit the industry or face acquisition or merger. Therefore, the EFS hypothesis suggests that public policy makers should focus on identifying and implementing strategies that enhance productivity and efficiency.

On the other hand, the SCP hypothesis simply states that the more a bank grows, the more efficient it becomes. The SCP hypothesis propounds that concentration is a source of greater profitability, rather than the consequence of more efficient firms increasing their share of the market (Berger et al., 2004). According to the SCP hypothesis, market concentration fosters collusion among large firms in the industry, which subsequently leads to higher profits. Hence, the protagonists of the SCP hypothesis suggest that changes in market concentration may have a positive influence on a firm's financial performance (Goldberg and Rai, 1996). Furthermore, the SCP hypothesis recognises the consequent positive relationship between market concentration and performance to be a result of the anti-competitive behaviour of firms with a large market share (Berger and Hannan, 1989).

The Relative Market Power (RMP) hypothesis, which is a special case of the SCP hypothesis, proposes that only firms with large market shares and a range of differentiated product lines are able to exercise market power to gain superior profits over non-competitive price-setting behaviour (Berger, 1995). The basic argument underlined by the SCP hypothesis supports the collusive power of the market and

encourages strategies that enhance market concentration. Consequently, if SCP holds in the banking industry, such strategies can be promoted.

The EFS and SCP hypotheses diverge on the basis that the causality of market concentration and performance is viewed differently. According to the SCP hypothesis, market concentration is exogenous; however, according to the EFS hypothesis, it is endogenous and dependent on bank efficiency. This means that each hypothesis provides a contrasting view for policy makers. According to the SCP hypothesis, anti-trust legislation would be socially beneficial. However, if the EFS theory predominates, policies that penalise or impair mergers would be socially costly.

As explained by Berger and Hannan (1989), the EFS and SCP hypotheses offer similar observations about the relationship between concentration and performance (profitability). The difference between these two theories mainly centres on ways of interpreting the relationship. Some studies have challenged the acceptability of the positive relationship predicted between market concentration and profitability by SCP. Smirlock (1985) pointed out that there is no relationship between concentration and profitability, but between profitability and market share. He found strong evidence to support the relationship between market share (which was used as a proxy for firm efficiency) and profitability, and showed that market concentration is not a sign of collusive behaviour, but the superior efficiency of leading firms.

Berger and Hannan (1994) pointed out four sources of anti-competitive behaviour that may have arisen as a consequence of high market concentration, namely:

1. a dominant firm in a market, able to set the prices in excess of competitive levels, may put lower pressure on managers to maintain operating costs at or near their competitive level;
2. managers' self-interested behaviour may lead to riskier financing decisions (which may be detrimental to the shareholders' interests) to reduce variation in earnings to protect their positions;
3. an increase in the political cost associated with obtaining and maintaining existing market power; and

4. the retention of inefficient managers or the maintenance of inefficient practices that allow managers to live a 'quiet life' to pursue other objectives or maintain market power gains.

Berger & Hannan's (1994) study presents an alternative to the EFS and SCP called the 'quiet life' hypothesis. It assumes that the managers of firms with relatively large market shares will not attempt to improve the efficiency of the use of resources since they can make adequate profits using their price-setting power (Punt and Rooij, 1999). This hypothesis predicts that large firms in the market use their market power to be 'quiet' in the market and earn profits without improving efficiency.

Early EFS studies used market share as a proxy for firm efficiency instead of direct efficiency measures (Molyneux and Forbes, 1995). However, the firm's market share did not represent its overall level of productivity and efficiency. The first application of direct efficiency measures by Berger and Hannan (1994) captured the effect of all factors influencing a firm's performance.

2.2.2 Measures of market concentration

Variables such as the buyer and seller cost relationship, the degree of product differentiation, market concentration, market share and entry conditions have been used in previous studies to represent market structure (Ashton, 1999). However, the majority of SCP studies have used a concentration ratio to represent market structure. Previous empirical analyses have applied two methods for estimating market concentration:

1. **'k' bank concentration ratio (CR_k);** CR_k takes the total market share of the k^{th} largest bank in the market ('k' denotes the number of banks considered in measuring the concentration ratio). Accordingly, this ratio ignores relatively small banks in the market and uses only selected larger banks in that market (Bikker and Haaf, 2002). CR_k indicates the percentage of a market or an industry accounted for by dominating banks only (Worthington, Briton and Rees, 2004). This ratio can be estimated in different ways, such as the percentage of employment, percentage of production and percentage of sales.

2. **Herfindahl-Hirshman Index (HHI)** [1] **;** HHI defines concentration as aggregates of weighted market shares of individual firms in the market, and stresses the importance of larger banks by assigning them a greater weight than smaller banks. It counts all banks and weights them according to their market share and thereby avoids an arbitrary cut-off level (Bikker and Haaf, 2002).

The literature identifies two major criticisms of the use of concentration ratios to proxy market structure (Hannan, 1997). First, the concentration ratio is dependent on the size and number of firms in the market. Second, it ignores the influence of non-bank financial institutions in the context of banking concentration. Nevertheless, concentration indices such as HHI use weighted averages of market shares, which account for both the size distribution and the number of banks. Therefore, this ratio has often been used as a simple proxy of the market structure in previous research.

2.3 The SCP of the wholesale funding markets

This section deals with the structure, conduct and performance of the WF market. Accordingly, it examines the relative importance of offshore funding to Australian banks, market concentration, forms of products/instruments, factors affecting entry into the market, and syndication/conglomeration aspects. The overall objective of this section is not only to highlight the relative importance of the offshore funding market to Australia, but also to provide a snapshot of how it has become an important element of the Australian financial sector over the last decade or so.

2.3.1 The Australian banking industry

Table 2.1 presents a profile of the Australian banking industry along with key features. Major banks hold over 76 percent of the total banking assets. The other domestic banks (the regionals), credit unions and building societies (CUBs) jointly hold close to 11% of the banking assets, leaving only 13% in the hands of foreign bank subsidiaries or branches. Similarly the majors hold just over 80% of public,

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1 $HHI = \sum_{i=1}^{N} \left(\frac{v_i}{V} \right)^2$,

N = number of firms, v_i = market share of ith firm, V =total market share

Table 2.1: Australian bank characteristics (consolidated data) June 2010

Item	Majors	Other domestic	Foreign subsidiaries	Foreign branches	CUs & BSs
Total assets ($b)	2,486	307	109	305	49
Average deposits ($b)	1,332	130	67	88	42
Net loan to deposits (%)	118.7	123.8	126.3	76.6	92.3
Total deposit/assets (%)	54.8	43.0	62.2	28.6	86.6
Equity/deposits (%)	10.8	22.2	11.9	n.a.	9.8
Number of entities	4	7	9	34	108

Source: APRA (www.apra.gov.au/statistics/ADI-Quarterly-Performance-stististics.cfm)

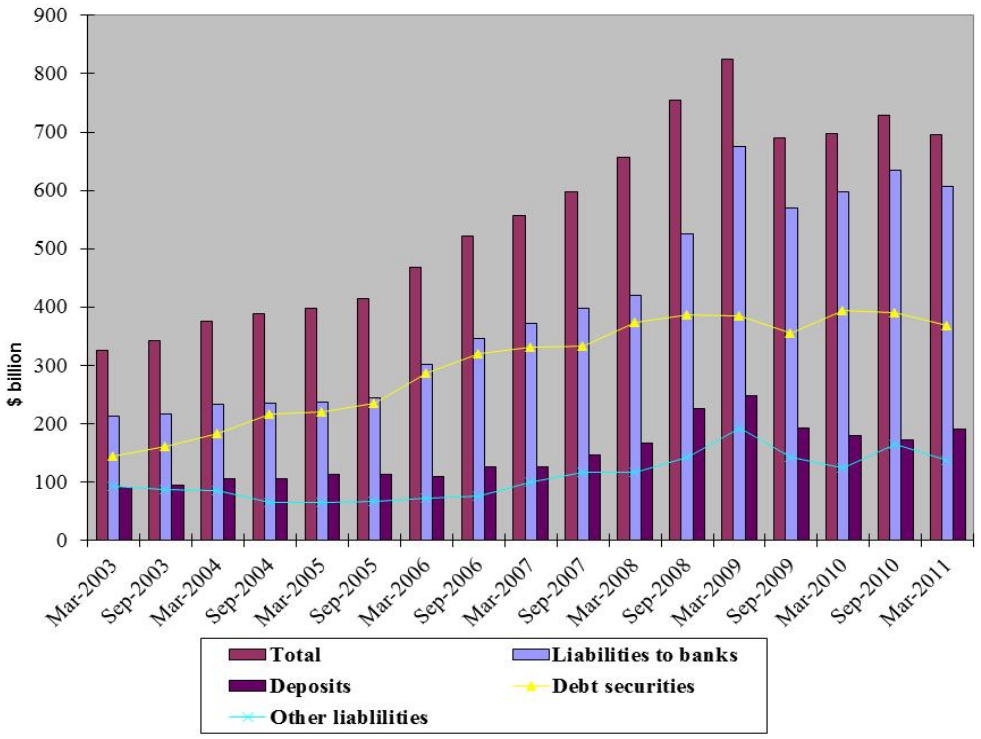
corporate and government deposits, which shows the power of the Australian major banks.

The regional banking sector has become a threat to the major banks by creating an effective network of branches around the continent and by developing a competitive range of products. Until the financial crisis, they too enjoyed credit creation through entry into popular securitisation markets, particularly through the mortgage-backed securities market. However, credit unions and building societies could not make a similar challenge (except for few such as Credit Union Australia and Heritage Building Society) mainly because they purely depended on member funding (86.6% – see Table 2.1). It is often argued that mergers and acquisitions in the mutuals segment of the Australian banking industry would lead to more effective competition in the industry (Garden and Ralston 1999).

2.3.2 Relative importance of offshore funding to Australian banks

Figure 2.2 presents a profile of the foreign liabilities of Australian banks. The overseas borrowings represented by debt securities have been gradually increasing over the last decade.

In particular, Australian banks have increased their offshore funding activities since the financial crisis, benefiting from the sluggish conditions in the global economy. This is also an indication that the Australian banking sector was in a strong position to absorb external shocks after the financial crisis. Figure 2.2 also shows that by



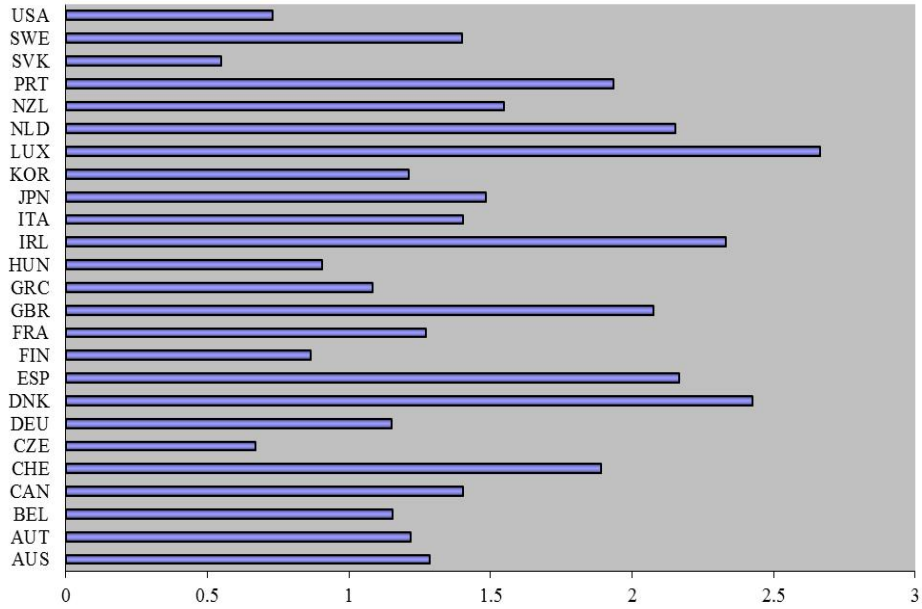
Source: ABS, Australian National Accounts, Financial Accounts

Figure 2.2: Foreign liabilities of Australian banks

March 2011, foreign liabilities of the banks were approximately $600 billion; over 53% of the country's GDP. Notably, the majority of the liabilities were in the form of debt securities.

As mentioned previously, banks in Australia, particularly the top tier banks including four majors, have reasonably diverse funding bases in which 43% is derived from deposits. According to RBA statistics, domestic capital markets provide a further 19% of funding, leaving approximately one third of funding in the hands of offshore capital markets. In contrast to many other developed countries, securitisation and equity imbedded in offshore capital accounted for only 3% and 7% respectively. Since the financial crisis, most of the major banks have emphasised deposit mobilisation, and as a result deposits have increased by 5%.

Figure 2.3 provides a comparative assessment of the strength of the banking sector relative to the economic output of a number of countries. Australian banking assets represent approximately 1.3 times of GDP and sit in the medium range of the group. This shows that the sector maintains a vital role in the economy.



Source: International Monetary Fund: Financial Statistic (2011)

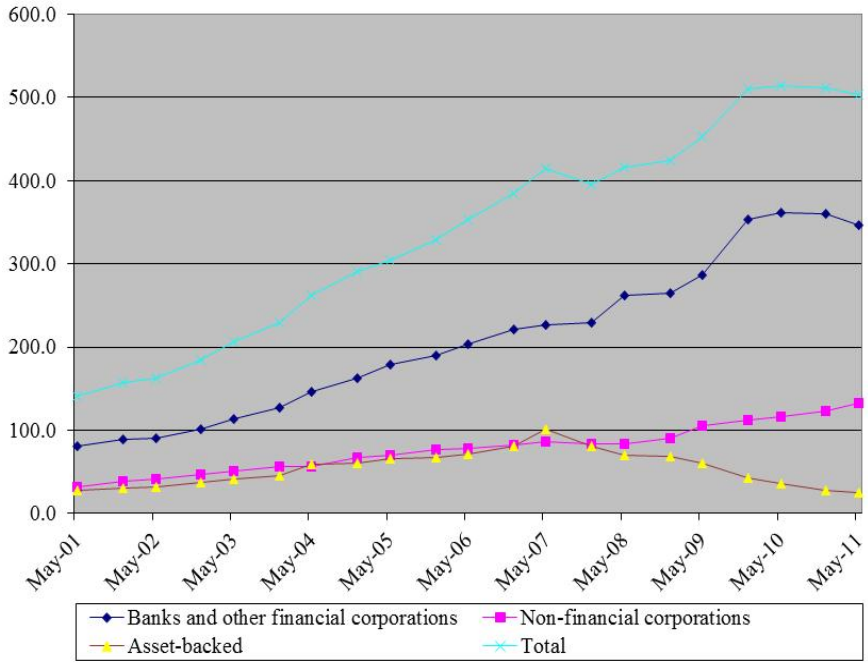
Figure 2.3: Ratio of bank assets to GDP

It is generally believed that Australian banks make less use of deposits than banks in the other countries. However, this is not true for the widely distributed third-tier banking sector which comprises some regional banks, credit unions and building societies. The third-tier banking sector still generates over 80% of their funding requirements from deposits due to lack of access to the sophisticated alternative funding options available to the major banks. It is also important to note that Australian bank deposits also include approximately $100 billion in foreign deposits (see Figure 2.2). According to RBA statistics (RBA: Bank's Financial Statements), this represents over 14% of foreign liabilities. In general, the overall proportion of deposits maintained by Australian banks is consistent with the UK (60%), USA and Germany (56%), but well below the level of Canada (77%) and Japan (69%). Notably, the average ratio of loans to deposits in Australian major banks is 131 (compared to Canada 91, Germany 97, Japan 79, UK 89 and USA 96). This is clearly shows that the Australian banks are underweight on deposits and rely on securitisation and alternative offshore funding.

Changes in the capital inflow can be measured by observing the movements in the balance of payments account. Changes in banks' offshore funding (including changes in capital expenditure) can be monitored through capital inflows and outflows. These

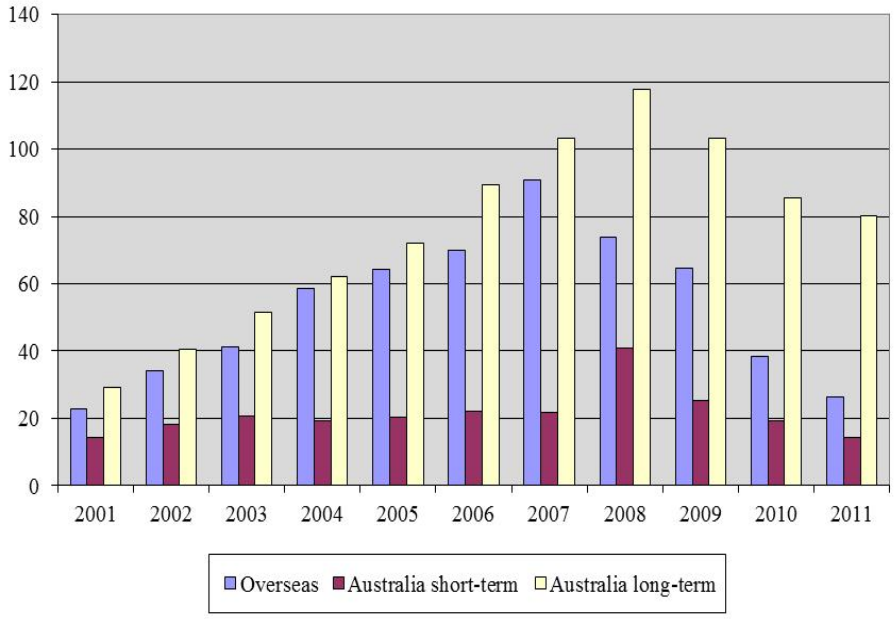
flows can come in the form of debt, or equity or as their derivatives. The most recent BOP account shows that the ratio of foreign investment in Australian equity to Australian investment in foreign equity, is on average, almost 1:1. In contrast, the ratio of foreign investment in Australian debt to Australian investment in foreign debt is 1:2.2. This shows the relative importance of overseas debt for the Australian economy. Furthermore the capital inflows created by Australian banks represents approximately 80% of net private sector inflows (see Figure 2.4). This also shows that offshore funding has become an attractive source of bank funding as it offers a cost effective platform to raise WF from offshore to fund local assets growth.

As can be seen in Figure 2.4, utilisation of offshore funding has somewhat declined in recent years. However, it will continue to be a viable alternative for Australian banks that they may use as an effective tool to counter changing interest rates. Figure 2.4 also shows the reliance of the Australian financial services sector on overseas debt markets with a significant increase in offshore funding volumes, particularly after the financial crisis. Notably, as in many other countries, securitisation (including mortgages) has become a less globally attractive option due to obvious issues with securitisation vehicles in global financial markets.



Source: ABS, Australian National Accounts, Financial Accounts

Figure 2.4: Australian private debts from overseas (in $ billions)



Source: International Monetary Fund: Financial Statistic (2011)

Figure 2.5: Securitisation of bank funding (in $ billions)

Figure 2.5 illustrates the growth of asset-backed securities in Australia. The majority of these securitisation instruments have been derived from mortgages (mortgage-backed securities). Interestingly, Australian banks have been able to maintain a stable level of short–term funding over the last decade. Furthermore, the availability of government-guaranteed funding (government-guaranteed bank debts) has effectively helped them to manage the short-term and long-term funding gap in response to the financial crisis.

2.3.3 Sourcing funds local vs offshore

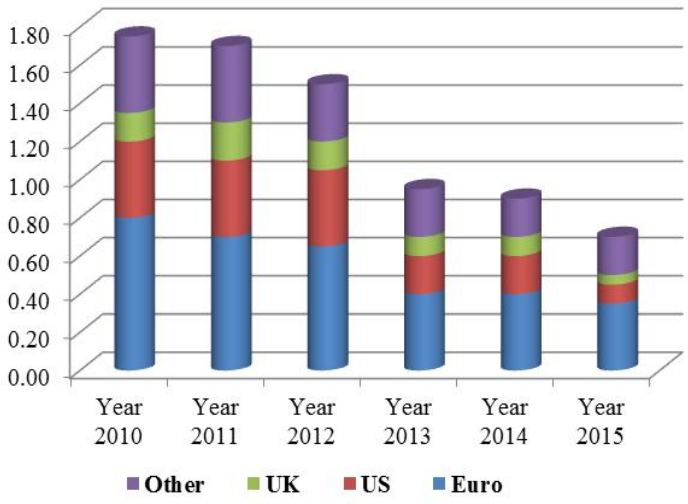
As shown in Figure 2.1, market and cost conditions, economies of scale, number of firms (or providers) in the market, demand and supply condition, and ease of entry and exit are important elements in the SCP approach. It is generally believed that Australian banks are trading at a premium in the sense that they are operating in a sounder market environment than their European and other western counterparts.

In other words, the Australian banks are trading expensively relative to their global counterparts due to a number of reasons. These include a stable and structured oligopolistic market environment, an efficient mortgage industry with traditionally low delinquency rates, increasing population growth which allows banks to

consolidate, and the economy is leveraging during a resources boom at a time when its major trading partners, China and India, are going through a rapid process of industrialisation. This means Australian banks are in a privileged position and can indicate to exporters of capital to Australia that they have a relatively low and stable credit/investment risk.

The recent increases in deposits backed by the government-guaranteed debts option have provided Australian banks with a range of debt options. According to the Reserve Bank of Australia (RBA, Bank's Financial Statements), approximately 70% of wholesale long-term funding is derived from offshore sources. The most important aspect to observe in global markets (particularly in the Euro Zone) is that the risk premium of WF markets is expected to rise. This would considerably affect the cost of offshore funding. Despite the strong performance of the Australian banking sector, banks may not immune to an increasing global credit risk and a rise in cost of funds. This may not only limit the funding options available to banks, but also reduce the effectiveness of expansionary monetary policy with banks not reacting promptly to reductions in interest rates. Figure 2.6 presents the future refinancing requirements of the global banking sector.

Figure 2.6 suggests that there will be an excess demand for debt that may be exacerbated by an increasing demand for sovereign debt from the US and Euro



Source: IMF Financial Statistics

Figure 2.6: Estimates of bank debts by maturity date ($ trillion)

regions. If international capital costs are higher, the local deposit rate must ultimately follow and banks must absorb the squeeze in margins and show little response to expansionary monetary policies. In short, the risk premium in domestic capital markets will flow though to the domestic economy.

2.3.4 Types of wholesale funding

The WF sector comprises a number of instruments such as NCD's Euro commercial papers, European medium term notes (EMTN), bonds, floating rate notes (off balance sheet) and securitisation instruments such as mortgages, margin lending, auto loans and credit cards. Approximately 30% to 40% of total funding is made up of WF for the major Australian banks. According to APRA estimates, the share of funding sourced from long-term wholesale debt (domestic and foreign) for the overall banking system has increased from 7% in mid-2007 to almost 25 percent in 2010 (RBA, 2010). The composition of bank funding in Australia is given in Table 2.2. Accordingly, banks have increased their funding through deposits by up to 50%, but they still rely on non-deposit funding alternatives.

Table 2.3 presents a snap shot of total deposits (household, corporate and government) and the total resident assets of the major banks. Interestingly, for all the four major banks, the deposit to asset ratio ranges from 52% to 56%. In contrast, regionals have maintained higher ratios than the four majors reflecting their high levels of deposit funding.

The composition of Australian bank funding of the four major banks is illustrated in Table 2.4: customer deposits represent approximately 50–60% of their funding.

This highlights the major Australian banks' heavy reliance on funding from short- and long-term WF markets. The excellent credit rating consistently maintained by Australian banks, even at the time of financial crisis, has helped them to use WF as an attractive alternative source.

Table 2.2: Composition of bank funding in Australia (% of funding liabilities)

Category	June 2007	October 2010
Major Banks		
Domestic Deposits	44	50
Short-term capital market liabilities	23	15
Long-term capital market liabilities	21	26
Equity	7	7
Securitisation	5	1
Regional Banks		
Domestic Deposits	39	48
Short-term capital market liabilities	22	13
Short-term capital market liabilities	10	16
Equity	12	13
Securitisation	17	10
Foreign Banks		
Domestic Deposits	26	27
Short-term capital market liabilities	60	53
Short-term capital market liabilities	11	17
Equity	2	3
Securitisation	1	0

Data Source: APRA & RBA

Table 2.3: Major banks: Australian deposits and assets

Bank	Total Deposits	Total Resident Assets	Deposits/Assets
ANZ	194,527	360,592	54%
CBA	288,559	515,805	56%
NAB	216,748	407,793	53%
WBC	276,907	528,148	52%

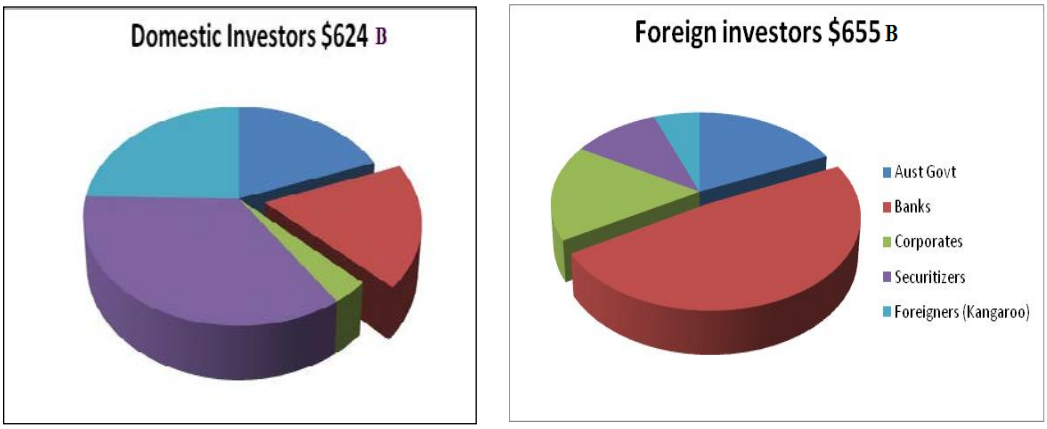
Source: APRA Monthly Banking Statistics, August 2010

Table 2.4: Major bank funding ($ billions)

Item	ANZ	CBA	NAB	WBC
Customer deposits	267	324	353	281
Short-term wholesale	41	101	na	110
Long-term wholesale	116	134	na	114
Total funding (excluding equity)	424	559	na	505
Equity	33	36	39	39

Source: Based on annual reports of banks, 2010

Australian bond issues of 2009 are analysed in terms of the issuers and investor interest in Figure 2.7. It is important to note that figure for foreign investor holdings of foreign issues are only related to Kangaroo Bonds issued in Australia and underestimate a large amount of issuance in foreign markets. However, the figure shows the relative significance of the Kangaroo market. As can be seen in Figure 2.7, government debt issues are equally distributed between domestic and foreign investors.



Source: ABS, Australian National Accounts (Financial Accounts – Cat. No. 5232.0, Sept 2009)

Figure 2.7: Investors and issues of Australian bonds

However, the figures show that a significant proportion of bank and corporate bonds were sold to foreign investors, highlighting the relative confidence of foreign

investors in the Australian bank and corporate sectors. In particular, banks seemed to have benefited from the environment after the financial crisis and managed to raise a substantial amount of funding from foreign markets using the government-guaranteed bond facility (this will be described later in this chapter). However mortgage-backed securities and Kangaroo Bonds were more attractive to the domestic investors.

2.3.5 Australian bond market structure

The effect of the financial crisis over the period from 2007 to 2009 resulted significant impacts on wholesale bonds and other asset-backed securities, particularly mortgage-backed securities (MBS) markets. This has resulted in a heavy burden on government budgets because most of the affected economies introduced various forms of recovery measures such as fiscal stimulation, credit default swaps (CDS), troubled assets relief funding (particularly in the USA) and the creation of government-guaranteed bank-issued bonds (particularly in Australia). The purpose of this section is to describe changes in stocks of debts.

According to the RBA (2011), WF margins of Australian Banks increased significantly during the crisis. For instance, yields on 3-year domestic issued bonds increased from a spread of 50 basis points over Commonwealth Government Securities (GCS) in the years leading up to the crisis, and peaked at 220 basis points (Figure 2.8). Improvements in capital markets at the beginning of 2009 reduced funding spreads to around 100 basis points on 3-year domestic debt issuance, although this was due in part to banks increasing their average tenors from 3 years in 2008 to 4½ years more recently.

Although the main focus of this research is on long-term wholesale debt, it is interesting to note that funding spreads on short-term wholesale debt, which contributes to approximately one-fifth of a banks funding requirements and is mainly priced off 1-month and 3-month bank bill rates increased significantly during the 2008 crisis. In the lead up to the financial crisis, bank bill rates were closely aligned to the overnight indexed swap rate (OIS, a swap rate which predicts the expected cash rate) with an average spread of around 10 basis points. With the onset of the financial crisis, bank bill rates were significantly higher than the OIS rate which

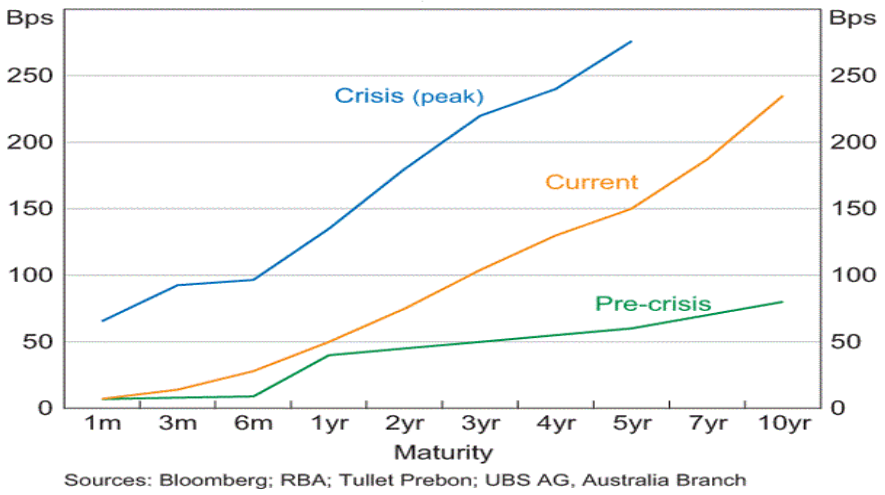


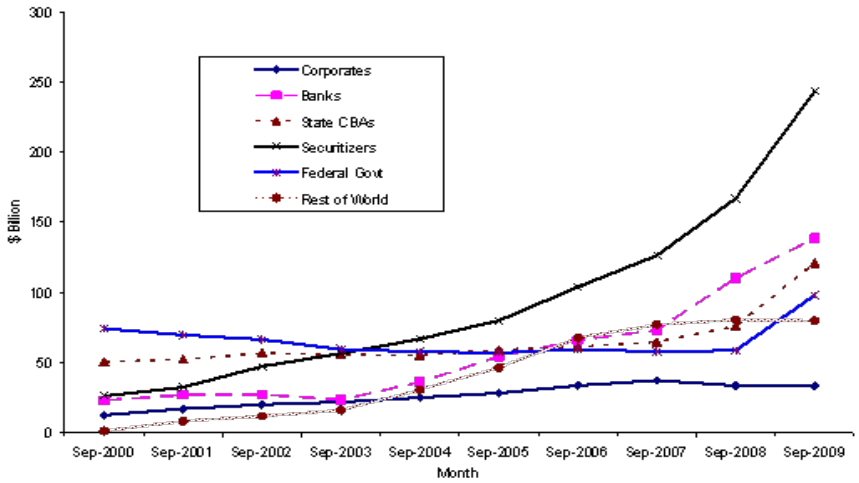
Figure 2.8: Major banks' WF spreads to OIS and GCS

indicates illiquidity within the credit markets. However, in the years after the financial crisis, the spread on bank bill rates to OIS have come back in to pre-crisis levels (Dean & Stewart 2012).

Also interesting to note is although RMBS (residential mortgage back securities) constitutes a negligible share of The Big Four banks' funding requirements, they are however heavily utilised by the second tier banks' as they are a more cost effective funding source compared with long-term WF. This is due in large part to their relative low assigned credit ratings. RMBS funding spreads (usually priced off the 3-month bank bill rate) increased significantly to around 100 basis points over the bank bill rate and has remained at these relatively high levels after the financial crisis.

The Australian bond market represents a large proportion of international funding, with Australian banks raising debt both from the domestic market (domestic investors) and international markets (overseas investors). The issues to investors can be Australian dollars (Kangaroo) or foreign currency denominated (Euro).

Major issuers of Australian bonds over the period 2000–2009 are further analysed in Figure 2.9. It shows the way in which stocks of bonds were issued by various issuers over the period (which also includes the post-financial crisis period). It can be seen that government (both federal and state) debt has been declining until recently. This

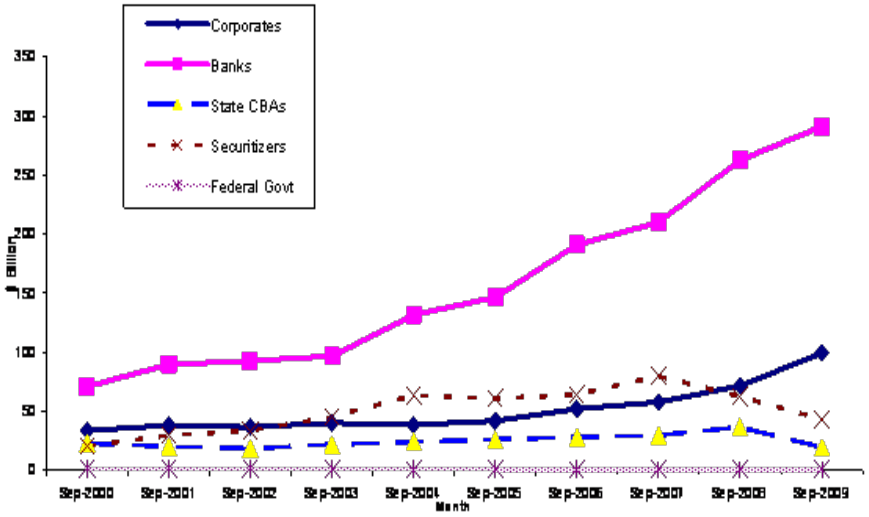


Source: ABS, Australian National Accounts (Financial Accounts – Cat. No. 5232.0, Sept 2009)

Figure 2.9: The distribution of bond issues in Australia

was mainly because government bond issues were performed by the central borrowing authorities (Australian Office of the Financial Management) purely to provide an effective alternative to investors other than capital generating activity, as the government maintained a healthy budget during the earlier part of the 2000–2010 decade. Figure 2.9 also shows the relative growth of asset-backed bond markets (mainly in the form of mortgage-backed securities until 2007, and government-guaranteed bonds thereafter) in the Australian bond market. Kangaroo Bonds grew until the financial crisis and then was the second largest sector of the market until it was surpassed by the banks issuing debt under the cover of the government-guarantee scheme (which will be discussed in the next section).

Figure 2.10 exhibits the time series aspects of the composition of foreign debt issues by Australian fund capital raisers. Notably, the share of bank bond issues has substantially increased over the period, recently accounting for almost 90% of total issues. This is mainly because there were declines in government issues and a slow uptake of corporate issues. The slow uptake of corporate issues is consistent with all other comparable nations. Another reason for this performance is that, unlike in other Western countries, the Australian corporate bond market is small and still evolving. As such, Australian corporates appear to be under-represented in the global corporate bond market.

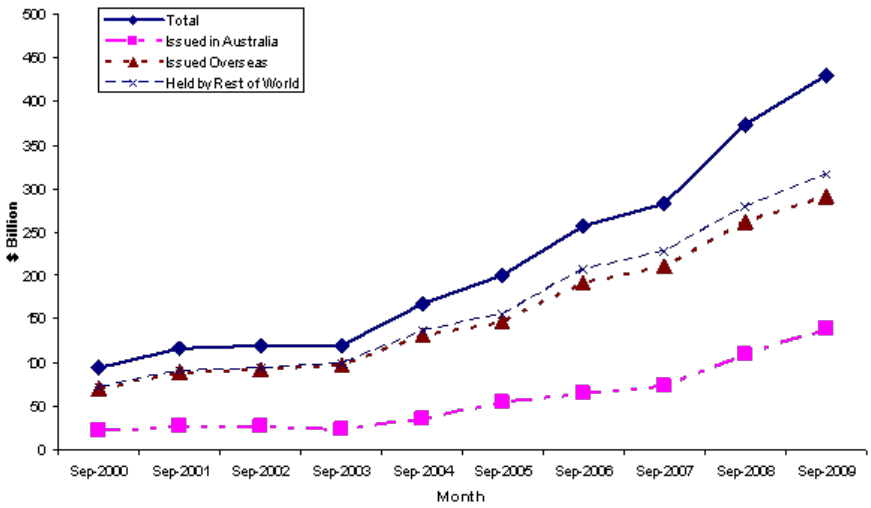


Source: ABS, Australian National Accounts (Financial Accounts – Cat. No. 5232.0, Sept 2009)

Figure 2.10: Australian share of overseas bond issues

2.3.6 Australian banking debt market

Over the last two decades Australian banks have increased their borrowing capabilities from international debt markets, with the four majors relying on the WF market over traditional deposit mobilisation from domestic sources. As a consequence, funding from domestic deposits has become a major activity of the lower tier banks (or mutuals), such as credit unions and building societies. The Australian banks perceived that, with the triple-A credit rating they consistently enjoyed, the relative cost of funding through the international wholesale debt market was cost efficient compared to traditional sources. However, disruption caused by the financial crisis imposed a significant dent on the banks' ability to rely on WF. However, this issue was almost settled within a very short period of time with the introduction of the government's 'economic stimulus package' that included the benefit to the banks from a guarantee over new bond debt issues (at a certain level of fee) that effectively replaced the lack of demand for asset-backed (or mortgage-backed) securities in the market. As a result the trends in debt issues continued to grow both domestically and internationally, while banks were reverting to increasing their share of deposits.

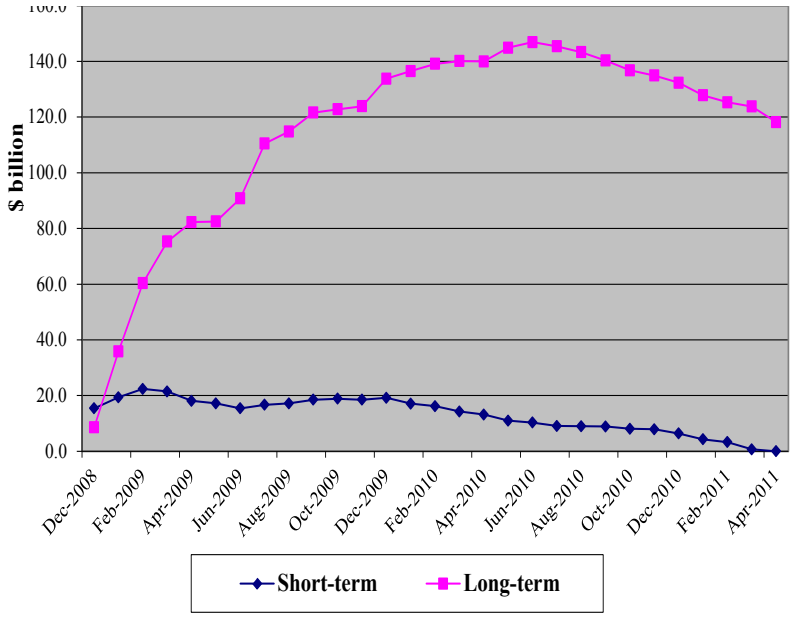


Source: ABS, Australian National Accounts (Financial Accounts – Cat. No. 5232.0, Sept 2009)

Figure 2.11: Distribution of Australian bank debt

As can be seen from Figure 2.11, total bank debt has steadily increased since 2003 in all categories. In particular, the post- financial crisis period can be seen as a period when banks increasingly sourced funds from debt markets. This was mainly because the government-guarantee scheme provided an attractive alternative to recoup the losses from funding through securitisation vehicles.

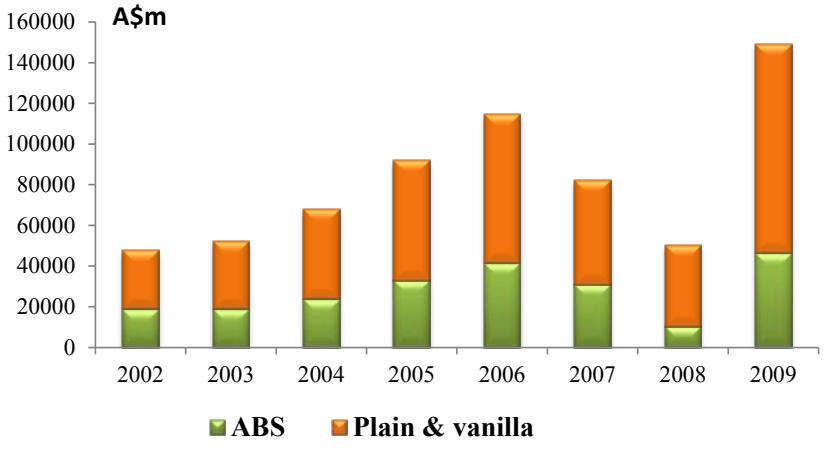
Although the four majors have benefited mostly from the scheme, other banks, including subsidiaries of foreign banks, have been able to raise their Australian funding requirements. The popularity of the relative utility of the facility can be seen in Figure 2.12, noting that in December 2008 the total funds raised increased from $45 billion to a peak of approximately $170 billion in February 2010. Interestingly, the scheme also provided the government with an alternative source of income through guarantee fees. For instance over $113 million was paid as monthly guarantee fees on a total of $169.4 billion outstanding debt at the end of February 2010. This amount translates to approximately 80 basis points for the average fees across all borrowers. (Note the basis for fees was set as 70 basis points for AA rated borrowers, and 100 for A rated borrowers with 130 basis points set for BBB borrowers.) Better rating of the four major banks helped them to get most of the benefits from the scheme. The government guarantee on short-term debt instruments was removed in April 2011. It is also important to note that, under the stimulus package, the guarantee was also extended to bank deposits held in Australia.



Source: http://www.guaranteescheme.gov.au/liabilities/summary-info.html

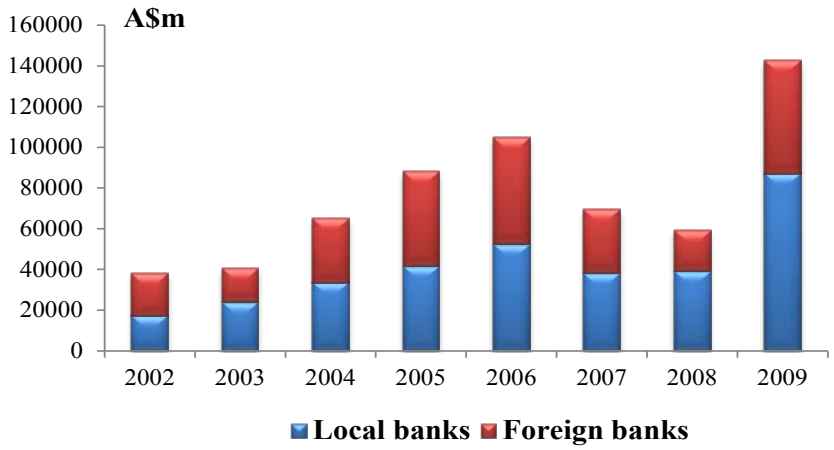
Figure 2.12: Amount of government guarantees

The following section profiles Australian bank debt with particular interest in the bond issues. Figures 2.13 and 2.14 provide a profile of Australian bond issues.



Source: Insto Database (2011)

Figure 2.13: Australian debt issues by type

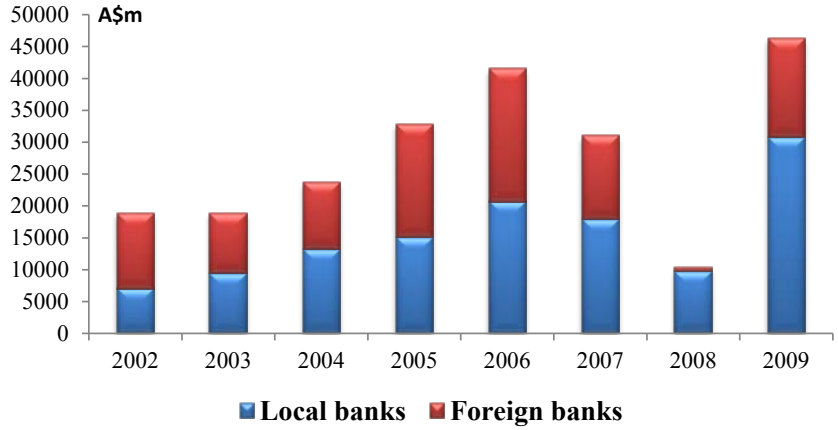


Source: Insto Database (2011)

Figure 2.14: Australian debt issues by banks

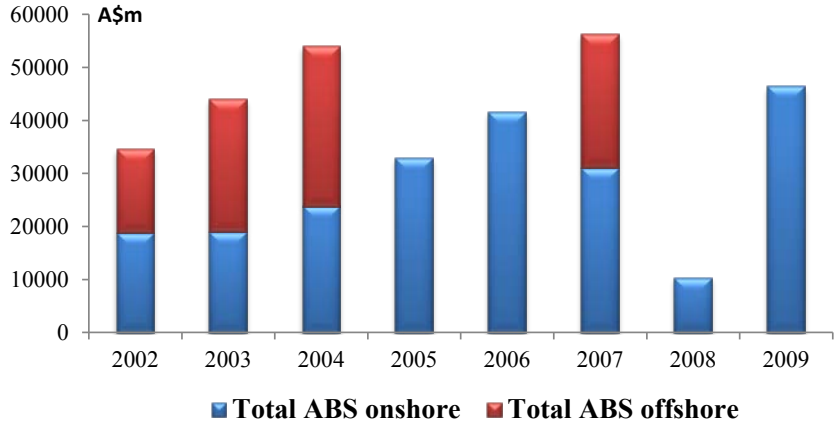
As can be seen from the figures, Australian banks, including subsidiaries of foreign banks, have been able to continually raise funds in the difficult market conditions following the financial crisis. Although there was a slight slump in debt issuance in 2008, the government guarantee introduced in 2008 helped the banks to change subordinated debts (assets-backed securities (ABS)) from the majority of mortgage-backed securities (which includes residential mortgage-backed (RMBS) and commercial mortgage-backed securities) to government-guaranteed securities. Note that data on ABS in Figure 2.13 include bond issues under government-guaranteed bonds. Similarly, Figure 2.14 shows that both domestic banks and subsidiaries of foreign banks managed their debt issuance effectively after financial crisis. However, the subsidiaries of foreign banks were less effective than their local counterparts when competing for domestic debt (see Figure 2.15). However, since the extension of the government guarantee to subsidiaries of foreign banks operating in Australia, they have been able to attract investment from domestic investors.

Figure 2.16 presents the distribution of ABS between onshore and offshore investors. Interestingly, there was no demand for Australian ABS by foreign investors in the two years prior to and after 2007. This may have been due to the volatile situation that prevailed before and after the financial crisis. However, this cannot be said for the plain and vanilla bond issues of Australian banks, which progressed steadily after a brief slump in 2007 (Figure 2.17).



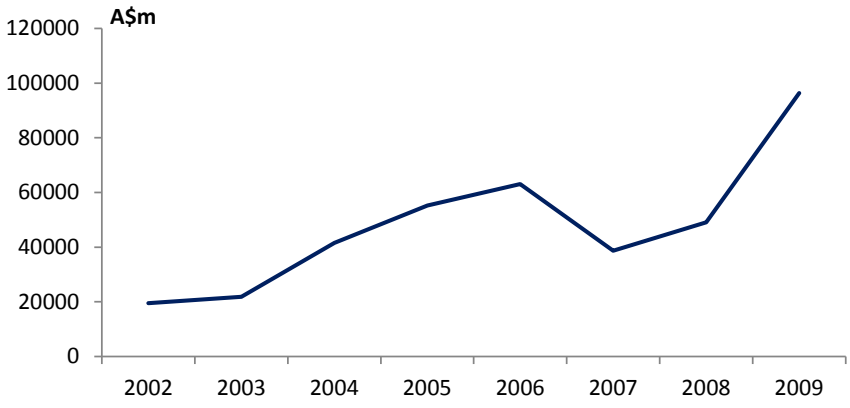
Source: Insto Database (2011)

Figure 2.15: Australian domestic debt issuances by banks



Source: Insto Database (2011)

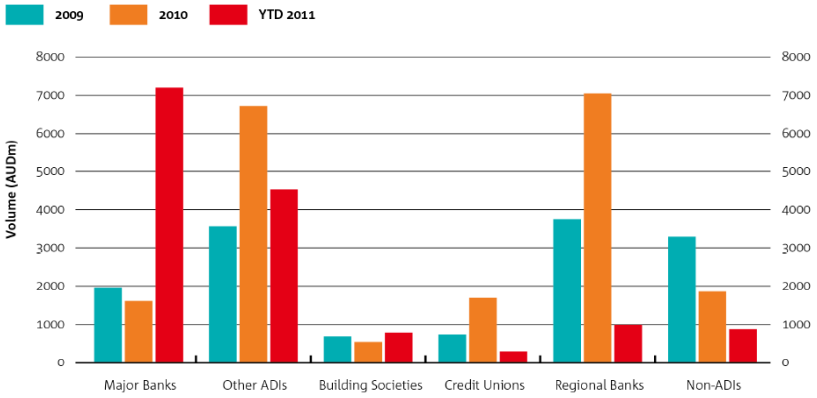
Figure 2.16: Demand for Australian ABS



Source: Insto Database (2011)

Figure 2.17: Total issuances of Australian plain & vanilla bonds

The winners and losers of the RMBS market after the financial crisis were evident in Australia. The loss of investor appetite for RMBS was felt largely by Australian regional banks, as well as the mutuals such as credit unions and building societies, due to their relatively low credit rating. However, they have all recovered since 2009 (see Figure 2.18).



Source: Insto Database (2011)

Figure 2.18: Issuance of RMBS by Australian financial institutions

As mentioned before, the Australian corporate bond market is somewhat weak compared to its counterparts in Western countries. The corporate sector of Australia is struggling to use capitalisation through debt markets even though it is vital for the growth of the corporate sector as well as the financial services sector. This has been a common feature of Asian capital markets in general. High relative credit ratings enjoyed by Australian banks and relative weakness in corporate debt markets can explain why Australian debt issuances are heavily dominated by financial institutions.

2.4 Conclusion

The purpose of this chapter was to provide a comprehensive overview of the WF market from global and Australian perspectives. This chapter covered the factors leading to the development of WF markets, including their structure, conduct and performance, and provided an overview of the size and scope of WF, focusing on Australian banks. From the information provided in this chapter on the size and

scope of the Australian bond market, it is evident that market growth has been dominated by bank-issued debt instruments and until the financial crisis, by the growth of securitisation and issues of Kangaroo Bonds. Banks were able to recover from the post-financial crisis funding slump by taking advantage of the government guarantee. Due to the strong performance of Australian banks, the relative supply of AAA rated Australian debts has increased substantially over the post-financial crisis period. The potential impediment of bank funding through Residential Mortgage Backed Securities (RMBS) was overcome with an effective government-guaranteed bond mechanism.

Domestic investors have rallied around local debt issuers. A substantial proportion of these investors include domestic superannuation funds and other institutional investors who reported negative earnings in their foreign investment portfolios after the financial crisis. With growing investment by domestic fund managers, the self-managed superannuation industry domestic debt market is also expected to be very prominent in the bank debt market.

Chapter 3

Bond Issuance Process

3.1 Introduction

Chapter 2 provided a comprehensive overview of WF markets from global and Australian perspectives. It covered the factors leading to the development of WF markets, including their structure, conduct and performance, and gave an overview of the size and scope of WF, focusing on Australian banks. The purpose of this chapter is to provide an overview of the bond issuance process to elucidate the researcher's understanding of the practical environment of the issuance process adopted by Australian banks. In particular, this chapter details the analysis, procedures and capabilities required for successful wholesale debt issuance in an Australian setting. Prior to examining these complexities it is prudent both to lay conceptual foundations and survey the evolving Australian debt market landscape.

3.1.1 Definition

A bond or more commonly, referred to as a note, is a contract that facilitates the payment of interest and repayment of principal. It is a financial debt instrument certifiing a contract between the borrower (bond issuer) and the lender (investor) as spelled out in the bond indenture creating a legally enforceable obligation and may be ranked according to its seniority (senior or subordinated) outlined later in this chapter. Investors evaluate the risk that the company issuing bonds will fail to meet its payment schedule, and jointly price this into the issue; the returns received by bondholders can be understood as the cost of this capital to the company. The issuer (bank, company, government, state government, council) promises to pay the bond's principal (par value of the bond) to the bondholder on a fixed date (maturity date) as well as interest (fixed or floating) for the life of the bond. As mentioned in the previous chapter, a majority of domestic Australian bank wholesale debt is priced on

the 90 day BBSW plus a margin dependent on the level of both sytematic and non-sytematic risk.

Bonds can be issued at a price lower than their par value in lieu of the periodic interest. On maturity the full par value is paid to the bondholder. Bonds are issued in multiples of $100 or $1,000, usually for periods of two to twenty years. Most bonds are negotiable, and are freely traded over security exchanges such as the ASX. Their market price depends mainly on the rating awarded by bond rating agencies on the basis of issuer's reputation (assigned credit rating) and financial strength. Investment in bonds offers two advantages: (1) known amount of interest income and, unlike other securities, (2) considerable pressure on the company to pay because the penalties for default are drastic. The major disadvantage, particulary investing in government bonds is that the amount of income is usually fixed and thus may be eroded by inflation. Companies use bonds to finance acquisitions or capital investments. Governments issue bonds to fund long-term capital projects, or to raise money for special situations, such as natural calamities or war.

3.1.2 Role of the cost of capital

Maximising shareholder value is a fundamental tenet of corporate management and this is achieved when the company's cost of capital is minimised. The major sources of bank capital are deposits, wholesale debt and equity. The broadly accepted standard for calculating total financing costs across debt and equity classes is the Weighted Average Cost of Capital (WACC), which can be determined using the following formula:

$$WACC = \frac{D}{D+E} \cdot K_d + \frac{E}{D+E} \cdot K_e \qquad \textbf{\textit{Equation 3.1}}$$

where D is total market value of debt, E is total market value of equity, and $\boldsymbol{K_d}$ **and** $\boldsymbol{K_e}$ are the respective costs.

The pre-issuance analysis (detailed in Section 3.2), undertaken when assessing whether bonds should be issued, fundamentally seeks to determine which sources of funding will minimise the WACC across time, while facilitating the desired business strategy.

3.1.3 Corporate debt in Australia

Australia's private corporate bond market has grown considerably since the early 1900s and has been significantly affected by regulatory changes including the:

- removal of interest rate controls on banks in 1973
- Australian Dollar being floated in 1983
- abolition of capital controls in 1983
- granting of foreign banking and exchange licenses in 1984 and 1985
- introduction of the compulsory 'Superannuation Guarantee' in 1992.

The access to international markets facilitated by this deregulation is clearly illustrated in Figure 3.1 by the growth in offshore corporate bond issuance, which has exceeded the onshore market since 1986.

Figure 3.2 illustrates a segmented breakdown of this growth and reveals Australian banks to be a key driver: approximately 50% of total bond issuance was attributable to them in the 1980s, with this figure rising close to 75% in recent years. Stemming from the aforementioned deregulation, the shift in Australian banks from asset management to liability management (Battellino and McMillan 1989) resulted in the expansion of balance sheets, and a transition from the extensive reliance on deposit funding to the utilisation of capital markets.

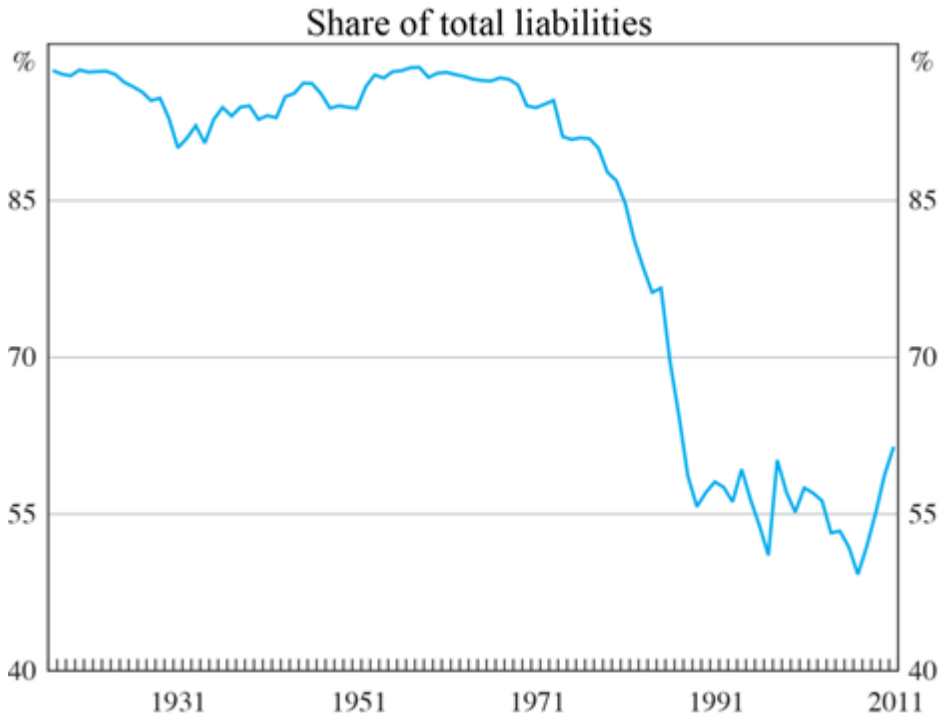


Figure 3.2: Australian bank deposits

3.1.4 Big Four bank WF strategies

The funding strategies of Australia & New Zealand Banking Group (ANZ), Commonwealth Bank of Australia (CBA), National Australia Bank (NAB), and Westpac Banking Corporation (WBC) (called the Big Four) are extremely similar in principle. The following two guiding principles underpin the long-term approach of the Big Four:

- Achieve diversity of funding across currency, maturity, investor type, markets (retail and wholesale), geographical location and debt product types.
- Inform and support investors to maintain an international profile through deal and non-deal roadshows, active relationship management, and transparency.

Collectively these achieve liquidity and pricing efficiency, and are expressly recognised in the following strategic outline excerpts.

Australia & New Zealand Banking Group

'The cornerstone of ANZ's funding strategy is to meet all funding requirements in a manner that achieves diversification by product, currency, geography and tenor, while maintaining a stable and prudent maturity profile.'

'ANZ aims to build liquid yield curves in its core funding currencies via regular, but not frequent benchmark issuance in AUD, USD, JPY and EUR.'

ANZ 2013, viewed 15th July 2013, <http://www.anz.com.au/>.

Commonwealth Bank of Australia

'Our strategy is to ensure sufficient, cost-effective and sustainable funding in the long term to meet the ongoing liquidity needs of the Commonwealth Bank Group and to satisfy the prudential requirements imposed by management and monetary authorities. This strategy is supported by regular calling programs and roadshows to ensure the Bank's international profile is maintained and its credit strength is well understood by investors and intermediaries.'

Commonwealth Bank of Australia 2013, viewed 15th July 2013, <http://www.CBA.com.au/>.

National Australia Bank

'The Group's WF objectives are to provide a structurally sound balance sheet whilst providing cost-effective funding to NAB's general banking business and its member banks.'

'The group's business activity and growth is funded through a prudent mix of WF across maturity profiles, geographies and investors.'
NAB 2013, viewed 15th July 2013, <http://www.nab.com.au/>.

Westpac Banking Corporation

'Westpac's WF strategy is focused on building a strong funding profile and broad investor base that will provide the bank with stable and efficiently priced WF within the parameters of prudent liquidity management.'

'Maintaining funding diversity is a key element of the bank's funding strategy.'
'In managing its funding programmes, the Group takes a long term approach ensuring investors remain fully informed and supported.'

Westpac 2013, viewed 15th July 2013, <http://www.westpac.com.au/>.

3.2 Pre-issuance analysis

The increasing adoption of WF by the Big Four indicates that it has continued to add value to their operations; this section considers the investigative steps that should be taken in determining whether bond financing is desirable.

3.2.1 Selecting advisors

Issuers may retain an underwriter, financial advisor, law firm or accounting firm as early as pre-issuance analysis if they require assistance during this phase. This is important to acknowledge upfront because the issuer may outsource the analysis

contained in the following sections, or associated considerations such as the tax implications or legality of an approach.

Even in instances where companies complete all analysis in-house, most will need external advisors to execute their desired strategy. Due to the Big Four banks' size and dedicated internal debt markets divisions, they often issue directly to investors domestically, but require the services of an investment bank when issuing overseas.

3.2.2 Corporate finance analysis

The first step in raising new capital is to determine the amount of external funding needed and the timeframe within which it is required. The company must then assess whether the projects to be financed are sound investments in the prevailing market climate, as they must be confident that the internal rate of return will exceed the borrowing cost. Most companies are unable to internally generate sufficient operating income to fund all desirable ventures and therefore must either miss opportunities or rely on external sources to fill this financing deficit. The following two analytical tools may be used to inform a company's assessments.

Cash flow forecasting

This tool allows the company to estimate their major expenditures and investments up until a specified a date, and from this approximate the amount of funding required and the deadline for securing it. In accordance with the maturity matching principle, the company categorises funding requirements according to their lifespan and seeks to utilise a funding source that matches this. Generally funding requirements can be categorised into one of the following three groups:

- **long-term,** used for core assets such as land, equipment, and buildings
- **medium- or short-term,** used to fund cyclical variations and lump sum payment obligations
- **contingency,** used to meet unforeseen requirements such as unexpected opportunities and downturns.

A cash flow forecast is only informative, however, to the extent that the inputs provided by management are objective, accurate and comprehensive. This can be problematic where management is pressured by incentives to meet goals or to

demonstrate that objectives are within reach. In ensuring completeness, the forecast should always include:

- Operating cash flow: cash a firm generates from revenue excluding costs related to long-term investment on capital items or investment in securities.
- Estimated capital expenditure: funds utilised by a firm for investing in fixed assets.
- Tax payments: payments to the Australian Taxation Office of 30% of a firm's operating income less interest expense.
- Principal repayment on loans: the return of investment capital to the lender.
- Existing interest payments: the liability incurred by a firm for borrowed funds. Interest expense is a non-operating expense. It is interest payable on any type of loans; notes, bonds, debentures, convertible debt or lines of credit.
- Payment and receipt of dividends: a percentage of a firm's net income paid out to ordinary shareholders. For the Big Four banks this usually represents up to 70% of their net income.

New funding sources, however, should not be included within the forecast unless it is absolutely certain that they will be obtained.

Capital structure planning

Capital structure refers to the composition of a company's funding sources, a combination of debt, equity and hybrid securities. The optimal capital structure is a combination of these that allows profitable projects to be undertaken and long-term survival of the organisation at the lowest WACC across time. The following interrelated factors may significantly impact a company's optimal capital structure:

- **Management preferences includes the following:**
  Owners retain more control through debt (as opposed to equity) financing, as no ownership interests in the company are transferred.
  Risk-tolerant managers can handle higher levels of debt, which creates financial risk through the possibility of default.
- **Regulatory considerations includes the following:**

Bankruptcy law sets the seniority of stakeholder claims and imposes financial incentives to avoid insolvency, which simultaneously makes equity financing more expensive and less risky for the company.

Tax law may allow deductions for certain sources of funding, which effectively lowers their cost to the company by creating a tax shield.

- **Business risk includes the following:**
  This is a measure of the fundamentals of the business including its sensitivity to macroeconomic, technological and regulatory changes, its power over suppliers and consumers, and the degree to which its products or services are diversified.

- **Financing alternatives includes the following:**
  A comparison of the availability, after-tax cost, and fit of financing alternatives to the firm's projects will influence which instruments they pursue, and hence alter the composition of their capital structure.

The mechanics of this investigation are explored below.

3.2.3 Assessing funding sources

The availability and attractiveness of equity and debt funding sources fluctuate. Extreme examples can be seen in comparing initial public offerings during and following the dot-com bubble, and residential mortgage-backed securities during and following the 2007 financial crisis. Excluding internally generated funds (a surplus of cash generated from operations), the funding sources available to a company are:

- equity instruments, which sell an ownership interest in the company
- debt instruments, which borrow today and require fixed future repayments
- hybrid instruments, which have characteristics of both debt and equity.

These sources can then be further divided into the type of market in which they are offered (private versus public) and the geographical location of that market. Private placements involve issuing securities to institutions or high net worth individuals, which generally saves on due diligence and disclosure costs, but often requires a higher yield to be paid due to the lack of liquidity.

An evaluative framework

When comparing the myriad funding variations, the cost of funding across time and the ability of the firm to provide the necessary returns to investors are the core considerations. Considered in isolation this is deceptively simple; as demonstrated below, a thorough solution for these criteria requires extensive and rigorous analysis.

1. Cost and availability over time

This first requires the basic terms of the deal to be considered:

- assess the specific terms of the instrument such as whether it imposes covenants, and whether it is convertible, redeemable, or cumulative
- approximate the after-tax funding cost of the source.

Following this, the sensitivity of the product to external factors, and outlook for those factors should be assessed. Many of the following variables will significantly influence the cost of funding sources over time, especially when the security is issued into a foreign country:

- interest rates
- exchange rates
- tax costs
- industry trends
- regulatory changes

Having investigated the potential impact of these factors, the company is in a position to evaluate the likely financial and opportunity costs of alternatives.

2. Repayment schedule

In compiling the likely cost of various funding sources, the prospective issuer has gathered the rate of return required by various classes of investors. These rates implicitly indicate how uncertain the market is about the cash flow to be received by investors: higher risk must be compensated by higher return. The firm, however, possesses much 'insider information' about prospective projects and accordingly must assess their ability to make repayments independently from market sentiment. Specifically, the issuer should map which project cash flows will be used to make repayments to investors, and assess how much flexibility

the firm requires. As stated, the maturity of the funding source and project are often matched to reduce uncertainty.

Common funding alternatives

Table 3.1 sets out the most common funding alternatives, the availability of each of these is country and market specific.

3.2.4 Internal management analysis

In addition to analysing project cash flows and prospective funding sources, the issuer must ensure that it has the capability to manage both the issuance and the ongoing responsibilities. The company's finance department must promptly meet debt payments without compromising operations, and (if a public issuance) continually disclose company information to the public. Internal legal staff may also be required to ensure compliance with any covenants or regulatory requirements.

Table 3.1 Common funding alternatives

Short-term	Debt	Trade credit
		Unsecured bank debt
		Line of credit
		Revolving credit facility
		Commercial paper
		Short-term secured loan
		Finance company
		Export finance
Intermediate or Long-term		Term loan
		Receivables finance
		Leasing
		Project finance
		Government finance
		Commercial mortgages
		Private debt securities
		Publicly placed debt or bonds
	Hybrid	Hybrid securities
	Equity	Privately placed equity securities
		Public placed equity

3.3 Structuring the issue

This section steps through the pre-transaction process for structuring the issue.

3.3.1 Appointing advisors

As stated in section 3.2.1, much of the analysis discussed in the previous section can be outsourced to advisors. Detailed below is an outline of the key advisors that an issuer may hire, the functions that they perform, and their fee structure.

Financial advisor

This role can be performed by an investment bank or specialised smaller firms who focus on advisory work; the essential characteristics of an advisor are expertise and integrity. The financial advisor may help the issuer structure the terms of the deal, prepare disclosure documents, and solicit bids from underwriters. In many instances firms will simply obtain these services directly from the underwriter.

Given that good advice requires an intimate knowledge of the issuer's business, these relationships begin with a confidentiality agreement. There may also be an exclusivity arrangement with the advisor, which prevents the issuer from executing the deal with another firm.

A percentage of the issue price, known as the 'underwriting spread', is set aside to compensate the advisor and underwriter. Approximately 20% of this is usually paid as a management fee for designing the issue and managing the process.

Underwriter

An underwriter is an entity that purchases the bond issue and resells it publically at a mark up, carrying the risk that the market will not purchase at the offering price. Despite this, the term has been extended to include situations where the entity markets and places the bonds without committing to a purchase, which is known as 'best efforts underwriting'.

Prospective issuers may hold a 'beauty contest' to interview a range of firms prior to making a selection, which often results in some free advice as firms strive to prove their understanding of the company and industry dynamics.

Where the underwriter makes the purchase and takes the risk, approximately 20% of the underwriting spread is paid as an underwriting fee; for sales and placement efforts, 60% of the spread is awarded as a selling concession.

Legal counsel

In addition to in-house legal representations, issuers usually retain an external firm that specialises in debt issuance. This firm works with the underwriter in structuring the transaction, particularly on the compliance with disclosure requirements and

taxation laws, and may be asked to provide an opinion on the legality of the issue. In Australia fees are charged at hourly rates that increase with seniority and expertise.

As more details of the transaction are decided upon, in-house and external legal counsel can begin preparing the documentation required to meet the relevant securities commission and securities exchange application requirements. The following documents (or similarly named equivalents) are likely to be required; requirements specific to Australia are detailed section in 3.3.3 in this chapter:

- corporate documents
  - certificate of registration
  - certified company constitution
  - board of directors resolution to issue
- indenture
  - this contract sets out the terms of the bond (see the following section) and a summary is provided in the information memorandum.
- for secured issues
  - security/pledge agreements
- disclosure documents
  - prospectus or short-form prospectus
  - information memorandum
  - audited financials
- underwriting agreement and syndicate agreement
  - these contracts set remuneration and allocation procedure terms between the issuer and underwriter, and between the underwriter and syndicate group respectively.

External auditors

For both public and private placements three to five years of audited financials are usually required, for which a flat fee is often charged. In addition to this, large international accounting firms are often utilised for cross-boarder taxation advice, which attracts an hourly rate.

3.3.2 Bond design

Many characteristics of bonds are customisable and can be tailored to achieve the issuer's objectives; the following elements can all influence the cost of funding.

Principal amount

While ideally the amount should reflect the funding required, market sentiment may affect the size of the issue. Larger markets generally seek sizable principal amounts to generate liquidity, and may accordingly require a premium for smaller amounts, whereas smaller markets are often unable to absorb a large amount.

Par Value

The amount to repaid on maturity is usually standardised at $1000 or $100, but may exceed this significantly in private placements.

Maturity

In accordance with the maturity matching principle, firms should seek to match debt repayments with project cash flows, both for ease of payment and to minimise interest rate risk. One notable exception to this is firms in a volatile environment, which may benefit from short-term maturity and future reconfiguration as circumstances change.

Coupon rate

This can be a fixed interest rate set at the time of issuance, a floating rate that periodically resets relative to a base rate, or feature no coupon and be sold at a discount to par value.

Currency

Debt is often issued in the same currency as the cash flows that will service the debt, to avoid exchange rate risk (or the need for further financial products to mitigate this). Other considerations include whether the markets are deep enough to support the required funding, and how attractive the cost of funding internationally is.

Redemption

A call provision gives the issuer the option to redeem part or all of an issue prior to maturity, at a specified date and price. While this gives the issuer the ability to refinance in the event that interest rates drop, the risk this poses to investors must be compensated by a higher yield.

A put provision allows bondholders to redeem the bond on designated dates for the sum of face value and accrued interest, which is compensated by lower yields.
Extraordinary redemption provisions allow the issuer to redeem bonds when a specified extraordinary event occurs, for instance, when a natural disaster destroys the project being financed.

Convertibility

These provisions give the bondholder the right to convert the bond into a defined number of common shares. This allows the investor to benefit from the issuer's ongoing performance as it effectively embeds two call options into the bond, one on the stock, and the other on the bond itself.

Covenants

These contractual terms protect the interests of bondholders by restricting or requiring certain actions. Powerful covenants can increase the credit rating of an issue and in turn produce lower borrowing costs.

Security

Corporate debt can either be secured or unsecured, if secured it means that collateral is held to ensure that the debt is repaid. Figure 3.3 details some basic alternatives for how a bond may be secured; note debentures in some markets refer to unsecured bonds and in others are a broad term for debt securities.

Seniority

In the event of liquidation, the seniority of debt determines the order in which creditors receive the company's assets; more senior debt is refunded first. Seniority reduces the funding cost and subordination (the opposite of seniority) increases it, because these modifications decrease and increase risk to investors respectively.

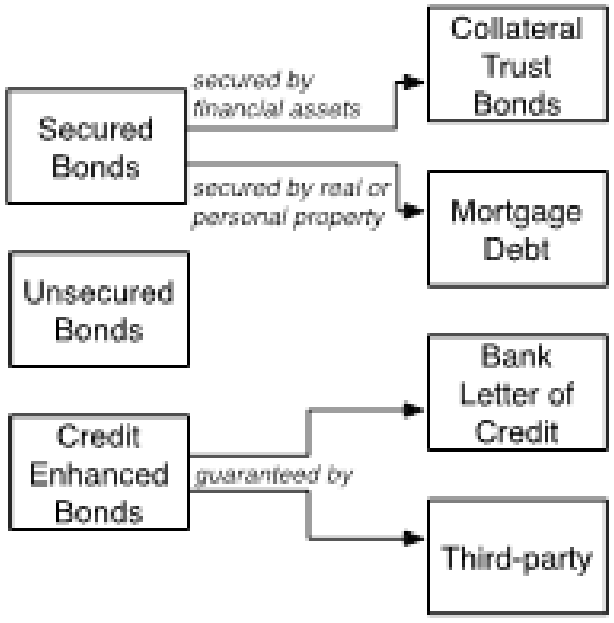


Figure 3.3: Bond Seniority

3.3.3 Regulatory limitations

Quotation requirements in Australia

The legal requirements to issuing debt vary significantly between jurisdictions. An overview of the core Australian Securities Exchange (ASX) requirements is provided below as an example of the hurdles an issuer is likely to face.

Listed entities must comply with the ASX Listing Rules, the offers of debentures requirements of Chapter 2L of the *Corporations Act 2001* (Commonwealth) and the fundraising provisions of Chapter 6D of the Corporations Act. Companies incorporated overseas must appoint a local agent, and be registered under the Corporations Act as a foreign company.

The ASX provides facilities for both retail and wholesale listings: the former are quoted through the ASX Interest Rate Securities Market, and the latter are listed but not matched (brokers must contact each other independently, mirroring the over-the-counter process). The basic requirements for quotation are:

- The aggregate face value of securities must be greater than or equal to $10m. For wholesale issues individual sales must be greater than or equal to $500,000.
- The issuer must provide the ASX with the offering documents.
  - This will usually involve a prospectus and information memorandum for retail issues, and likely a deed poll for wholesale issues.
- The issuer must satisfy clearing system requirements, including paying the fees for the settlement system used.
  - The CHESS system is used for retail issues and the Austraclear system is (most often) used for wholesale issues.
- ASX listing fees are paid (see ASX Guidance Note 15 and 15A).

Capital adequacy requirements

As Australian banks are Authorised Deposit-taking Institutions for the purposes of section 9 of the *Banking Act 1959* (Commonwealth), they are subject to the Capital Adequacy requirements set by the Australian Prudential Regulation Authority. Standards such as APS110 impose minimum prudential capital requirements (PCRs) that require banks to hold types of capital equal to percentages of their 'risk-weighted assets'. While an extensive discussion of these elements goes beyond the scope of this thesis, such requirements may limit the funding options available to a bank.

US Private Placements (Rule 144A)

This option is particularly popular with Australian businesses that have infrequent long-term funding needs, lower ratings and no need to hedge out the exchange rate risk of the US Dollar. For Australian financial institutions this is a comparatively minor funding source: the Reserve Bank of Australia has indicated (based on 2004 estimates) that this market accounts for only 6 per cent of financial institutions' outstanding offshore securities.

The distinguishing feature of the 144A market is that investors are all 'Qualified Institutional Buyers' (QIBs) who form an exclusive secondary market. This removes many onerous disclosure requirements, but still requires statements of the issuer's

business (products and services), at least two years of financial statements, and two credit ratings for the bonds prior to issue.

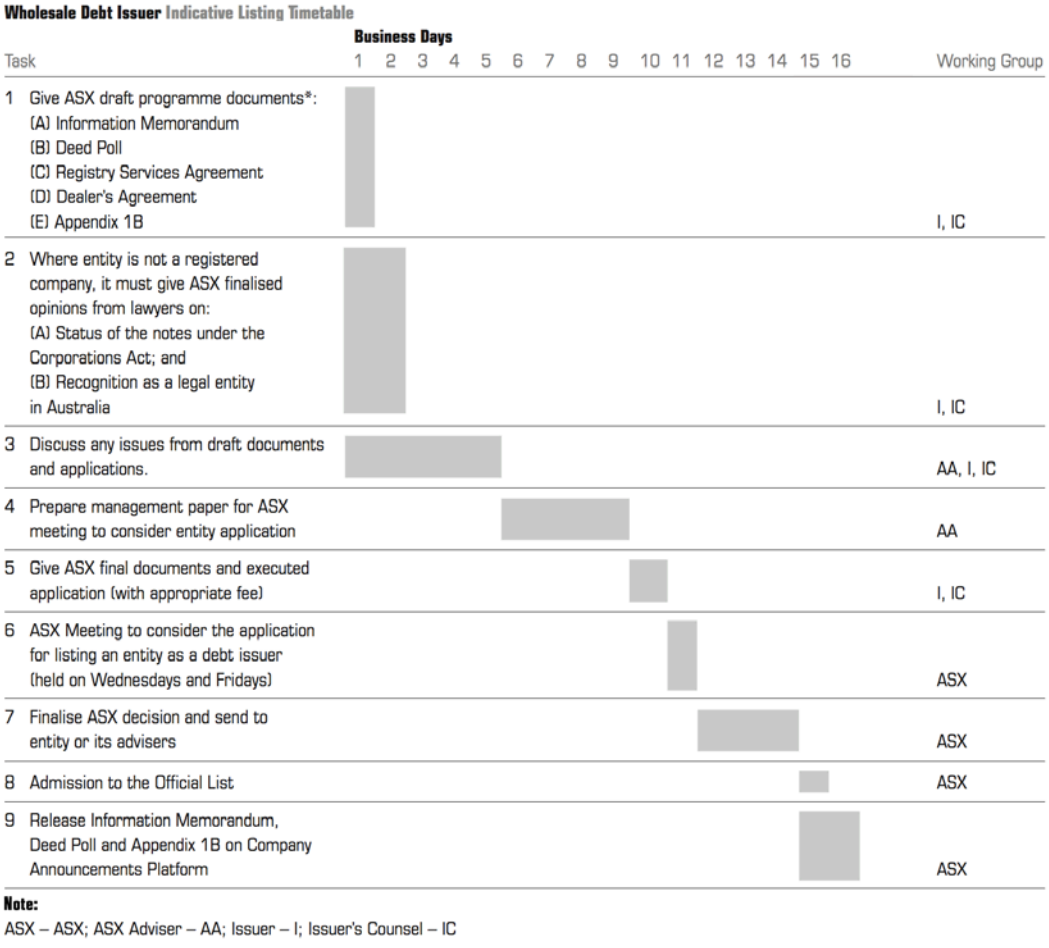
3.4 Executing the transaction

Placement, registration and listing

Figures 3.4 and 3.5 indicate two indicative timetables and are adapted from an Australian Securities Exchange Debt Listing Guide; they illustrate the tasks and working groups involved in listing and quotation respectively.

Marketing

Where a managing underwriter has been retained they often host 'road shows', a series of meetings where the issuer's management present to institutional investors and sales personnel. For a particularly large or complicated issue this can involve

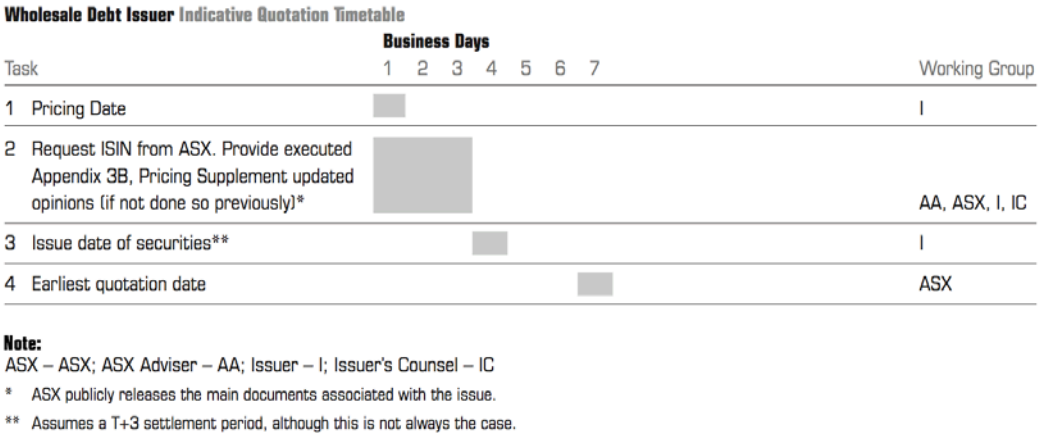


Wholesale Debt Issuer Indicative Listing Timetable

Task	Business Days 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	Working Group
1 Give ASX draft programme documents*: (A) Information Memorandum (B) Deed Poll (C) Registry Services Agreement (D) Dealer's Agreement (E) Appendix 1B		I, IC
2 Where entity is not a registered company, it must give ASX finalised opinions from lawyers on: (A) Status of the notes under the Corporations Act; and (B) Recognition as a legal entity in Australia		I, IC
3 Discuss any issues from draft documents and applications.		AA, I, IC
4 Prepare management paper for ASX meeting to consider entity application		AA
5 Give ASX final documents and executed application (with appropriate fee)		I, IC
6 ASX Meeting to consider the application for listing an entity as a debt issuer (held on Wednesdays and Fridays)		ASX
7 Finalise ASX decision and send to entity or its advisers		ASX
8 Admission to the Official List		ASX
9 Release Information Memorandum, Deed Poll and Appendix 1B on Company Announcements Platform		ASX

Note:
ASX – ASX; ASX Adviser – AA; Issuer – I; Issuer's Counsel – IC

Figure 3.4: Wholesale debt issuer indicative listing timetable
Source: Australian Securities Exchange, 2013.



Wholesale Debt Issuer Indicative Quotation Timetable

Task	Business Days 1 2 3 4 5 6 7	Working Group
1 Pricing Date		I
2 Request ISIN from ASX. Provide executed Appendix 3B, Pricing Supplement updated opinions (if not done so previously)*		AA, ASX, I, IC
3 Issue date of securities**		I
4 Earliest quotation date		ASX

Note:
ASX – ASX; ASX Adviser – AA; Issuer – I; Issuer's Counsel – IC

* ASX publicly releases the main documents associated with the issue.

** Assumes a T+3 settlement period, although this is not always the case.

Figure 3.5: Wholesale debt issuer indicative quotation timetable
Source: Australian Securities Exchange, 2013.

travelling to several cities and countries.

In addition to generating interest from investors, these negotiations allow the issuer to get an indication of the market sentiment surrounding their issue as desired quantities and prices are revealed. This feedback can be highly instructive: where particularly low quantities are sought, the issuer may modify the terms of the issue.

3.5 Conclusion

This chapter provided an overview of the bond issuance process by the Big Four Australian banks.

The analysis of Corporate Debt in Australia has shown that a large portion of this debt was made up by the Big Four banks issuing approximately 50% of bonds, with this figure rising to 75% in recent years. As part of the analysis of Corporate Debt in Australia, WF strategies of the Big Four banks was examined and indicated they had similar funding strategies, diversifying funds across currency maturity, investor type, geographical locations and debt product types.

Pre Issuance Analysis showed the desirability of bond financing by looking at the selection of advisors, corporate finance analysis, cash flow forecasting, capital

structure planning and assessing the funding sources available to the Big Four banks. Assessing the funding sources included costs and availability of funding over time, repayment schedule, common funding alternatives and internal management analysis.

Structuring the Issue analysed the steps in the pre-transaction process. This included appointing advisors; financial advisor, underwriter, legal counsel and external auditors. Another key component to structuring the issue is designing the bond characteristics. This includes the principal amount, par value, maturity, coupon rate, currency denomination, redemption, convertibility, covenants, security and the level of seniority. Finally, regulatory limitations are applied. This includes quotation requirements in Australia, capital adequacy requirements set by the Australian Regulation Authority, and regulatory limitations for issuance into the US private placements market.

The final stage of bond issuance is Executing the Transaction. This includes placement, registration and listing on the relevant exchange. Figure 3.4 provides a comprehensive wholesale debt issuer listing timetable, which highlighted the timeframe in which the key working groups submitted documents for execution. Figure 3.5 provides an indicative quotation timetable for the relevant working group. The final stage includes marketing the issue which consists mainly of road shows where management presents to institutional investors and sales personnel.

Chapter 4

The Theoretical Background

4.1 Introduction

Chapters 2 and 3 presented a comprehensive overview of the WF market from global and Australian perspectives. The purpose of this chapter is to extend this overview to incorporate the theoretical and empirical literature on WF markets. This chapter reviews the research available on WF markets to develop a sound framework for analysing the research question. The chapter also analyses empirical evidence and industry practices and their implication for the size and scope, as well as the growth, of WF markets.

This chapter consists of seven sections including the introduction. The next section reviews literature on the role of WF markets. This section will expand on discussion from chapter 1 in particular examining the drivers of WF, the role of capital in the financial intermediation process, the issue of liquidity risk, positive and negative impacts of WF, the effect of WF on conventional economic thought such as interest rates, crowding out (in) effects and capital flows, and also the causality between crowding out effects and capital flows. The third section examines literature related to the drivers of banking activity and funding strategies. The fourth section analyses WF in terms of a relationship between investor (WF partner) and investee (borrower – financial institutions who want to use it to increase their profitability in business activities) using a utility-based approach. The penultimate section examines the literature on recent research on the future of Australian bank funding, with the object of forming a suitable analytical framework to examine the research questions. The final section summarises the chapter.

4.2 The role of wholesale funding markets

The empirical literature on WF markets is limited due to a number of reasons identified in the next paragraph. This chapter reviews the most recent literature related to WF markets and then draws on theories underpinning crowding out, deficits, capital flows, interest rate and risks associated with WF.

First, global WF markets are still emerging. Furthermore, due to the nature of the market in which most buyers and sellers represent major financial institutions and investors, the information available on the basis of transaction and settlement, volumes and other details of market transaction are limited thus wholesale funding by the banking sector has received very little attention. Traditionally banks have financed their daily operations by driving demand from retail deposits. This implies that incentives (that the threat of a run imposes on bank managers) make them a superior form of financing despite their fragility (Diamond and Rajan, 2001).

Furthermore, banks have also relied on some other traditional methods of raising funds, such as certificates of deposit, federal funding (overnight cash) and repo markets, which are considered short-term funding options. As discussed in chapter 1, access to new funding opportunities provided Australian banks with the ability to reduce their reliance on raising funds through traditional retail deposit funding. As a result issuance in the Australian domestic bond market increased from 10 percent during the decade before 2000 to approximately 30 percent in the decade ending 2010 (ABS, 2010). In addition, the funding composition of the Big Four suggests that by 2009, the percentage of domestic deposits to WF declined to 53% whereas short-term and long-term offshore capital rose to 26% percent of total liabilities (RBA, 2009).

4.2.1 Role of capital and financial institutions

Modigliani and Miller (1958) provided the point of departure for all modern research on capital structures with the proposition that, in a frictionless world of perfect information arbitrage and competitive markets, a firm's capital structure cannot affect its value. Ho

wever, Berger, Herring & Szego (1995) contrasted this proposition sharply by proposing that a firm with risk-free debt could borrow at an interest rate below the

required rate of return on equity, reducing its weighted average cost of financing and leverage. The proposition by Modigliani and Miller was challenged, based on the prevalence of an assumed set of imperfections such as taxes, cost of financial distress, transaction costs, asymmetric information and continued regulation in the financial services industry (Leyland and Pyle, 1977; Miller, 1995). To highlight the role of capital in financial institutions, Berger et al. (1995) defined market capital requirements as the ratio of equity to assets that maximises the value of a bank to exempt it from regulatory capital requirements, and suggested that regulatory capital requirements are motivated by safety nets, particularly the deposit insurance component and regulatory capital requirements, to protect an economy from negative externalities caused by bank failures, especially systemic risk. They suggested that setting regulatory capital requirements may have some additional unintended consequences such as incentives for some banks to increase their risk of failure, distort relative prices and create allocation inefficiencies that divert financial resources from their most productive resources. Accordingly they set the foundation for future research to enhance our understanding of how market and regulatory capital requirements affect financial institution behaviour, and how the WF markets influence capital raising by financial institutions.

The regulatory capital requirement has also received considerable attention in the literature. Protagonists of minimal prudential supervision, led by Calomiris (1998), argued that banks themselves are superior monitors of other banks. He promoted the proposition that there is no better authority to identify a risky bank than another bank (although such incidents were not documented). Calomiris received further theoretical support from Rochet and Tirole (1996), who proposed that interbank relationships established through federal fund transactions, or similar interdependencies, generate powerful incentives for all banks to monitor each other. They also pointed out that the effectiveness of banks as monitors of other banks is influenced by other existing policies, most notably the 'too-big-to-fail' maxim which asserts that the largest banks should be viewed as being immune to failure. These banks' creditors, including other banks, would have little incentive to monitor their exposure.

Furfine (2001) implicitly supported the minimal prudential supervision argument by providing evidence that banks are effective monitors of their peers by showing that interest rates paid on US federal fund transactions (which are equivalent to the overnight cash provisions of the RBA) reflect the differences in credit risk across borrowers. He further revealed that the size and relative importance in the fund market of trading institutions seemingly affects the rate charged for overnight borrowing (in Australia this is called the overnight cash rate), thereby offering insight into the nature of competition in the federal funds market. He further concluded that transaction volumes and the size of transaction effects are uncovered, providing evidence of cooperative interbank relationships (Furfine, 2001).

Compounding the above discussion, some studies suggested that prudential supervision and markets are often complementary sources of information about the financial health of banks, because such market information is useful for supplementing traditional banking supervision (Berger et al., 1998; De Young et al., 1998; Peek et al., 1999). However, Billet, Garfinkel & O'Neal (1998) claimed that banks show an ability to prevent market-based monitoring by shifting their liabilities away from claim holders (uninsured depositors) with a substantial incentive to monitor those (insured) depositors who have little incentive to monitor them. The application of these propositions in the modern WF markets is an important empirical question needing further investigation. According to Ellis and Flannery (1992) and Hannan and Hanweck (1988), the rates paid on wholesale (uninsured) NCDs have the potential to be used as the proxy measure of bank risk.

4.2.2 Liquidity risk and wholesale funding

Generally, a bank is required to be aware of, and manage, all aspects of systemic and un-systemic risk covering market risk, credit risk, interest rate risk, operational risk, insurance risk and exchange rate risk where appropriate. Continuous financial regulation reforms took place between the 1980s and the 2000s that succeeded in focusing attention on the credit markets, insurance (i.e., *The Financial Services Reform Act of Australia 2002*), and operational risks (i.e., Business Continuity Management Regulation of APRA). A substantial amount of regulatory and academic literature is available on these risks. However, the relative importance of liquidity risk was not felt by the researchers until the onset of the financial crisis in

early 2007, although historical events in the 1930s and again in the 1970s provided ample evidence of the importance of bank liquidity, with multiple bank failures in industrialised countries. The introduction of BASEL II standards (BASEL, 2004) set out the policies to deal with credit and interest rate risks, but they implicitly assumed that credit and interest rate risks would insulate banks from liquidity risk. Sharma (2004) identified two types of liquidity risks, namely, funding liquidity risk (FLR) and market liquidity risk (MLR).

FLR is defined as the risk that counterparties who provide the bank with short-term funding will withdraw or not roll over that funding, leading to a run. In contrast, MLR is defined as the risk of a generalised disruption in asset markets that make otherwise normally liquid assets illiquid (Diamond and Rajan, 2001; Gorton and Huang, 2004). The recent financial crisis was ample evidence of the importance of MLR. For instance, the Northern Rock Bank, the fifth largest mortgage lender in the UK, had relied heavily on the securitisation market for funding and when this market essentially closed, Northern Rock had experienced a bank run. Yorulmazer (2009) investigated the impact of this single event and showed that both the bank run and the subsequent bailout announcement had a significant effect on the rest of the UK banking system, measured by abnormal negative returns on the stock price of the bank. Yorulmazer's results also showed that the effects were a rational response by investors to market news about the liability side of the bank balance sheet. He concluded that a bank that relies on funding from wholesale markets would be significantly affected. This is consistent with the drying up of liquidity in wholesale markets and record high levels of the London Interbank Offered Rate (LIBOR) during the crisis.

4.2.3 The bright and dark sides of wholesale funding

As mentioned in Chapter 1, most of the banks increasingly relied on WF markets and used short-term and long-term debt securities to supplement traditional retail deposits. The growth of wholesale markets not only provided efficient access to credit, but was also used as an information source to identify a bank's health. In order to meet the funding shortages, banks tap into WF markets to attract the liquidity surplus of non-financial corporations, households (via money-market mutual funds), other financial institutions, federal, state and local authorities and

offshore entities (Huang & Ratnovski, 2008). The WF markets comprise NCDs, ECP, EMTN (Euro medium term note), Euro dollar deposits, brokered deposits and bonds/notes with floating and fixed coupon rates.

The question of how these developments in WF options affect bank risk (FLR and MLR in particular) has been raised in the literature. This question led researchers to examine the 'bright' and the 'dark' sides of WF. The literature on the bright side asserts that WF provides an opportunity to exploit valuable investing/borrowing opportunities without being constrained by the local depositor, thereby giving wholesale financiers the ability to supply market discipline and refinance shortfalls due to unexpected retail withdrawals (Goodfriend and King, 1998; Calomiris, 1999).

Huang and Ratnovski, (2008, p. 8), identified a number of effects in treating WF markets as a bright side.

- The use of wholesale funds allows banks to expand the volume of lending beyond the constraints of fixed local depositors' base.
- Wholesale financiers have the capacity to monitor banks and, if well-informed, exert welfare-enhancing market disciplines: i.e., they roll over funding to good banks but force liquidation of bad ones.
- The monitoring incentives of wholesale financiers are maximised when they are senior creditors in early liquidations: this allows them to internalise the benefits of monitoring.
- Profit-maximising private choices of banks and wholesale financiers are consistent with constrained-optimal outcomes: banks choose a maximum possible amount of wholesale funds and make them senior, to which wholesale financiers respond by monitoring and providing market discipline.

One of the questions yet to be answered by the bright side theorists is 'what would be the impact of wholesale financiers identifying seniors of the banking industry and allowing access to funds by the others in the industry?'. Particularly in Australia, can this activity lead to giving the major banks an unfair advantage over the lower banking tiers such as regional banks and member-based depository institutions?

The recession led by the financial crisis provided ample evidence of how soon the bright side of WF can turn to the dark side. It is undeniable that banks can use an excess flow of funds through wholesale markets to engage in aggressive expansion of lending portfolios while compromising credit quality, within a context where financiers exercise insufficient market discipline. This may lead to the possibility of abrupt withdrawal of financiers from wholesale markets at the refinancing stage due to negative rumours that may trigger liquidations (as observed in the sub-prime crisis, see Whalen (2008)). Huang and Ratnovski (2008) showed that the dark side of WF, (particularly the short-term funding segment) dominates the bright side when bank assets are more at arm's length and tradable. However, no empirical evidence is available for the behaviour of long-term funding markets, particularly those dominated by floating-rate mechanisms. Some empirical evidence does exist that highlights that the extent of a banks' reliance on WF is a source of vulnerability to interbank transmission in light of the recent financial crisis (Raddatz, 2010).

4.2.4 Interest rate, 'crowding out' and deficits

Although this thesis does not explicitly examine the relationship between crowding out and WF markets, it must however be acknowledged given the extensive degree of literature on the topic. The controversy over the relationship between interest rates, 'crowding out' and deficits began during the financial liberalisation of the late 1980s, with Cebula (1987) supplying empirical evidence to show that US federal governments do indeed have a positive and significant impact on short-term interest rates, and explained the mechanism of crowding out. However, Spector and Van Cott (1988) argued that because higher interest rates may be inversely associated with the level of crowding out; the statistical significance of the relationship between interest rates and the deficit is irrelevant for the question of crowding out. They suggested a focus on private investment rather than an unreliable interest rate nexus. However, it is important to acknowledge the correlation between interest rates and private investment. This suggests that private investment (encouraged through the WF markets) are not only linked to interest rates, but also to the budget deficit and crowding out.

The relationships between crowding out, interest rates and exchange rate shocks, and their relevance to bank lending have been adequately examined in the literature. For

instance in Turkey, Degirmen (2007) showed an increase in public sector borrowing increased capital and decreased lending at state banks, suggesting a crowding out effect of fiscal policy initiatives. However, Alani (2006) pointed out that within the global market context, government bonds may be captured by both domestic and financial markets; deficit financing (by the issue of government bonds) does not lead to a crowding out of private sector investments and may in fact lead to 'crowding in'. Alani (2006) further suggested that government bond issues do not affect the interest rate because they are sensitive to the direction of government expenditure, and depend on interest rates in international financial markets more than in domestic markets because of the globalisation and the integration of financial markets.

4.2.5 Causality between crowding out and the external debts

In contrast to the literature outlined above, some studies conducted in highly indebted, less developed countries have tested the causality between crowding out and the level of external debt in the absence of efficient access to global WF markets. Fofack and Ndikumana (2009) tested causality using a co-integration and error correction model and concluded that the presence of dual causality (implied by positive co-variation of external debts and capital flight), but highlighted the role of external debt over capital flight.

4.3 Bank activity and funding strategies

Bank activity and funding strategies play an important role in the process of evaluating different banking models. The recent financial crisis in particular has showed that banks have been exposed to excessive risk through reliance on WF. For instance, Taylor and Williams (2008) and Capiro, Demirguc-Kunt and Kane (2008) showed that interbank money market rates rose dramatically, reflecting a perception of increased counterparty risk during the crisis and, by October 2008, interbank lending in the US and Europe had come to virtual standstill. However, one must consider both the asset and funding sides when considering different types of banking business models.

4.3.1 Asset side

The literature makes conflicting predictions on banks' optimal assets or portfolio mix, the optimal level of financing, and the best match between assets and liabilities. It is generally agreed that financial institutions (banks in particular), in the provision of financial services, gain information about their customers that may prove useful for the purposes of cross-selling. Accordingly, Diamond (1991), Rajan (1992) and Stein (2002) confirmed that banks optimally combine activities of various kinds, for instance loan-making with securities underwriting. Therefore the practices of combining different types of activities such as non-interest-earning and interest-earning will give them an opportunity to diversify risk and thereby increase operational performance. The research also shows that the extent of risk diversification benefits from combining income-generating activities of various kinds (including off-balance sheet transactions) further depends on the co-movements in the risky income from these activities.

However, Jensen and Meckling (1976) and Jensen (1986) argued that the optimal size and scope of a banking institution should also reflect finance-specific technologies and potential agency problems that arise within the institution if it becomes too complex. Based on this evidence, Demirguc-Kunt and Huizinga (2009) argued that, even if further diversification into different activities cannot be considered as optimal in terms of the overall risk-return trade off they face, insiders may still support this diversification as long as it enhances their ability to extract private benefits which are sufficiently large. Myers and Rajan (1998) also argued that asset liquidity may increase opportunities for bank managers to trade against bank interest. Thus, diversifying into more liquid non-traditional banking such as proprietary trading, and other off-balance sheet transactions that generate non-interest income, may end up increasing bank fragility and reducing overall performance. However, there is a growing debate on bank diversification and its impact on risk.

Over the past 20 years the banking landscape has changed dramatically. There has been a process of disintermediation where traditional activities of intermediation for banks have declined, and have been compensated by an increase in fee-based activities (Kaufman and Mote, 1994; Allen and Santomero, 2001). Several factors

have been attributed to the shift from interest income to non-interest income, including deregulation of the financial markets, and technological and financial innovation (Hawtrey, 2003; De young and Rice, 2004b). Another explanation for the increase in non-interest income could be endogenous reasons: managers diversify into other areas of financial services to exploit private gains or reap the benefits of diversification. This could be to build a larger empire (Berger et al., 1999) or for reputational gains (Milbourn et al., 1999).

Interestingly, in Australia, banks were already pre-empting the disintermediation of funds and moved into generating non-interest income before the reduction of interest margins (Williams and Rajaguru, 2009). The rise in non-interest income also signals a convergence of non-interest income for banks around the globe (Antzoulatos et al., 2011). Two hypotheses have been presented for this enigma. The first hypothesis is that banks worldwide follow similar strategies. That is, there is a herding effect among banks encouraging them to follow the strategies of one leading bank. The second hypothesis is that there is an optimum level of non-interest income for banks worldwide. In both instances, this represents an increase in systematic risk worldwide (Antzoulatos et al., 2011).

There is growing debate over the impact of diversification. One group argues that diversification brings sufficient financial benefits to the banks, see Kwast (1989), Kwan (1997), Smith et al. (2003), Holzhäuser (2006) and Baele et al. (2007). They claim that diversification improves the return on equity and organic growth through improved operational efficiency by using excess capacity and improved economies of scale and scope. On the other hand, contrasting empirical research shows that diversification has not produced any positive results, but increased risk due to overexposure of banks. Three studies that supports this view was by De young and Rice (2004)b, Stiroh (2004) and Stiroh (2006). Furthermore, DeLong (2001) distinguished between geographical and activity diversification of bank mergers. By performing an event study to determine the cumulative abnormal returns of mergers during 1988–1995 for domestic US banks, the author found that activity focus was highly valued by the market. Activity mergers added 1.5% in value, whereas activity diversification destroyed 0.9%. Geographical diversification or focus did not destroy value. Possible explanations for the results were presented by Acharya et al. (2006),

who examined the effect on loan portfolio diversification and found a diversification discount for Italian banks that diversify sectorally and industrially. For low to moderate risk banks, there was no diversification benefit, while for larger banks there was an increase in risk. They explained that there were diseconomies of scope associated with the increase in diversification. They presented three reasons why this might be so. First, managers may lack expertise in new areas and so there are learning costs. Second, competition in a new area could subject the expanding bank to adverse selection. Third, there are possible agency costs associated with increase scale.

4.3.2 Funding side

The strategies of the funding side also stress the importance of information acquisition when determining the optimal mix of banks' deposit mobilisation and non-deposit funding. As Diamond (1984) pointed out, there is a general acceptance of the view that banks need to be partially equity financed to provide bankers with appropriate incentives to monitor the projects they finance. Calomiris and Kahn (1991) also supported this proposition by arguing that demandable deposits provide depositors with appropriate incentives to monitor banks and force liquidation of insolvent ones. However, as Calomiris (1999) showed, a bank's debt composition and its ability to fund itself in wholesale capital markets signals its credit worthiness to potential depositors. Accordingly, Calomiris showed that bank holders of subordinated debt can perform the function of monitoring (as well as supervising) a bank if subordinated debt is credibly excluded from deposit insurance. This shows that non-deposit funding in a bank's funding mix can reduce bank fragility through better monitoring. This aspect is further examined later in this chapter using the principal-agent framework.

It is generally agreed that deposit and non-deposit funding carry different risks resulting in potential illiquidity in the form of a bank run or a sudden withdrawal of WF. As mentioned in section 3.2.4 of this chapter, with particular relevance to WF, there is an ongoing debate over the bright and dark sides of WF. As Dermirguc-Kunt and Huizinga (2009) pointed out, deposit and non-deposit funding are also different in terms of the speed and size on changes in funding spreads. They further showed

volume and price (cost) of WF, in particular, may adjust more quickly to reflect a bank's riskiness.

Apart from the assets and funding side strategies, other models also consider the simultaneous determination of bank activities and bank funding and offer an explanation as to why traditional lending and deposit taking activities are likely to be observed within the same firm. Song and Thakor (2010) argued that the openness of relationship lending enhances bank fragility since it reduces the potential for bank liability holders to assess a bank's solvency. Thus, to reduce bank fragility, banks making relationship loans are financed relatively heavily by core deposits. Kashyap et al. (2002) proposed that financial services entail the provision of liquidity to bank customers which in turn improves the institution's own liquidity management.

Empirical research conducted by Dermirguc-Kunt and Huizinga (2009) using a large sample of international banks and data covering 1995 to 2007, examined not only the relative importance of non-traditional banking activities and non-deposit funding to banks' assets, but also the funding mix, to illustrate changes in asset and funding mix for different types of financial institutions prior to the recent financial crisis. They concluded that banking strategies that rely prominently on generating non-interest income or attracting non-deposit funding are very risky.

4.4 Wholesale funding: A principal-agent model of investor and borrower based on utility function

Agency theory deals with the issues of the principal-agent problem that is relevant to the majority of financial intermediations. In economic theory, the principal-agent problem treats the difficulties that arise under incomplete and asymmetric information when a principal uses an agent. The principal may use various mechanisms to align the interests of the agent with those of the principal; i.e., pricing/rates/commission, profit-sharing, performance-based remuneration. Principal-Agency theory explains how to best organise relationships in which one party (the principal) determines the work, which another party (the agent) undertakes (Eisenhardt, 1989). The theory is also applicable when there is uncertainty. In uncertain environments, in most business settings, two agency problems such as

adverse selection and moral hazard may arise. Adverse selection is the condition under which the principal cannot ascertain if the agent accurately represents their ability to do the work for which they are being paid. Moral hazard is the condition under which the principal cannot be sure if the agent has put forth maximum effort (Eisenhardt, 1989).

According to agency theory, business entities are growing larger and more complicated than ever. Therefore, ownership and management are separated. As a result, agents tend to place their personal interests first (Lin, 2004). They make decisions that maximise benefits to themselves, instead to the principal. Due to the principal's limited capabilities to process information, agency issues are created.

As noted before, wholesale funders are similar to conventional wholesale financial institutions (such as investment banks) and investors because they provide funds and services to suitable borrowers. However, in the case of WF arrangements, principals must obtain information from a third party, that is, rating agencies and market intelligence reports. If information asymmetry exists, this will become a serious issue due to high volatility of returns. Therefore one must assume that the efficient market hypothesis prevails in WF markets at all times. Based upon the model inference by Holmstrom's (1979) assumption regarding the agent's (the borrower in this case) utility function, it is assumed that both principal (the wholesale funder) and agent are fully aware that they both rationally pursue the maximisation of utility. Therefore, agents strive to increase a firm's output; and then principals and agents distribute the output according to the compensation system. In other words, agents work hard to improve a firm's value, thereby increasing their wealth and rating; thus the agent's utility increases. However, a firm's output is determined in accordance with the agent's contribution and other reasons beyond the agent's control. Factors beyond the agent's control are called uncontrollable risk (or systematic risk). As far as agency relationship is concerned, wealth is the only element that determines an agent's utility function. However, an agent's utility function is determined according to their wealth and contribution to growth of the firm. Therefore, contributions result in a negative utility and the negative utility increases as contributions increase.

Holmstrom (1979) argued that an agent's compensation serves as a proxy incentive mechanism. However, the supervision mechanism was not included in the model. A firm's production would also be affected by supervision. Therefore, following Holmstrom (1979), a principal's participation can be considered as the information provided by markets on the performance of financial intuitions (by means of ranking, stability, profitability, etc).

Holmstrom (1979) incorporated the neo-classical utility theory into his model and assumed that human beings were born to pursue the maximisation of personal interests. The *Basic Model between Principals and Agents* stresses the value of information, but overlooks the contributions made by technology and knowledge of production.

4.4.1 The criteria of the model and derivation of the utility functions

Agency theory is incorporated into the model with emphasis on an investor's contributions to, and influence on, a borrower firm when information asymmetry exists between the investor and the borrowing firm. Wholesale investors and borrowers are assumed to be risk-averters and, as far as the agency relationship is concerned, neither party may disturb the other party. Therefore, wholesale investors and borrowers attempt to maximise their personal utility and abide by the contracts at the same time.

Borrowers act as agents for wholesale investors and are therefore required to work in the best interest of investors by maintaining their performance (maintaining their ranking at highest level possible). As far as the agency relationship between investors and borrowers is concerned, it is assumed that the wealth possessed by investors, or the difference between a firm's profits and investors' income, determines the investors' utility function. An investor's utility function is determined by a firm's profits and the borrower's performance in terms of profitability and stability. Further, it is assumed that the borrower's performance, as evidenced by profitability and stability, creates negative utility for investors through reducing margins. The theoretical framework of Holmstrom's (1979) model, is adopted in this study. Holstrom's model is extended to include the critical contributions made by borrower

firms as well as the principals' contributions to the operating performance. The model makes the following assumptions:

- Borrowing firms improve their productivity through diversified portfolio development with access to new lines of debt. Therefore, investee firms' capabilities determine investors' returns. Let $\gamma \in \acute{A} \subseteq R$ be an investee firm's capability, $\acute{A}$ be the set of relevant productivity and R be the set of real numbers. Facing information asymmetry, investors are likely to determine whether to make decisions on performance improvement based on their personal interests. Thus, their decisions affect the firms' profits.

- Let q represent a borrower's profits which are determined in accordance with a number of factors beyond investors' control, in addition to γ. These factors are represented by a random variable θ; known as a random state of nature. It represents the external environmental factors affecting the borrower's profits. It is assumed that an investor faces θ after γ is selected. In other words, the profits of the investor's q are determined by the borrowing firm's capabilities γ together with the random variable θ; that is $q = q(\gamma,\theta)$. It is assumed that investors only choose options that increase returns. Further, it is assumed that the marginal returns created via the borrowing firm's capabilities decrease. Thus $q(\gamma,\theta)$ $q(\gamma,\theta)$ is continuously differentiable up to the second order partial derivative with respect to γ and

$$\frac{\partial q(\gamma,\theta)}{\partial \gamma} > 0, \quad \frac{\partial^2 q(\gamma,\theta)}{\partial \gamma^2} < 0 \tag{4.1.1}$$

- An investor may use other funding options to help a borrower, such as equity participation or debt to equity swaps. Let $a \geq 0$ represent an investor's participation. This study attempts to find out whether an investor's participation, a, helps a firm to increase its profits.

- Investors tend to assist borrowers to minimise agency-related issues between investors and borrowers, and thus prevent managers from putting their own self interests ahead of the firm's. As far as income compensation is concerned, investors are entitled to a fixed return and variable compensation market valuations of debt instruments. The amount of variable compensation is determined in accordance with the performance of the borrowing firms. It is assumed that the borrower's compensation increases as the firm's profit

increases. Let $p \in (0,1)$ represent the proportion of returns from borrowers. Investors help the firm increase its profit through participation and, therefore, the firm's profit is determined by the investors' participation. Hence $(1+a)q(\gamma,\theta)$ represents the profit of the firm with investors' participation and $(1+a)q(\gamma,\theta)$ represents the borrower's variable compensation. Let $f \geq 0$ represent the fixed amount of compensation for investors. Then the incentive plan for investors is represented by the linear structure as follows:

$$f + (1+a)q(\gamma,\theta)p$$

Set and rearrange

$$C_e := f + (1+a)q(\gamma,\theta)p \tag{4.1.2}$$

and

$$C_v = (1+a)q(\gamma,\theta)(1-p) - f \tag{4.1.3}$$

Then C_e represents the firm's compensation and C_v represents the compensation for the investors.

- Consistent with Holmstrom (1979) and Jin (2008), this study assumes that the Von Neumann-Morgenstern utility function (abbreviated as VN-M utility function) represents the utility functions for the principals and agents. Let

$$V(C_v) = V\left[(1+a)q(\gamma,\theta)(1-p) - f\right] \tag{4.1.4}$$

be the utility function for investors and

$$\begin{aligned} U(C_e,\gamma) &= M(C_e) - K(\gamma) \\ &= M\left[f + (1+a)q(\gamma,\theta)p\right] - K(\gamma) \end{aligned} \tag{4.1.5}$$

be the utility function for borrowers, where $M(C_e)$ represents the utility of the profits earned by the borrowers from the firms and $K(\gamma)$ represents the negative utility created by the improved efficiency of the firm. *V, M* and *K* are assumed to be continuously differentiable up to their second-order derivatives. In addition, it is assumed that investors and borrowers are risk averse and their utility increases and marginal utility decreases as their wealth increases, that is,

$$V'(C_v) = \frac{dV(C_v)}{dC_v} > 0 \quad , \quad V''(C_v) = \frac{d^2V(C_v)}{dC_v^2} < 0$$

and

$$M'(C_e) = \frac{dM(C_e)}{dC_e} > 0 \quad M''(C_e) = \frac{d^2M(C_e)}{dC_e^2} < 0 \quad , \tag{4.1.6}$$

Function $K(\gamma)$ represents the negative utility created by the firm's improvement in efficiency. The negative effect is assumed to increase as the investee firm enhances its capabilities for the borrowers and the marginal negative utility increases as the firm enhances its operational capabilities, i.e.,

$$K'(\gamma) = \frac{dK(\gamma)}{d\gamma} > 0 \quad , \quad K''(\gamma) = \frac{d^2K(\gamma)}{d\gamma^2} > 0 \tag{4.1.7}$$

4.4.2 Model inference and proposition

The contractual behaviours of investors and borrowers are analysed in the context of the assumptions made in the section 4.4.1. Both parties understand that the other intends to maximise utility rationally. Therefore, contractual behaviour is expressed in the optimisation and implications equation as follows:

$$\underset{a,p,f}{Max} \; Å_\theta\left[V(C_v)\right] \tag{4.1.8}$$

subject to

$$Å_\theta\left[U(C_e,\gamma)\right] \geq \bar{u} \tag{4.1.9}$$

and

$$\gamma \in \arg\max_{\gamma' \in A} E\left[U(C_e,\gamma')\right] \tag{4.1.10}$$

An optimum strategy or solution of the optimisation problem (4.1.8)–(4.1.10) is assumed to exist for the investor.

According to equation (4.1.8), investors select the most suitable contracts to maximise their expected utility. Equation (4.1.9) represents the borrowers' considerations of opportunity costs, where $\bar{u}$ represents the reserved utility level, which assures that borrowers' expected utility stays above a certain level. In reality,

$\bar{u}$ is determined in accordance with the market. If the utility created by the agency contract is lower than the utility determined by the market, borrowers are unlikely to accept the agency contract. Equation (4.1.10) relates to the decisions that maximise the borrowers' expected utility under the incentive plan $C_e = f + (1+a)q(\gamma,\theta)$. Wholesale investors are not familiar with the operational capabilities of the investment objects when they enter into the contract. The asymmetry of information available to investors and borrowers is characterised by the dependence on γ in their utilities. Borrowers are likely to initiate decisions on operational advancement based upon their personal interest, and thus maximise their expected utility.

The necessary condition of the constraint (4.1.10) is given by its first order condition with respect to γ. Taking the utility function for borrowers $U(C_e,\gamma)$, we differentiate this with respect to γ to obtain the necessary condition:

$$\frac{\partial E[U(C_e,\gamma)]}{\partial \gamma} = 0 \tag{4.1.11}$$

Taking the expression for borrowers' compensation given by $C_e = f + (1+a)q(\gamma,\theta)p$ and substituting this in the utility function for borrowers $U(C_e,\gamma) = M(C_e) - K(\gamma)$, we have from (4.1.11) that

$$\frac{\partial E[M(f + (1+a)q(\gamma,\theta)p) - K(\gamma)]}{\partial \gamma} = 0 \tag{4.1.12}$$

Assume the probability distribution of θ is continuous. It then follows from Leibnitz's rule and (4.1.12) that

$$E\left[\frac{dM(C_e)}{dC_e}(1+a)p\frac{\partial q}{\partial \gamma}\right] - K'(\gamma) = 0 \tag{4.1.13}$$

To simplify the discussion, assume necessary conditions for the implicit function theorem to hold so that γ can be solved implicitly from equation (4.1.13) in terms of other variables. Therefore γ can be determined as a function of (a, p, f), that is $\gamma = \gamma(a, p, f)$.

To obtain the necessary conditions for the optimisation, the Lagrangian multiplier is introduced (based on the necessary condition (4.1.13) of (4.1.10) and (4.1.8)–(4.1.9)),

$$L(a,p,f;\gamma,\lambda,\mu) := \mathbf{E}_\theta\left[V(C_v)\right] + \lambda\left[\bar{h} - \mathbf{E}_\theta\left[U(C_e,\gamma)\right]\right]$$

$$+ \mu\left(E\left[M'(Ce)(1+a)p\frac{\partial q}{\partial \gamma}\right] - K'(\gamma)\right) \tag{4.1.14}$$

where λ and μ are the corresponding Lagrangian multipliers. Under the assumption of the existence of the optimal solution of the optimisation problem, the Kuhn-Tucker Theorem (see pp. 740–741 in Chapter 19 in Taha (1992)) is used to obtain the following necessary conditions for the optimal solution $(a^*, p^*, f^*;\gamma^*)$ (*Note there is no condition on* μ *after equation (4.1.17) since the constraint (3.1.13) is an equality, unlike the inequality constraint in equation (4.1.16)*)

$$\frac{\partial L}{\partial a} = 0,\ \frac{\partial L}{\partial p} = 0,\quad \frac{\partial L}{\partial f} = 0, \tag{4.1.15}$$

$$\mathbf{E}_\theta\left[U(C_e,\gamma)\right] \geq \bar{h},\ \ \lambda \geq 0,\ \ \lambda\left(\mathbf{E}_\theta\left[U(C_e,\gamma)\right] - \bar{h}\right) = 0 \tag{4.1.16}$$

$$E\left[\frac{dM(C_e)}{dC_e}(1+a)p\frac{\partial q}{\partial \gamma}\right] - K'(\gamma) = 0 \tag{4.1.17}$$

Therefore, if $(a^*, p^*, f^*, \gamma^*)$ is an optimal solution to the optimisation problem, it should satisfy the necessary conditions (4.1.15)–(4.1.17). Based on these assumptions, $\gamma^* = \gamma^*(a,p,f)$ solves equation (4.1.17). After substituting $\gamma^* = \gamma(a,p,f)$ into (4.1.15) and (4.1.16), the constrained optimisation problem is treated as finding a solution in variable (a,p,f). The optimal solution is then substituted, say (a^*, p^*, f^*), back to γ^* to obtain $\gamma^* = \gamma^*(a^*, p^*, f^*)$.

The following discussion examines how the returns ratio designed by investors for borrowers, and the borrower firm's operational capabilities is related. Intuitively, the ratio of the returns p designed by the investor for the loan would encourage borrowers to improve the firm's operational capabilities γ. In other words, the

borrowers are likely to increase the operational capabilities γ as more profits are accrued to them. Mathematically, this suggests that

$$\frac{\partial \gamma}{\partial p} > 0, \tag{4.1.18}$$

The sufficient conditions under which (4.1.18) holds are now derived.

Denote

$$W(a, p, f; \gamma) := \mathbf{E}\left[\frac{dM(C_e)}{dC_e}(1+a)p\frac{\partial q}{\partial \gamma}\right] - K'(\gamma) \tag{4.1.19}$$

It then follows from the necessary condition (4.1.17) that

$$W(a, p, f; \gamma) = 0 \tag{4.1.20}$$

Equation (4.1.20) is differentiated with respect to γ to obtain

$$\frac{\partial W}{\partial p} + \frac{\partial W}{\partial \gamma}\frac{\partial \gamma}{\partial p} = 0 \tag{4.1.21}$$

Based on the assumption that the utility function M is twice continuously differentiable, Lebnitz's rule is used to obtain from (4.1.19)

$$\frac{\partial W}{\partial p} = \mathbf{E}\left[\frac{d^2M(C_e)}{dC_e^2}\frac{\partial C_e}{\partial p}(1+a)p\frac{\partial q}{\partial \gamma} + \frac{dM(C_e)}{dC_e}(1+a)\frac{\partial q}{\partial \gamma}\right] \tag{4.1.22}$$

and

$$\frac{\partial W}{\partial \gamma} = \mathbf{E}\left[\frac{d^2M(C_e)}{dC_e^2}\frac{\partial C_e}{\partial \gamma}(1+a)p\frac{\partial q}{\partial \gamma} + \frac{dM(C_e)}{dC_e}(1+a)p\frac{\partial^2 q}{\partial \gamma^2}\right] - K''(\gamma) \tag{4.1.23}$$

note that

$$\frac{\partial C_e}{\partial p} = (1+a)q(\gamma, \theta), \quad \frac{\partial C_e}{\partial \lambda} = (1+a)p\left(\frac{\partial q(\gamma, \theta)}{\partial \gamma}\right)$$

It then follows from (4.1.22) and (4.1.23) that

$$\frac{\partial W}{\partial p} = \mathbf{E}\left[\frac{d^2M(C_e)}{dC_e^2}(1+a)^2 pq(\gamma, \theta)\frac{\partial q}{\partial \gamma} + \frac{dM(C_e)}{dC_e}(1+a)\frac{\partial q}{\partial \gamma}\right] \tag{4.1.24}$$

and

$$\frac{\partial W}{\partial \gamma} = \mathbf{E}\left[\frac{d^2 M(C_e)}{dC_e^2}(1+a)^2 p^2 (\frac{\partial q}{\partial \gamma})^2\right] + E\left[\frac{dM(C_e)}{dC_e}(1+a)p\frac{\partial^2 q}{\partial \gamma^2}\right] - K''(\gamma)$$

(4.1.25)

The sign of $\frac{\partial W}{\partial \gamma}$ in (4.1.25) is now examined. From the assumption that $a \geq 0, p \geq 0, M'' \leq 0, \frac{\partial^2 q}{\partial \gamma^2} < 0$ and $K'' > 0$, it can be seen from (4.1.25) that

$$\frac{\partial W}{\partial \gamma} < 0 \tag{4.1.26}$$

Noting that $M' > 0$, equation (4.1.24) can be rewritten as

$$\frac{\partial W}{\partial p} = \mathbf{E}\left[(1+a)M'(C_e)\left(1 - \frac{-1(1+a)pq(\gamma,\theta)M''(C_e)}{M'(C_e)}\right)\frac{\partial q}{\partial \gamma}\right] \tag{3.1.27}$$

Borrowers' compensation includes a fixed amount return and variable returns $(1+a)q(\gamma,\theta)p$. Therefore, f is considered the borrower' fixed wealth and the variable return $(1+a)q(\gamma,\theta)p$ is considered to be a risky asset. The borrowers' risks increase as the risk of the asset increases. It is assumed that borrowers avert risks and the relative risk aversion coefficient of the utility function *M* of borrowers is smaller than one [see Huang and Litzenberger (1988) for the definition and related discussion],

$$C_e \frac{-M''(C_e)}{M'(C_e)} < 1 \tag{4.1.28}$$

Note that $M' > 0, M'' < 0, f \geq 0$ and $(1+a)pq(\gamma,\theta) \leq f + (1+a)pq(\gamma,\theta) = C_e$.

Hence

$$\frac{-(1+a)pq(\gamma,\theta)M''(C_e)}{M'(C_e)} \leq \frac{-C_e M''(C_e)}{M'(C_e)} < 1$$

This implies that

$$1-\frac{-1(1+a)pq(\gamma,\theta)M''(C_e)}{M'(C_e)}>0 \tag{4.1.29}$$

Note that $M'>0$ and $1+a>0$, we have from (4.1.29) that

$$(1+a)M'(C_e)\left(1-\frac{-1(1+a)pq(\gamma,\theta)M''(C_e)}{M'(C_e)}\right)>0 \tag{4.1.30}$$

Following from the assumption $\frac{\partial q}{\partial \gamma}>0$, we obtain from (4.1.27) and (4.1.30) that

$$\frac{\partial W}{\partial p}=\mathbf{E}\left[(1+a)M'(C_e)\left(1-\frac{-1(1+a)pq(\gamma,\theta)M''(C_e)}{M'(C_e)}\right)\frac{\partial q}{\partial \gamma}\right]>0 \tag{4.1.31}$$

This, together with (4.1.26) and (4.1.21) leads to (4.1.18). It is, therefore shown that (4.1.18) holds under condition (4.1.28). By summarising the analysis, Proposition 1 is obtained.

Proposition 1.

Assume

$$\frac{-C_eM''(C_e)}{M'(C_e)}<1$$

then

$$\frac{\partial \gamma}{\partial p}>0$$

In other words, if the relative risk aversion coefficient of the utility function *M* of the borrowers is strictly less than one, then as investors share a higher percentage of the return to borrower, the firm's operational capabilities of the borrowers is improved. Similarly, the borrowers' operational capabilities are expected to increase as the investors increase their participation. Mathematically, this corresponds to

$$\frac{\partial \gamma}{\partial a}>0 \tag{4.1.32}$$

Equation (4.1.32) holds under condition (4.1.28). Equation (4.1.20) is differentiated with respect to *a* to obtain

$$\frac{\partial W}{\partial a}+\frac{\partial W}{\partial \gamma}\frac{\partial \gamma}{\partial a}=0 \tag{4.1.33}$$

Based on the assumption that the utility function M is twice continuously differentiable, Lebnitz's rule is used to obtain from (4.1.19) that

$$\frac{\partial W}{\partial a}=\mathbf{E}\left[\frac{d^2M(C_e)}{dC_e^2}\frac{\partial C_e}{\partial a}(1+a)p\frac{\partial q}{\partial \gamma}+\frac{dM(C_e)}{dC_e}p\frac{\partial q}{\partial \gamma}\right] \tag{4.1.34}$$

Note that

$$\frac{\partial C_e}{\partial a}=pq(\gamma,\theta)$$

It then follows from (4.1.34) that

$$\frac{\partial W}{\partial a}=\mathbf{E}\left[M'(C_e)(1+a)p^2q(\gamma,\theta)\frac{\partial q}{\partial \gamma}+M'(C_e)p\frac{\partial q}{\partial \gamma}\right]$$

$$=\mathbf{E}\left[M'(C_e)p\frac{\partial q}{\partial \gamma}\left(1-\frac{-M''(C_e)(1+a)pq(\gamma,\theta)}{M'(C_e)}\right)\right] \tag{4.1.35}$$

We have shown that $\frac{\partial W}{\partial \gamma}<0$. From the assumption that $M'>0, p>0, \frac{\partial q}{\partial \gamma}>0$, condition (4.1.28) and equation (4.1.35), we have $\frac{\partial W}{\partial a}>0$. It then follows from (4.1.33) that (4.1.32) holds. This leads to Proposition 2.

Proposition 2

Assume

$$\frac{-C_eM''(C_e)}{M'(C_e)}<1$$

then

$$\frac{\partial \gamma}{\partial a}>0$$

In other words, if the relative risk aversion coefficient of the utility function M of the borrowers is strictly less than one, then as investors increase their participation, the borrowing firm's operational capabilities are improved.

The ultimate purpose of the model inference is to find out whether the changes of investors' participation and the changes in the borrowers' revenue-sharing ratio affect the borrowing firm's operating performance. In this model, profit $q(\gamma,\theta)$ represents the firm's operating performance. Therefore, the following are investigated:

$$\frac{\partial q(\gamma,\theta)}{\partial p} \text{ and } \frac{\partial q(\gamma,\theta)}{\partial a}$$

It follows from $q = q(\gamma,\theta)$ and $\gamma = \gamma(a, p, f)$ that

$$\frac{\partial q(\gamma,\theta)}{\partial p} = \frac{\partial q(\gamma,\theta)}{\partial \gamma}\frac{\partial \gamma}{\partial p}, \quad \frac{\partial q(\gamma,\theta)}{\partial a} = \frac{\partial q(\gamma,\theta)}{\partial \gamma}\frac{\partial \gamma}{\partial a} \tag{4.1.36}$$

It then follows from $\frac{\partial q(\gamma,\theta)}{\partial \gamma} > 0$, (4.1.18) and (4.1.32) that, under the same assumption (4.1.28),

$$\frac{\partial q(\gamma,\theta)}{\partial p} > 0, \quad \frac{\partial q(\gamma,\theta)}{\partial a} > 0 \tag{4.1.37}$$

This leads to the following Proposition 3.

Proposition 3

Assume

$$\frac{-C_e M''(C_e)}{M'(C_e)} < 1$$

then

$$\frac{\partial q(\gamma,\theta)}{\partial p} > 0, \quad \frac{\partial q(\gamma,\theta)}{\partial a} > 0$$

In other words, if the relative risk aversion coefficient of the utility function M of the borrowers is strictly less than one, then the final propositions are:

- As wholesale investors increase their participation, the borrowing firm's operating performance is improved;
- As the investors enjoy a higher percentage of returns from borrowers, the borrowing firm's operating performance is improved.

4.5 The financial crisis and bank wholesale funding

Until the Financial Crisis and more recently, the European Debt Crisis, little research focused on drivers of bank WF. Many researchers echoed the notion that leading up to the financial crisis, European sovereign spreads and thus bank funding spreads was driven by international risk appetite (Codogno, Favero & Missale 2003; Geyer, Kossmeier & Pitcher 2004; Caceres, Guzzo, Basurto & Miguel 2010; Favero, Pagano & Thadden 2010). In contrast to this Sgherri and Zoli (2009) found that after the collapse of Lehman brothers in 2008, debt spreads were driven primarily by financial markets that became wary of sovereign debt issuers.

Interestingly Zoli (2013) found significant drivers of Italian bank funding spreads to Italian Government bonds- a more direct measure of funding costs- were affected by movements in Italian sovereign debt spreads, 3 month euribor-the benchmark interest rate similar to the Bank Bill Swap Rate in Australia-and the S&P share price index options (VIX index) and was quickly transmitted into bank lending rates. Sovereign spreads are calculated by yield differentiation between Italian 10-year government bonds and 10-year German bonds (bunds). Zoli also found changes in the VIX was statically significant on Italian sovereign spreads. Furthermore, the paper found the correlation of Italian bank funding spreads and that of sovereign yield spreads were exacerbated by banks that had relatively lower capital ratios and higher non-performing loans.

Furthermore and in line with the predictions, Zoli (2013) also explored the impact of sovereign spreads on lending conditions in Italy. In the middle of 2011, credit markets conditions deteriorated due to high volatility in the sovereign debt markets. As a result, bank WF costs increased significantly and limited the banks from the international WF markets. The change in sovereign spreads rapidly transmitted into corporate loan costs. Business lending rates increased by 100bps and new consumer mortgages by 80bps. In addition, Zoli (2013) found approximately 30-40 percent of the increase in sovereign spreads were priced into corporate loans within three months, and 50-60 percent priced in within six months.

Similar inferences are found in Elton, Gruber, Agrawal & Mann (2001). In the main, the findings discussed suggest that credit spreads on investment grade corporate debt

is determined by three variables: taxes, default risk and systematic risk, however, taxes and default risk made up only about half of the explanatory variable determining funding spreads. According to the authors, the remainder of funding spread determinants was determined by the same influences that affect systematic risk in the stock market. Further support can be found in the work of Collin-Dufresnse, Goldstein & Martin (2001) where funding spread determinants on corporate debt are driven by an aggregate systematic factor common to all corporate bonds, however, their paper suggests the need for further analysis on the interaction between systematic risk and credit risk.

Although limited academic research on bank WF spreads exists in Australia, Lepone and Wong (2009) looked at factors driving WF spreads within the Australian corporate bond market. The main findings suggest fluctuations in the spot rate (the difference in the 10 year government bond yield and the three year government bond yield) and changes in the slope of the yield curve are the most significant determinants of WF spreads, with both variables showing a negative correlation with credit spreads.

Further evidence from an Australian perspective can be found in the work of Batten & Hogan (2003), where the authors developed an equilibrium model of WF spread determinants on Japanese Yen Eurobonds (a Yen Eurobond is denominated in Japanese Yen and issued by a non-Japanese company outside Japan i.e., an Australian corporate issuing bonds in Japanese Yen and repaying them in Yen). Most of the evidence suggests stock market volatility (measured by the VIX) had limited influence on WF spreads, whereas the interest rate factor, currency volatility, and changes in the term structure influenced WF spread behaviour.

4.6 Summary

As can be seen in the literature covered in this chapter, the capital markets, interest rates, exchange rate, liquidity risk, market risk, ‘crowding out’ and capital flows have received research attention. The processes of regulatory reforms coupled with investor behaviour and technological innovation (as identified in Figure 1.1) based on competition and market efficiency theories, have led to almost perfect information

arbitrage and innovation in capital markets. The development of WF markets can be considered as one of these innovations although there are some on-going debate about the bright and dark sides of the markets particularly after the recent financial crisis. One of the most important studies in the literature is about the risk involved in banks unimpeded access to the WF market; particularly liquidity risk. Sharma (2004) described liquidity risk in terms of adverse liquidity outcomes that arise from a combination of an external or non-liquidity trigger event and an internal vulnerability. He further describes the liquidity outcomes as: 'the inability to pay liabilities' or 'realising a market loss' (as a result of the premature or forced sale of assets to raise funds) or 'the loss of a business opportunity/franchise due to a lack of liquidity'. The prevalence of these possible outcomes points to the strong correlation between market risk and liquidity risk. Thus a study of the WF market adopts the body of knowledge already available in the literature (Raddatz 2010) since it looks at liquidity and wholesale funds in the transmission of the US sub-prime crisis (The Financial Crisis). As explained in the previous section, modern researchers have focused on drivers of WF spreads mainly as a response to the financial crisis. This research formed the basis for the model specification in Chapter 6.

Chapter 5

Research Methodology

5.1 Introduction

This chapter synthesises the contents of the previous 3 chapters with more specific literature on wholesale bank funding or bank funding literature in order to provide a sound basis or justification for the research questions to be addressed in this dissertation. After providing a comprehensive overview of the WF market from the global and Australian perspective in chapters 2 and 3, the theoretical and empirical literature underpinning WF markets was examined in chapter 4. This chapter extends this literature particularly to provide a justification for the research questions and the research methodology adopted to analyse those questions.

This chapter consists of six sections including the introduction. The next section revisits the literature related to the role of WF markets in order to justify the development of hypotheses. Section three describes the research questions and related hypotheses. Section four provides the methodology employed in data collection. The penultimate section provides descriptive statistics of the data used for modal and hypothesis testing purposes as well as a rational for selection of appropriate variables to be used in empirical estimations. The final section provides a summary of the research method.

5.2 The role of wholesale funding markets

The empirical literature related to WF markets is limited. This is because the growth of global wholesale bank funding commenced as a result of globalisation, the rapid growth in information technology and financial innovations introduced in the 1990s. Until the onset of the financial crisis, researches have concentrated on the “dark” and “bright” sides of WF as outlined in chapter 4. Similarly a theoretical framework of Holmstrom (1979) and Jin (2006) was extended to propose that when wholesale

investors increase their participation in the funding market the borrowers could increase their efficiency so that both parties will benefit. This section revisits the WF market in order to justify the research gaps and then draws on the theories underpinning crowding out, deficits, capital flows, interest rate and risks associated with WF.

Figure 1.1 of Chapter 1, identified the drivers of WF. Accordingly, reforms were led by the belief in the comparative advantage of global trading environments and the facilitation of global capital mobility which created a platform for investors to diversify their investments and the borrowers to increase their funding sources. This reform has not only improved global competition but also established the stability and integrity of the global financial markets. This was further supported by the rapid growth in information technology coupled with the financial innovations and the introduction of efficient management information systems. Figure 1.1 also presented the exogenous factors contributing to the development of WF markets such as general economic conditions, cost of funding, exchange rates, lending rates and funding spreads. Although these factors have been identified in the literature researchers have shown little interest in measuring their true impact until the recent GFC.

In contrast, there is substantial literature on the role of capital in financial institutions. As pointed out in Chapter 4, Modigliani and Miller (1958) provided the point of departure for all modern research on capital structures with the proposition that in a frictionless world of perfect information arbitrage and competitive markets, a firm's capital structure cannot affect its value. Berger et al (1995) counter proposed this with the proposition that a firm with risk-free debt could borrow at an interest rate below the required rate of return on equity, thereby reducing its weighted average cost of financing and leverage. The proposition by Modigliani and Miller was challenged based on the prevalence of an assumed set of imperfections such as taxes, cost of financial distress, transaction costs, asymmetric information and continued regulation in the financial services industry (Leyland and Pyle, 1977; Miller, 1995). To highlight the role of capital in financial institutions, Burger et al (1995) defined the market capital requirements as the ratio of equity to assets that maximises the value of a bank to exempt it from regulatory capital requirements.

They suggested that regulatory capital requirements are motivated by the safety-net requirements, particularly the deposit insurance component and regulatory capital requirements to protect an economy from negative externalities (especially systemic risk) caused by bank failures. They suggested that setting regulatory capital requirements may have some additional unintended consequences such as providing incentives for some banks to increase their risk of failure, distorting relative funding prices and creating allocation inefficiencies that divert financial resources from their most productive resources. Accordingly, they set the foundation for future research to enhance our understanding of how market and regulatory capital requirements affect financial institutions behaviour and what role the WF markets plays in influencing the capital raising by financial institutions.

The model developed by Greenbaum and Thakor (1987) provided interesting insights into the choice of funding through traditional means (deposits) over other forms (such as securitisation). They examined a bank's choice of whether to fund the assets side of their balance sheet (loans) by deposit mobilization or to sell the loans to investors (securitisation). They found that in the presence of symmetric information on borrowers' payoff and no government interventions a bank is indifferent between capital raising through traditional deposit funding over other forms such as securitisation funding. Alternatively they suggested that in the presence of asymmetric information and with no government interventions, banks will prefer capital raising from non-deposit sources. In essence they suggested that regulation can influence the bank's choices with subsidies because it may lead to back-favouring capital raising through deposits. Interestingly they found that, in the presence of third-party insurers and mutual funds, banks prefer funding from alternative sources (e.g. WF). This proposition may have given strong support for the formation of the global WF market.

One of the most important studies in the literature is about the risk involved in banks' unimpeded access to WF, particularly liquidity risk. Sharma (2004) described the liquidity risk in terms of adverse liquidity outcomes that arise from a combination of an external or non-liquidity trigger event and an internal vulnerability. He further describes the liquidity outcomes as: 'the inability to pay liabilities' or 'realising a market loss' (as a result of the premature or forced sale of assets to raise funds) or

'the loss of a business opportunity/franchise due to a lack of liquidity'. The prevalence of these possible outcomes points to the strong correlation between market risk and liquidity risk. Indeed these risks are the primary focus of this thesis because, for the banks, they are of systemic importance since any of the adverse liquidity outcomes may distort the whole financial system. Thus a comprehensive study of the WF market adopts the body of knowledge already available in the literature (Raddatz 2010) since it looks at liquidity and wholesale funds during the financial crisis.

5.3 Development of hypotheses

A unique Australian model of the WF market is required to assess the potential contributions by disaggregating market activities into domestic from offshore components. The model developed in this study is based on the extant literature related to economic and financial market theories and empirical investigations. Results from testing the WF market models will be compared to prior research to identify potential sample period issues or disparities caused by differences in variable measurements.

5.3.1 Research Question One

There is no comparable literature available related to the specific research questions. The focus of this study is the research question on "What factors drive bank wholesale bank funding spreads?" In order to address this research question it is assumed that WF spreads are key determinants of WF. A set of 5 hypothesis are developed below linking the WF spreads to potential drivers:

$H0_1$ *Wholesale funding spreads of Australian Banks are influenced by the movement of the official exchange rate.*

$H0_2$ *Wholesale funding spreads of Australian Banks are influenced by the Bank bill rate.*

$H0_3$ *Wholesale funding spreads of Australian Banks are influenced by the Volatility Index (VIX) which represents market volatility.*

H0$_4$ *Wholesale funding spreads of Australian Banks are influenced by the Cash Gap which is the difference between the domestic cash rate and the foreign interest rate.*

H0$_5$ *Wholesale funding spreads of Australian Banks are influenced by the Bond Gap which is the difference between the domestic 5-year domestic Government Bond yield and the foreign Government bond yield.*

5.4 The issue of stationarity

Testing and dealing with time-series properties of data has been one of the central themes in econometrics since the 1970s. In an influential paper, Newbold and Granger (1974) reported a serious fault in econometric literature time series regression, namely "spurious regression". The problem often arises when applying the OLS method in regression models consisting of an integrated time-series. In this case, the measurement of goodness of fit such as the coefficient of multiple correlations R^2 or the corrected coefficient: (adjusted $R^{2)}$ may be high but the Durbin-Watson statistic may present extremely low values. This problem appears even when the time-series are independent of each other. Consequently, regression coefficients are likely to be insignificant and the significance tests based on regression can be invalid. Newbold and Granger (1974) argued that this issue is attributed to the autocorrelation error in regression analysis.

The simulation finding of Newbold and Granger (1974) was formally analysed by Phillips (1986). Specifically, Phillips (1986) developed a new asymptotic theory to verify that in spurious regressions, t-ratio and F-ratio statistics deriving from the OLS regression diverge with an infinite increasing sample size and hence do not hold limiting distributions. The coefficients and R^2 converge to non-standard limiting distributions and the Durbin-Watson statistic converges in probability to zero. Therefore, the "spurious regression" problem could not be solved by increasing sample size.

Since the warning by Newbold and Granger (1974) on "spurious regression", stationarity property of times series has drawn much attention. There are a number of

econometric techniques proposed to test for stationarity properties, including Dickey-Fuller, Phillips – Perron and KPSS methods.

5.4.1 The augmented Dickey-Fuller unit root test

Dickey and Fuller (1979) developed a procedure that investigates whether a series has a unit root against the alternative of following a random walk. The initial model had a form:

$$y_t = \alpha + \gamma t + \beta y_{t-1} + u_t$$

Where u_t is IID$(0; \partial)$. However, to deal with the autocorrelation issue, the augmented Dickey-Fuller test fits an expanded model:

$$\Delta y_t = \alpha + \gamma t + \beta y_{t-1} + \theta_1 \Delta y_{t-1} + \theta_2 \Delta y_{t-2} + \cdots + \theta_k \Delta y_{t-k} + u_t$$

Where k is the specified lags. Via OLS estimation, the test for the null hypothesis of containing unit root $H_0: \beta = 0$ is $T = \hat{\beta}/\hat{\delta}_{\beta}$. Dickey and Fuller (1979) proved that in the case of null hypothesis, this T-statistic does not follow the Student's t-distribution.

Hamilton (1994) classified four situations when applying the augmented Dickey-Fuller test which examined a different null hypotheses. The first examines the null of a random walk without drift and no constant($\alpha = 0;\ \gamma = 0$). The second examines the null of a random walk without drift but with a constant ($\alpha \neq 0;\ \gamma = 0$). The third examines the null of a random walk with drift and no constant ($\alpha = 0;\ \gamma \neq 0$). The last examines the null of a random walk with both drift and a constant ($\alpha \neq 0;\ \gamma \neq 0$). It was shown that the t-statistic, $T = \hat{\beta}/\hat{\delta}_{\beta}$, is not a standard distribution except in the third case. MacKinnon (1996) developed a method to approximate the *P*-value and Fuller (1996) provided a table of P-value which is used popularly in augmented Dickey-Fuller tests.

5.4.2 The Phillips–Perron unit root test

Phillips and Perron (1988) developed a nonparametric method to control autocorrelation issues in unit root testing, which was an alternative to the method

using additional lags of the "first-differenced variable" applied in augmented Dickey-Fuller procedure. The Phillips–Perron modelled the following:

$$y_t = \alpha + \gamma t + \beta y_{t-1} + u_t$$

Where α and γ can be excluded. Via OLS regression, Phillips and Perron (1988) suggested using two statistics Z_ρ and Z_τ, which have the same distribution as T-statistic in the Dickey-Fuller test.

$$Z_\rho = n(\hat{\beta}_n - 1) - \frac{1}{2}\frac{n^2\hat{\partial}^2}{s_n^2}(\hat{\lambda}_n^2 - \hat{\gamma}_{0,n})$$

$$Z_\tau = \sqrt{\frac{\hat{\gamma}_{0,n}}{\hat{\lambda}_n^2}}\frac{\hat{\beta}_n - 1}{\hat{\partial}} - \frac{1}{2}(\hat{\lambda}_n^2 - \hat{\gamma}_{0,n})\frac{1}{\hat{\lambda}_n}\frac{n\hat{\partial}}{s_n}$$

$$\hat{\gamma}_{j,n} = \frac{1}{n}\sum_{i=j+1}^{n} \hat{u}_i\hat{u}_{i-j}$$

$$\hat{\lambda}_n^2 = \hat{\gamma}_{0,n} + 2\sum_{j=1}^{q}(1 - \frac{j}{q+1})\,\hat{\gamma}_{j,n}$$

$$s_n^2 = \frac{1}{n-k}\sum_{i=1}^{n}\hat{u}_i^2$$

Where u_i is the residual, k is the number of regression covariates, ∂ is the standard error of β; where all are obtained from the OLS regression. q is the number of lags used in estimating $\hat{\lambda}_n^2$ following the method suggested by Newey and West (1987). The P-value for Z_ρ and Z_τ is provided by Fuller (1996).

5.4.3 The Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test

While the Dickey-Fuller and Phillips–Perron tests use the null hypothesis that examining time-series data are non-stationary, Kwiatkowski, Phillips, Schmidt, and Shin (1992) developed a unit root test procedure with the null hypothesis of stationarity. They were concerned with fitting the regression model into which a series y_t consisting of three component: deterministic terms, a purely random walk v_t, and a stationary error u_t.

$$y_t = \alpha + \gamma t + \beta v_t + u_t$$

$$v_t = v_{t-1} + \varepsilon_t;\ \varepsilon_t \sim N(0, \partial_\varepsilon^2)$$

The null hypothesis of stationarity is: $H_0: \partial_\varepsilon^2 = 0$, testing against the alternative $H_1: \partial_\varepsilon^2 > 0$. The test statistic in the KPSS procedure is the Lagrange multiplier $\hat{\zeta}_v$:

$$\hat{\zeta}_v = \left(T^{-2} \sum_{t=1}^{T} \hat{S}_t^2 \right) \Big/ \hat{\lambda}^2$$

$$\hat{S}_t = \sum_{j=1}^{t} \hat{u}_j$$

Where u_t is the residual derived from OLS regressing y_t on deterministic terms, and λ is the variance of u_t. The *P*-value for Lagrange multiplier statistic $\hat{\zeta}$ is based on the simulation method and provided by Kwiatkowski et al. (1992).

5.5 Lag length selection criterion

One of the most crucial econometric techniques in economic time series studies can be the estimation of the lag length of the autoregressive process. In practice, there are several selection criteria employed simultaneously to examine the lag length of the autoregressive process. The most popular criteria include the Akaike's information criterion (AIC) (Akaike, 1973), Schwarz information criterion (SIC) (Schwarz, 1978), and the Hannan-Quinn criterion (HQC) (Hannan & Quinn, 1978).

The AIC is a means of model selection as it looks for the optimal balance between the complexity and the goodness of fit of the model. It measures the information lost when using a model to represent the data generation process in order to evaluate the relative quality of a model based on an underlying set of data. Examining a set of candidate models for the data, the AIC statistic has the following form:

$$AIC = 2k - 2\ln(L)$$

Where k is the number of parameters in each model and L is the maximized value derived from the likelihood function for the model. The model generating smallest value of the AIC statistic is chosen.

As a close variant AIC, the SIC bases partly on the likelihood model.

$$SIC = -2\left(\frac{l}{T}\right) + klog(T)/T$$

Where l is the log value of the likelihood function and T is the number of observations. Schwarz (1978) proved that the SIC statistic is an increasing function of the error variance and the number of repressors. Therefore, the model generating the lower SIC value is chosen because it has either lower error variance or higher goodness of fit.

Alternative to the AIC and SIC model selection, the HQC is used to select the most effective model:

$$HQ = \frac{2l}{T} + 2klog(\log(T))/T$$

The model with the smallest value of the HQ statistic is chosen as most effective.

5.6 Cointegration models

Since the influential paper of Newbold and Granger (1974), there has been much attention on dealing with non-stationary series which was ignored before. Following Box and Jenkins (1976), researchers have advocated using a "first-difference" form of time-series (before regression) analysis in order to integrate it into a stationary series. This procedure had been considered as a prerequisite in time-series analysis. Nevertheless, the "differenced model" had also been criticised as a "specified model" that could not predict a long run relationship between variables (Hendry & Mizon, 1978; Hendry, Srba, & Yeo, 1978; Sargan, 1964). It could be a misspecification error if a long run state exists between a set of variables and the deviation from this state affects consequent innovation in the variables.

5.6.1 Cointegration test

This puzzle was significantly solved by Granger (1981) by introducing the concept of co-integration. Granger contributed to time-series analysis literature by pointing out that a set of non-stationary data series could have linear combinations which are stationary at level. Resting on this idea, Engle and Granger (1987) developed a two-step method to test for the existence of cointegration. Considering a set of series y_t and x_t, both are I(1). The first step is to apply OLS regression to form a cointegrating vector for the underlying series system:

$$y_t = \alpha + \beta x_t + u_t$$

The predicted residual series (û) measures the disequilibrium of and by nature, the purpose of the cointegration test is to test the stationarity of û. According to Engle and Granger (1987), the set of series y_t and x_t is considered as cointegrated if û is proved to be I(0). The second step involves testing the stationarity of û, where Engle and Granger (1987) suggested applying augmented Dickey-Fuller unit root test. They provided critical values for the case of one regressor which was derived from Monte Carlo simulations. Engle and Yoo (1987) and MacKinnon (1990) an extended critical values table for multivariable models.

However, the Engle and Granger method has a drawback because it is weak in testing for cointegration relations in multivariate cases with more than one cointegrating vector. Johansen (1988, 1991) developed a cointegration testing method based on a system of Lagrange multiplier estimators. Johansen' method is essentially the maximum likelihood estimation of the reduced rank model [2]. Considering an unrestricted multivariate representation of the vector consisting of n variables X_t:

$$X_t = \Pi_1 X_{t-1} + \cdots + \Pi_k X_{t-k} + \mu + \varepsilon_t$$

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \mu + \varepsilon_t$$

[2] The detail of Johansen cointegration procedure is provided by Johansen (1995)

$$\Gamma_1 = \sum_{j=1}^{i} \Pi_j - I$$

$$\Pi = -(I - \Pi_1 - \Pi_2 \ldots - \Pi_k)$$

where Π are $n \times n$ parameter matrixes; μ is a vector of n constant terms; and ε is the independent and identically distributed disturbance. If the rank of Π is $r < n$, Π can be written as $\Pi = \alpha\beta'$, where α and β are $n \times r$ matrices of coefficients and the rows of β' are the rank cointegrating vectors. The presence of cointegration relationships implies restrictions on Π. It has been shown by Johansen and Juselius (1990) that if the vector process is stationary, the matrix Π has full rank. In the case that r cointegrating vectors exist, the number of parameters is reduced from $n \times n$ to $nr + (n - r)r$. Based on the maximum likelihood estimation, there are two test statistics (Q- statistics) used in the Johansen procedure:

$$-2\ln(Q) = -T \sum_{i=r+1}^{n} \ln(1 - \widehat{\lambda_i})$$

$$-2\ln(Q) = -T\ln(1 - \widehat{\lambda_{r+1}})$$

Where λ are the eigen values derived from solving the determinant equation for the maximum likelihood estimator for Γ'. The former estimator is namely a "trace test" and the latter is "a maximum eigen-value test". The tests based on two estimators have slightly different meanings. The one based on the former estimator examines the null hypothesis that there are, at most, r cointegrating vectors in an underlying set of series, while the test based on the latter estimator considers the null hypothesis that there are r cointegrating vectors in an underlying set. Johansen and Juselius (1990) provide the critical values for the "trace test" and "the maximum eigen-value test".

5.6.2 Autoregressive distributed lag models

Besides two conventional methods, mentioned above, to test the existence of long run relationship between time series, M. H Pesaran and Shin (1999); M Hashem Pesaran, Shin, and Smith (2001); M H Pesaran and Smith (1998) have recently developed a new approach to this problem. They showed that the usual autoregressive distributed lag (ARDL) model could be effective in investigating the cointegration property of time series. The new approach focuses on the cointegration relationship at series level between a dependent variable and a set of independent variables, when the stationarity of regressors is not known certainly to be "trend" or "first-difference" stationarity. Taking into account the stationarity and cointegration properties of underlying time series, it is straightforward that if all data series are stationary at level, the OLS model could be directly used with their level. In the second situation when the data series are cointegrated, both the error correction model and the OLS regression model could be used to investigate the short run and long run relationship between the series. The third straightforward case is that all data series are not integrated at a same order and then the OLS regression model is normally used with stationary differences for of each data series. However, the problem turns out to be more complicated when some of the underlying data series may be stationary; some may be fractionally integrated or even integrated at "first-difference". Because the cointegration could present among some of the first order integrated series, none of three conventional approaches could be effective in this situation.

Considering the general ARDL form:

$$\Delta y_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-1} + e_t$$

Where y_t the dependent is variable; Z_t is the vector of variables, both dependent and independent; Γ_i represents the short run response matrices; Π is the long run multiplier matrix. e_t is the a disturbance term, which is, in particular, serially independent. The ARDL cointegration procedure is concerned with performing an *F*-test of the hypothesis $H_0: \Pi = 0$. This hypothesis is pointed out to be equivalent to the hypothesis of no cointegration (M Hashem Pesaran et al., 2001) and hence the

rejection of the null hypothesis means the presence of a long run relationship among the time-series data. The empirical issue of this testing strategy is the distribution of the *F*-statistic which is both non-standard and varying on the cointegrating rank of the system and a nuisance parameter. Moreover, because the *F*-statistic does not converge with an infinitely large sample, this problem cannot be solved by enlarging the sample size. Nevertheless, although there are no exact critical values for the *F*-statistic for the bundle of both stationary and non-stationary variables, M Hashem Pesaran et al. (2001) developed a bound approach to asymptotically determine the critical value of the *F*-statistic. The lower and upper bounds on the critical values of the *F*-statistic are provided which vary according to the number of variables. The lower bound is determined under the assumption that all of the series data are stationary in level. The upper bound is the case that all of the series exhibit "first-difference" stationarity. The actual *F*-value may lie within or outside the lower and upper bounds and hence some decision rules are proposed based on the actual *F*-value. If the actual *F* -value lies below the lower bound, the variables are stationary and so there is no cointegration relationship. If the actual *F* - value exceeds the upper bound, the variables are cointegrated. Otherwise, if the *F*-statistic lies within the lower and upper bounds, it is an inconclusive case.

Beside the *F* – test, M Hashem Pesaran et al. (2001) also suggests a cross check procedure based on a *T*-test. The bounds *T* – test is set up with the null hypothesis that the coefficient of $y_{t-1}$is zero, against the alternative hypothesis that it is smaller than zero. The lower bound is determined under the assumption that all of the data series have "first-difference" stationarity. The upper bound is the case that all of the series are stationary in level. If the actual *T* – statistic is less than the lower bound, it is concluded that the long run relationship among series exists. If the actual *T* – statistic is more than the higher bound, this supports the conclusion that all series are stationary at level.

The ARDL model to investigate the long run relationship among series has some obvious advantages compared to conventional cointegration methods. Firstly, the ARDL approach does not require pre-testing the order of integration, which is an absolute necessity in other cointegration methodologies. Second, its output is consistent even in small sample sizes (Narayan, 2004).

5.7 Model specification

In this section, an error correction model is used to investigate the factors influencing the fluctuation of the wholesale banking interest spread.

5.7.1 Vector Error Correction Model for 2-variable case

A general form for a Vector Error Correction Model (VEC) can be specified as:

$$\Delta y_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{i=1}^{p} \gamma_i \Delta x_{t-i} - \lambda(y_{t-1} - \delta x_{t-1}) + \mu_t$$

Where $y_{t-1} - \delta x_{t-1}$ is the long run cointegrating relationship between the two variables. λ is the error-correction parameter that measures how *y* reacts to deviations from the long run equilibrium.

When applying the VEC model to more than two variables it may be possibile that more than one cointegrating relationship exists among the variables. To deal with this situation Johansen and Juselius (1990) and Johansen (1988) generalized the procedure for testing [for] cointegrating relationships to allow more than one cointegrating equation. Pesaran, M. H., et al. (2001) develops a new approach to the problem of testing the existence of a level relationship between a dependent variable and a set of regressors, when it is not known with certainty whether the underlying regressors are trend- or first-difference stationary.

5.7.2 Vector Error Correction Model for multi variable case

A general form of VECM in a multivariable case can be expressed as:

$$\Delta Z_t = \alpha_0 + \alpha_1 t + \sum_{i=1}^{p} \Gamma_i \Delta Z_{t-i} + \Pi Z_{t-1} + e_t$$

Where Z_t is the vector of variables, Γ_i is the short run response matrices, Π is the long run multiplier matrix.

For the purpose of this study the general case is transformed to a specific model as shown below:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p} \Phi_i \Delta X_{t-1} + \Gamma D_t + \varepsilon_t$$

Where X is the vector of endogenous variables, including WF spread ($SPREAD$), the nominal exchange rate AUD/USD (EXR), the 90- day bank bill swap rate ($BANKBILL$), the cash rate gap ($CASHRGAP$), the government bond yield gap ($BONDGAP$), and the volatility index (VIX), and where D is the vector of exogenous variables. In this study, the sole deterministic variable, *Dummy*, proxies for the effect of the financial crisis is specified as exogenous. *Dummy* is 1 with the observations occurring after the event of Lehman Brothers' bankruptcy, which is considered as a starting point for the financial crisis; *Dummy* is 0 otherwise.

5.8 Justification for variable selection

As outlined in the literature review chapter (chapter 4) previous researchers Codogno et. al. (2003); Geyer et. al. (2004); Favero et. al. (2010) argued that leading up to the financial crisis, European sovereign spreads (and thus bank funding spreads) were driven by international risk appetite. In contrast to this Sgherri and Zoli (2009) and Caceres et. al. (2010) found after the collapse of Lehman brothers in 2008, that funding spreads were driven primarily by financial markets which became wary of sovereign debt issuers.

Zoli's (2013) research was based on the relationship between Italian bank funding spreads and Italian Government bonds- which they regarded as a more direct measure of funding costs. The spreads are affected by movements in Italian sovereign debt spreads, 3 month euribor-the benchmark interest rate similar to the Bank Bill Swap Rate in Australia-and the S&P share price index options (VIX index). These rates were quickly transmitted into bank lending rates. Sovereign spreads are calculated by yield differentiation between Italian 10-year government bonds and 10-year German bonds (bunds). It was also highlighted that changes in the VIX were statistically significant on Italian sovereign spreads. Furthermore, the correlation of Italian bank funding spreads with sovereign yield spreads was exacerbated by banks that had relatively lower capital ratios and higher non-performing loans.

As expected a *priori*, Zoli found significance on changing sovereign spreads and the effect on lending conditions in Italy. In the middle of 2011, credit markets conditions deteriorated due to high volatility in the sovereign debt markets. As a result, bank WF costs increased significantly and limited the banks from the international WF markets. The change in sovereign spreads rapidly transmitted into corporate loan costs. Business lending rates increased by 100bps and new consumer mortgages by 80bps. In addition, Zoli found approximately 30-40 percent of the increase in sovereign spreads were priced into corporate loans within three months, and 50-60 percent were priced in within six months.

Elton et.al (2001) found similar results suggesting that funding spreads on investment grade corporate debt are determined by three variables: taxes, default risk and systematic risk. However, taxes and default risk made up only about half of the explanatory variable determining funding spreads. Accordingly, the remainder of funding spreads are determined by the same influences that affect systematic risk in the stock market. Further support can be found in the work of Collin-Dufresnse et. al. (2001) in which funding spread determinants on corporate debt are driven by an aggregate systematic factor common to all corporate bonds. However, their paper suggests the need for further analysis on the interaction between systematic risk and credit risk.

Although limited empirical research on bank funding spreads exists in Australia, Lepone and Wong (2009) looked at factors driving corporate funding spreads within the Australian corporate bond market. The main findings suggest fluctuations in the spot rate (the difference in the 10-year government bond yield and the three year government bond yield) and changes in the slope of the yield curve are the most significant determinants of funding spreads, with both variables showing a negative correlation with funding spreads.

Long-established structural theories of spread drivers predict that asset and interest rate factors are negatively correlated to the changes in credit spreads on risky corporate bonds. A recent paper by Riedel et. al. (2013) investigated funding spread drivers on U.S dollar denominated EuroBond of four major Latin American

sovereign bond issuers (Brazil, Colombia, Mexico and Venezuela). Explanatory variables included changes in asset prices, implied market volatility (measured by VIX), interest rates, gold prices and foreign exchange rates. As predicted and in line with the aforementioned theory, changes in interest rates, gold prices and returns of the local stock market have a negative correlation with funding spreads. The VIX and U.S. dollar exchange rate was found to have a positive correlation with funding spreads.

Further support on spread drivers can be found in the work of Thuraisamy et. al (2008). Their research investigated the yield spreads on sovereign Eurobonds issued in international markets by major Latin American issuers (Brazil, Chile, Colombia, Mexico and Venezuela) using four drivers: an asset and interest rate factor—consistent with structural models of credit spread pricing; the exchange rate—consistent with macroeconomic determinants and the slope of the yield curve—consistent with a business cycle effect. In line with predictions, the authors found that the change in credit spread is negatively related to the first two factors while the exchange rate is positively related (consistent with local currency depreciation as credit spreads rise). Furthermore, the findings suggest that the slope of the yield curve, which captures the business cycle effect, has a positive relationship with short bonds and a negative relationship with the long bonds in our sample.

Although the main focus of this thesis is about determinants driving wholesale bank funding spreads in Australia, an interesting paper by Ito (2007) examined variables driving interest rate swap spreads in Japan using four determinants: (1) the spread between the 6-month libor minus 6-month Treasury Bill; (2) the corporate bond spread between the 10-year bond issued by the Tokyo Electric Power Company and the 10-year JGB yield ; (3) JGB yield's and corresponding maturity of the interest rate swap and (4) the slope of the yield curve (JGB yield corresponding to the maturity of swap spread minus 6-month Treasury Bills). Interest rate swap spreads are the difference between the interest rate swap and the yield on a government of the same maturity. Ito's evidence suggests 2-year and 4-year swap spreads are mostly influenced by the spread between the 6-month libor minus 6-month Treasury Bill, interest rate and slope of the yield curve. The 7- year and 10-year interest rate swap are mostly driven by the corporate bond spread.

Similar research on interest rate spread drivers from a Japanese perspective was conducted by Pynnonen et. al. (2006), where they developed an equilibrium correction model of credit spreads on quality Japanese yen Eurobonds. Their research found significance in the relationships between several factors including the risk-free interest rate; firm asset volatility and the firms's asset return correlation with changes in the risk-free rate. Their results confirm that the most significant factor driving credit spreads is the change in the risk-free rate. The relationship was negative.

Longstaff and Schwartz (1995) used a closed-form valuation model to value risky corporate debt. The model incorporated both a default and an interest rate risk. In the main, the findings suggest that funding spreads are strongly negatively correlated to interest rates. Default risk was found to be positive. Further support can be found in the work of Batten et. al. (2005) where the authors investigated drivers of spreads including, the Australian Government bond yields and the All Ordinaries stock market on non-callable Australian dollar denominated EuroBonds using the closed-form valuation model of Longstaff and Schwartz. In line with their predictions the authors found that changes in funding spreads are negatively correlated with changes in the Australian Government bond yields (a proxy for the interest rate factor in the Longstaff and Schwartz model) and the All Ordinaries Index(a proxy for the asset factor in the Longstaff and Schwartz model).

Similar research was found in the work of Duffee (1998). Duffee found strong significance in funding spreads on investment-grade non-callable bonds fall when the three-month Treasury bill yield rises. This relationship appears to continue for more than a year and was found to be a natural consequence of variations in the value of the option to call.

A recent paper by Comert (2012) investigated the relationship between the Fed interest rate (the equivalent of the RBA's cash rate in Australia) and the long term rates in the US from 1983 to 2007. Most of the evidence suggests a steady decoupling between the Fed interest rate and long term interest rates even before the financial crisis. In other words, the effectiveness of monetary policy through

influencing the Fed interest rate was diminishing. Comert analysed four representative dependent variables on the Fed interest rate: 10-year Treasury, AAA bonds, BAA bonds and Mortgage rates. Most of the evidence suggests monetary policy has been losing control across all four proxies for long term rates over the respective time period.

Similar findings are found in the work of Rudebusch et. al. (2006). The authors used two empirical no-arbitrage macro-finance models of the term structure of interest rates. The main findings suggest that neither of the two models employed were able to explain the conundrum which exists between the Fed interest rate and long term bond yields. The authors considered variables that lie outside the predicative powers of the models. One variable-the (short run implied) volatility-was found to be the most important variable explaining up to one third of the relationship. However, the other two thirds of the conundrum remain unexplained.

> *"Long-term interest rates have trended lower in recent months even as the Federal Reserve has raised the level of the target federal funds rate by 150 basis points. This development contrasts with most experience, which suggests that, other things being equal, increasing short-term interest rates are normally accompanied by a rise in longer-term yields... For the moment, the broadly unanticipated behaviour of world bond markets remains a conundrum."*
> Testimony of Fed Chairman Alan Greenspan to U.S. Senate, February 16, 2005

In contrast to this, research from an Australian perspective Steward et. al. (2013), Robertson & Rush (2013) and the Reserve Bank of Australia suggest that the RBA's cash rate is a determinant of wholesale bank funding costs. In other words, the policy rate determined by the RBA is priced into long term interest rates in the broader economy including wholesale bank funding.

However, a recent publication by the Australian Bankers Association (2013) suggested bank WF and changes in the policy rate set by the RBA had reduced impact since the 2007 financial crisis and had not been an accurate indicator of changes in bank funding costs.

5.9 Conclusion

This chapter began with a review of the literature related to the role of WF markets in order to justify the development of several research hypotheses. It then specified the research question and related hypotheses. Thereafter it highlighted the importance of prior testing of the time-series data to avoid potential issues of spurious regressions. Finally it concluded an appropriate model to derive estimates and a rationale for selection of the appropriate variables to be used in empirical estimations to be performed in Chapter 6.

Chapter 6

Model Estimation and Results

6.1 Introduction

As outlined in the introduction the ability to access the global WF market has changed the traditional asset and liability management practices of the Australian banking industry. This chapter provides a comprehensive overview of testing carried out prior to model specification, the model estimation and results derived. This chapter also provides a synthesis of the model specification based on content covered in the previous chapters, explains the model estimation process and presents the empirical results. Section 5 describes the model specification process.

The chapter is set out as follows. The next section outlines a description of data used for the study. Section 3 provides descriptive statistics. Section 4 explains the empirical analyses including unit roots tests and the methodology used for the selection of appropriate lag length. The penultimate section presents the empirical estimates of the variables used in this research and the final section provides a brief summary of findings.

6.2 Data

In order to examine the long-run driving determinants of WF spreads, a long-span data set is desirable. For this study data was extracted from the Bloomberg data system from the beginning of January 2000. Daily data for each variable was averaged in weekly blocks (of 7 days). The output of this function was used as the figure for that week. This was done for 648 weeks, finishing at the first week of June 2012.

A weekly dataset was selected to prevent any potential non-synchronous, low volume trading and bid-ask spread problems arising from daily data series analysis. It

was also thought that the use of this frequency would be less likely to conceal short-term factors.

6.2.1 Process used to derive individual variables

A Bloomberg Terminal was used to obtain the data for debt issuance deals that met all of the following criteria:

- Issuer's ticker code ANZ, CBAAU (CBA), NAB, and WSTP (Westpac)
- (Maturity date – Issue date) > 1 year (to eliminate short-term issues).
- Deals indexed directly to the 3M BBSW (to view only comparable domestic deals).
- Floater rate available and quoted (to ensure comparison possible).

The daily average "Floater Spread" across deals was then calculated for every "Issue Date" from January 2000 to June 2012. Due to the large number of constraints there were many instances where no deals were completed. The following steps were taken to prepare this daily deal data into a weekly summary:

1. Weekly average WF spreads calculated.
2. 3-Period moving average generated across weekly WF spreads, with the moving average of the last deals repeated over periods where no new deal data was available.

Using the same data and date range the amounts issued each day were summed to calculate total daily issuance.

Exchange rate data for the AUD to USD was collected from the Reserve Bank of Australia with quotes up until June 2012. The data was then collated into a single excel sheet simply using the "=" to directly refer to the original contents, such that 4PM daily quotes from January 2000 to June 2012.

Daily figures for the cash rate from January 2000 to June 2012 were gathered from the Reserve Bank of Australia, listed under the Mnemonic "FFIRMMCRID". Daily figures of the US Federal funds rate from January 2000 to June 2012 were ascertained from the Bloomberg data system.

Daily figures of the 90 day bank bill from January 2000 to June 2012 were gathered from the Reserve Bank of Australia, listed under the Mnemonic "FFIRMMBAB90D".

The remaining weekly data (the VIX, the 5-year Australian Government bond and the 5-year US Treasury) were also collected from the Bloomberg data system from January 2000 to June 2012:

- **The exchange rate (AUD\USD)** is expressed as an indirect exchange rate. This means the exchange rate states the amount of USD required to purchase one AUD.
- **The spread to bank bill (DBANKBILLS)** represents bank funding spreads relative to the bank bill rate. The Australian bank bill rate, known as the Bank Bill Swap Rate (BBSW) is an independent and transparent benchmark borrowing interest rate set approximately 10am daily in Sydney. Banks typically price their funding requirements to the 90 BBSW.
- **The cash rate gap (CASHRGAP)** is the 10-year historical difference between the Australian cash rate set by The Reserve Bank of Australia and the federal funds rate set by The Federal Reserve in the United States. The rate denotes the interbank interest rate financial institutions charge each other to borrow and lend on uncollateralised funds usually on an overnight basis. Within the respective countries, the rates are used by monetary authorities to influence macro-economic factors in particular employment, economic growth and price stability.
- **The Volatility Index (VIX)** is a measure of market risk commonly referred to as "the investors' fear gauge". The index represents market expectations of near term volatility. It is calculated using the implied volatility of call and put options trading on the S&P 500 index an index representing the United States top 500 industrial companies based on market capitalisation.
- **The bond yield gap (BONDGAP)** is the 10-year historical difference between the Australian 5-year Treasury bond issued Bond yields and the 5-year United States Treasury issued bond yields. A treasury bond is a debt security issued by a national government usually in the country's own sovereign currency to fund government spending. The yield on a bond is

determined by the market. When the price of a bond falls, this drives yields in the opposite direction and the yield increases and *vice versa* for an increase in bond prices.

6.3 Descriptive statistics

The descriptive statistics and the correlation matrix of the data used in this research are given in Tables 6.1 and 6.2.

Table 6.1: Data descriptive statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	No. of Obs.
SPREAD	65.13	54	325	0	53.64193	554
DBANKBILLS	5.27	5.016	8.013	3.043	1.089087	554
AUDUSD	0.7924	0.77207	1.09616	0.50566	0.150111	554
VIX	21.69	19.145	79.13	10.02	9.972099	554
CASHRGAP	3.17	3.47875	5.68	0.5	1.304069	554
BONDGAP5	2.15	2.105	4.125	0.165	0.852364	554

Table 6.2: Correlation matrix

Variable	SPREAD	DBANK-BILLS	AUD\USD	VIX	CASHR-GAP	BOND-GAP5
SPREAD	1					
DBANK-BILLS	-0.2392	1				
AUD\USD	0.4395	0.1535	1			
VIX	0.2813	-0.3065	-0.1530	1		
CASHR-GAP	0.3588	-0.1642	0.35457	0.38644	1	
BOND\ GAP5	0.3843	-0.0441	0.61073	0.2931	0.7629	1

6.4 Empirical analysis

In order to avoid issues related to spurious regressions, prior testing for stationarity of variables was carried out. This section presents the results of these tests.

6.4.1 Unit root tests

In the first step, the unit root test is performed to investigate the stationarity property of the time-series data. If all examined time-series data are found to be stationary, this result could suggest a VAR model should be applied; otherwise variables do not have finite variance and the VAR model might lead to the spurious estimate problem. In the case of non-stationarity, the co-integration property of the variable vectors will be inspected by the ARDL method (M. H Pesaran & Shin, 1999); M Hashem Pesaran et al. (2001); M H Pesaran and Smith (1998) to seek for the ability to apply the VECM model.

To apply the ARDL method, it requires that none of the series are I(2). We apply three alternative procedures to test for the stationarity property of the underlying series, which are the augmented Dickey - Fuller (ADF) test (Dickey & Fuller, 1979), the Phillips–Perron (PP) test (Phillips & Perron, 1988), and the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Test (Kwiatkowski et al., 1992). Unit root test procedures' outputs strongly reject the existence of an I(2) series in the set of variables. As can be seen in Table 6.3, all series are stationary at "level" or at "first-difference".

Table 6.3: Unit root tests

Variable	***ADF***	***PP***	***KPSS***
	t-statistic	***t-statistic***	***LM-Statistic***
SPREAD	-6.2326***	-6.0710***	2.1339
D(SPREAD)	-17.4555***	-37.5288***	0.0902
EXR	-1.7023	-1.5784	2.3318***
D(EXR)	-18.5451***	-18.4529***	0.0583
BANKBILL	-0.8637	-1.4408	0.4067*
D(BANKBILL)	-7.3837***	-25.6735***	0.2142
VIX	-3.4684***	-3.8353***	0.4168
D(VIX)	-27.2755***	-27.3271***	0.0373
CASHRGAP	-2.0531	-1.4269	0.6452**
D(CASHRGAP)	-4.7246***	-22.3197***	0.1521
BONDGAP	-2.2938	-2.3599	1.3212***
D(BONDGAP)	-18.2313***	-25.2587***	0.0858

****, **, and *** indicate the statistical significance at 10%, 5% and 1%, respectively***

6.4.2 ARDL model

Considering the conditional error correction model, this is similar to a traditional ECM exception in that the error correction vector is not determined:

$$\Delta SPREAD_t = \alpha_0 + \sum_{i=1}^{p_1} \alpha_{1i} \Delta SPREAD_{t-i} + \sum_{j=1}^{p_2} \alpha_{2j} \Delta EXR_{t-j} + \sum_{k=1}^{p_3} \alpha_{3k} \Delta CASHRGAP_{t-k} + \sum_{l=1}^{p_4} \alpha_{4l} \Delta BANKBILL_{t-l} + \sum_{m=1}^{p_5} \alpha_{5m} \Delta VIX_{t-m} + \sum_{n=1}^{p_6} \alpha_{6n} \Delta BONDGAP_{t-n} + \beta_1 SPREAD_{t-1} + \beta_2 EXR_{t-1} + \beta_3 CASHRGAP_{t-1} + \beta_4 BANKBILL_{t-1} + \beta_5 VIX_{t-1} + \beta_6 BONDGAP_{t-1} + \gamma Dummy_t + \varepsilon_t$$

Where $p_{1\ldots7}$ are lags of "first different" terms. The lags lengths are selected based on information criteria, including the AIC (Akaike, 1973), the SIC (Schwarz, 1978), the HQC (Hannan & Quinn, 1978), to balance between the complexity and the goodness of fit of the models. The results are slightly different among selection criteria. The AIC suggests a lag length of 3; the SIC and Hannan-Quinn Information Criterion (HQIC) suggest a lag length of 2 (see Table 6.4). While the overestimated lag length is criticised as a decreasing the degree of freedom and the power of the test, underestimated lag length can cause serial correlation in the errors and make estimates seriously biased. Taking advantage of a large sample size, the maximum suggested lag length of 3 is used in following empirical analysis.

Table 6.4: Lag length selection criteria

Lag	LogL	AIC	SIC	HQ
0	-6507.288	23.8582	23.9054	23.8766
1	-1296.394	4.9025	5.2335	5.0319
2	-1163.513	4.5476	5.1623*	4.7879*
3	-1102.53	4.4561*	5.3545	4.8073
4	-1067.137	4.4583	5.6404	4.9204
5	-1037.884	4.483093	5.948821	5.056059
6	-1008.772	4.508321	6.257738	5.192183
7	-973.2738	4.51016	6.543266	5.304919
8	-948.0301	4.549561	6.866356	5.455216

* indicates lag order selected by the criterion

6.5 Empirical estimates

With the selected lags length, the conditional error correction model is estimated by OLS method (see Table 6.5).

Table 6.5: Empirical estimates–conditional ECM

Dependent variable: $\Delta SPREAD_t$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-0.9156	10.7066	-0.0855	0.9319
$\Delta SPREAD_{t-1}$	0.1193	0.0437	2.7276	0.0066
$\Delta SPREAD_{t-2}$	0.0813	0.0428	1.9007	0.0579
$\Delta SPREAD_{t-3}$	-0.1075	0.0425	-2.5302	0.0117
ΔEXR_{t-1}	-223.7512	93.5973	-2.3906	0.0172
$\Delta BANKBILL_{t-1}$	-5.9708	10.1916	-0.5859	0.5582
ΔVIX_{t-1}	-0.3031	0.3493	-0.8676	0.3860
$\Delta CASHRGAP_{t-1}$	-2.0745	9.6692	-0.2145	0.8302
$\Delta BONDGAP_{t-1}$	8.1870	5.9165	1.3838	0.1670
$SPREAD_{t-1}$	-0.2325	0.0324	-7.1838	0.0000
EXR_{t-1}	12.5061	13.6765	0.9144	0.3609
$BANKBILL_{t-1}$	0.0668	0.1703	0.3926	0.6948
VIX_{t-1}	0.2464	1.4185	0.1737	0.8622
$CASHRGAP_{t-1}$	-0.2031	2.6818	-0.0757	0.9397
$BONDGAP_{t-1}$	13.2365	4.0372	3.2786	0.0011
$Dummy_t$	-0.9156	10.7066	-0.0855	0.9319
R-squared	0.1534	No of Obs		550
Adjusted R-squared	0.1312	Mean dependent variable		0.1695
S.E. of regression	25.4589	S.D. dependent variable		27.3140
Sum squared resid	344973.4	AIC		9.3389
Log likelihood	-2553.197	SIC		9.4564
Durbin-Watson stat	2.0104	HQC		9.3848
Breusch-Godfrey serial correlation LM test:				
F- Statistic	0.3984	Prob. $F(3,531)$		0.7542
χ^2- statistic	1.2328	Prob. $\chi^2(3)$		0.7542

The Breusch-Godfrey Serial Correlation test (Breusch, 1978; Godfrey, 1978) does not reject the null hypothesis that there is no serial correlation. This supports the strict requirement of the bound testing procedure that the disturbance terms of the conditional ECM must be serially independent. In order to investigate the dynamic stability of the autoregressive model, the inverse roots of the characteristic equation

associated with the autoregressive model is estimated. Because the inverse roots lie inside the unit circle, it is concluded that the model is dynamically stable (see Figure 6.1).

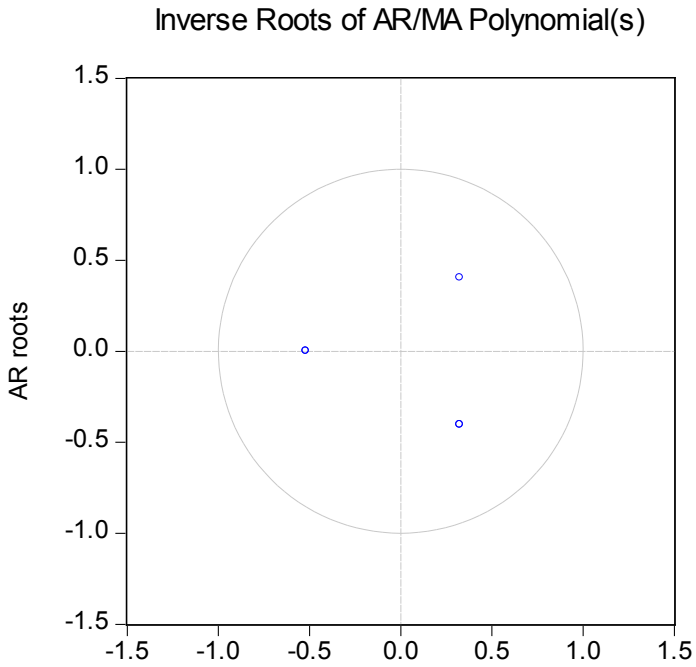


Figure 6. 1: Dynamic stability test - unrestricted

The next step in ARDL procedure suggested by M Hashem Pesaran et al. (2001) is to investigate the presence of a long run relationship among time-series. The *F*- test for the hypothesis that $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ is conducted. The calculated *F*- statistic is 10.62. With the coefficient *k* equals the number of series minus one, $k = 5$, M Hashem Pesaran et al. (2001) provided the lower and upper bounds for the *F*-test statistic at the 10%, 5%, 2.5% and 1% significance levels are [2.36 , 3.35], [2.62 , 3.79], [2.96 , 4.18] and [3.41 , 4.68] respectively[3]. As the calculated value of *F*-statistic is greater than the upper bound at the 1% significance level. This shows the evidence for a long run relationship among time series.

[3] Table CI (iii) on the page 300 of M Hashem Pesaran et al. (2001)

To cross check, the $t-$ test for the null hypothesis $\beta_1 = 0$ against $\beta_1 < 0$ is conducted. The calculated t- statistic is -7.1838. With $k = 5$, M Hashem Pesaran et al. (2001) provided the lower and upper bounds for the t-test statistic at the 10%, 5%, 2.5% and 1% significance levels are [-2.57 , -3.86], [-2.86 , -4.19], [-3.13 , -4.46] and [-3.43 , -4.79] respectively[4]. As the calculated value of *F*-statistic is less than the I(1) bound at the 1% significance level, this supports the conclusion that there is a long run relationship among time-series data.

As the bound testing suggests the existence of the long run relationship, the restricted ECM is built up. Firstly, the long run relationship is modeled by the equation:

$$SPREAD_t = \beta_1 + \beta_2 EXR_t + \beta_3 BANKBILL_t + \beta_4 VIX_t + \beta_5 CASHRGAP_t + \beta_6 BONDGAP_t + \varepsilon_t$$

Using the predicted residual from the OLS regression as error correction terms, EC, the shortrun relationship has the form:

$$\begin{aligned}\Delta SPREAD_t &= \alpha_0 \\ &+ \sum_{i=1}^{p_1} \alpha_{1i} \Delta SPREAD_{t-i} + \sum_{j=1}^{p_2} \alpha_{2j} \Delta EXR_{t-j} \\ &+ \sum_{k=1}^{p_3} \alpha_{3k} \Delta BANKBILL_{t-k} + \sum_{l=1}^{p_4} \alpha_{4l} \Delta VIX_{t-l} \\ &+ \sum_{m=1}^{p_5} \alpha_{5m} \Delta CASHRGAP_{t-m} \\ &+ \sum_{n=1}^{p_6} \alpha_{6n} \Delta BONDGAP_{t-n} + \beta EC_{t-1} + \gamma Dummy_t + \varepsilon_t\end{aligned}$$

From Panel A (Table 6.6), it can be shown that EXR, VIX and $CASHRGAP$ have positive effects on $SPREAD$ in the long run whereas $BANKBILL$ and $BONDGAP$

[4] Table CII (iii) on the page 303 of M Hashem Pesaran et al. (2001)

affect $SPREAD$ negatively. From Panel A, it is worth noting that the coefficient of the error correction term, EC_{t-1}, is negative and strongly statistically significant. This demonstrates the cointegration relationship between time-series data. The EC_{t-1} coefficient magnitude indicates that over 22% of any disequilibrium between SPREAD and its determinants is corrected within one period (one week). The short run relationships among variables are analysed in impulse-response analysis.

We also check the dynamic stability of the restricted ECM (Figure 6.2). Obviously, the inverse roots lie inside the unit circle so the model is dynamically stable.

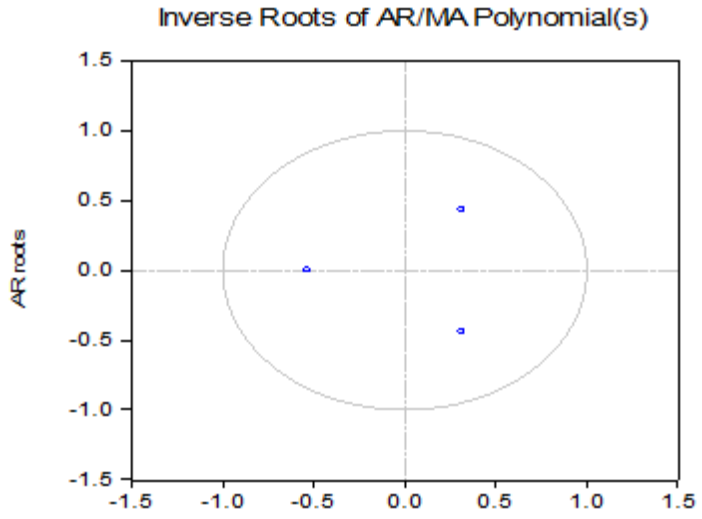


Figure 6 2: Dynamic stability test - restricted

Table 6.6: Empirical estimates – restricted ECM

Regressors	**Coefficient**	***t*- statistic**
Panel A: Long run relationship (dependent variable: $SPREAD_t$)		
EXR_t	155.2386	11.6100
$BANKBILL_t$	-15.6862	-10.9500
VIX_t	1.0744	5.7200
$CASHRGAP_t$	3.0658	1.3600
$BONDGAP_t$	-3.4004	-0.8700
Panel B: Shortrun relationship (dependent variable: $\Delta SPREAD_t$)		
$Constant$	-0.6799	-0.50
$\Delta SPREAD_{t-1}$	0.1109	2.53
$\Delta SPREAD_{t-2}$	0.0731	1.70
$\Delta SPREAD_{t-3}$	-0.1143	-2.68
ΔEXR_{t-1}	-244.7565	-2.65
$\Delta BANKBILL_{t-1}$	-4.3255	-0.43
ΔVIX_{t-1}	-0.3347	-0.98
$\Delta CASHRGAP_{t-1}$	-1.0310	-0.11
$\Delta BONDGAP_{t-1}$	9.2412	1.62
EC_{t-1}	-0.2076	-6.68
$Dummy_t$	2.3205	1.00

6.5.2 Impulse response analyses

From the impulse-response figures (see Figure 6.3), it could be seen that influence of a shock to $SPREAD$ diminishes gradually and almost vanishes after ten weeks.

An impulse from EXR has a negative effect on $SPREAD$ and takes approximately 5-10 weeks to fully adjust to exchange rate shock The effect vanishes after 10 weeks.

An impulse from $BANKBILL$ has a negative effect on $SPREAD$ that increases over time and remains stable after six weeks.

An impulse from VIX has a positive effect on $SPREAD$ that increases over time and remains stable after 10 weeks.

The response of $SPREAD$ to an impulse from $CASHRGAP$ is shown to be insignificant.

An impulse from $BONDGAP$ has a positive effect on $SPREAD$ that rapidly decreases after two weeks and almost vanishes and remains stable after ten weeks.

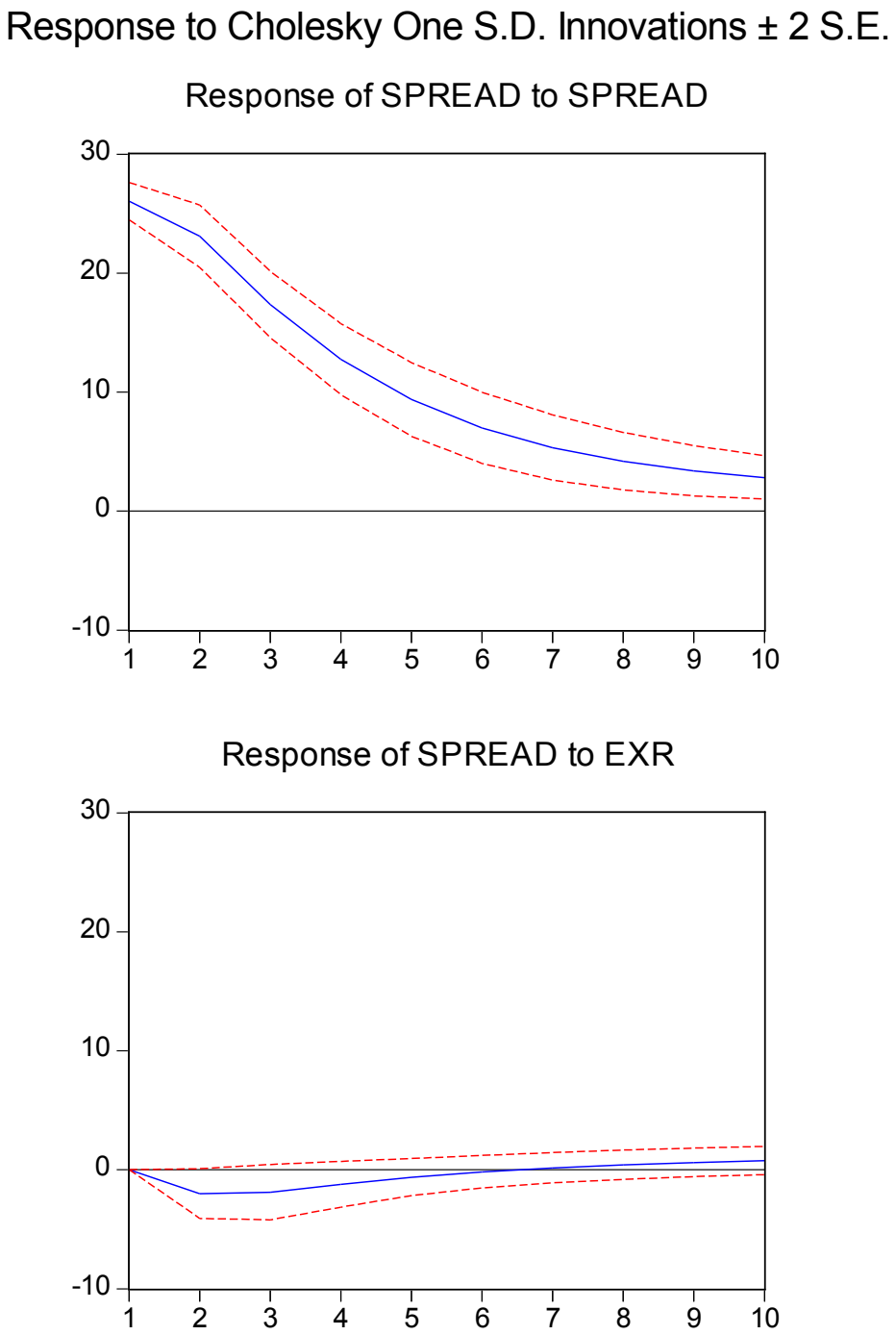


Figure 6.3: Spread variables' reaction to impulses

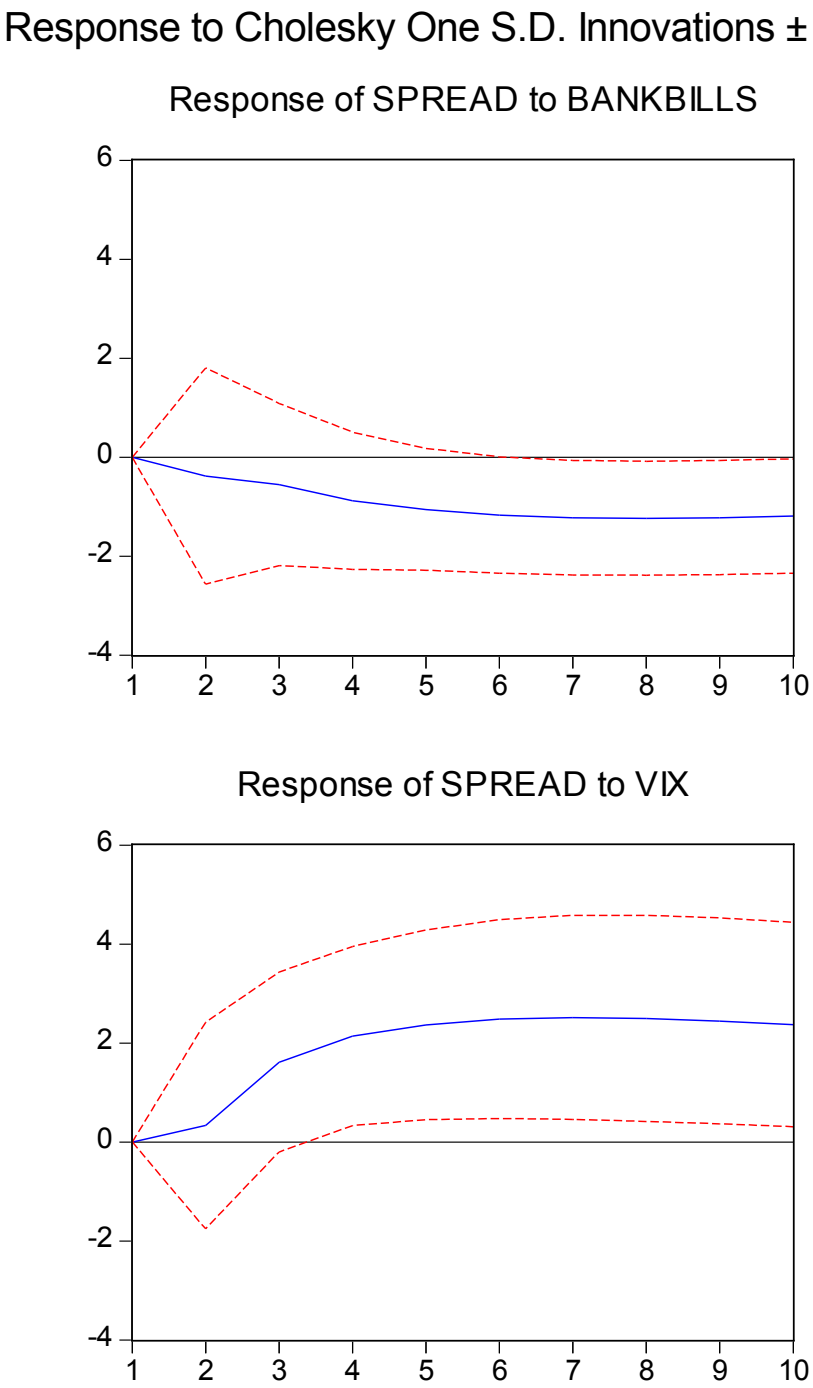


Figure 6.3 contd: Spread variables' reaction to impulses

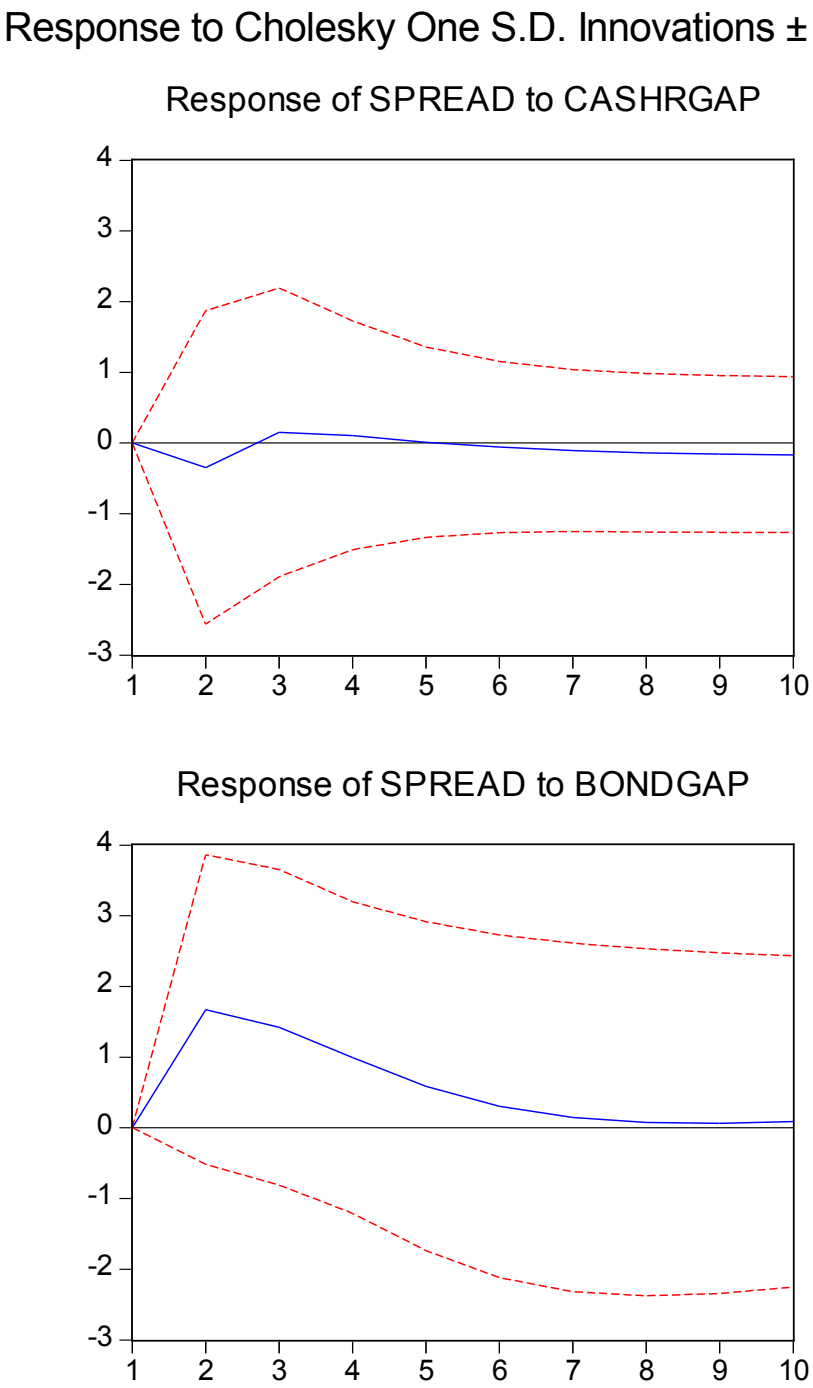


Figure 6.3 contd: Spread variables' reaction to impulses

6.5.3 Granger causality tests

To examine the bi-directional relationship between $SPREAD$ and independent variables, the Granger causality test is applied. The results are presented in Table 6.7.

Table 6.7: Granger causality test result

Null Hypothesis:	Obs	*F*-Statistic	Prob.
EXR does not Granger Cause SPREAD	554	8.89451	0.0002
SPREAD does not Granger Cause EXR		1.33009	0.2653
BANKBILL does not Granger Cause SPREAD	554	1.21691	0.2969
SPREAD does not Granger Cause BANKBILL		8.47911	0.0002
VIX does not Granger Cause SPREAD	554	2.04701	0.1301
SPREAD does not Granger Cause VIX		1.77419	0.1706
CASHRGAP does not Granger Cause SPREAD	554	3.94707	0.0199
SPREAD does not Granger Cause CASHRGAP		1.74250	0.1761
BONDGAP does not Granger Cause SPREAD	554	5.32442	0.0051
SPREAD does not Granger Cause BONDGAP5		0.33791	0.7134
DBANKBILLS does not Granger Cause AUDUSD	554	2.92694	0.0544
AUDUSD does not Granger Cause DBANKBILLS		5.98101	0.0027

The one-direction casual relationship is found between $SPREAD$ and EXR in which EXR Granger-causes $SPREAD$. Similarly, $CASHRGAP$ and $BONDGAP$ are found to Granger-causes $SPREAD$ while the inverse Granger-causalities does not exist. The Granger-causality relationship between $SPREAD$ and $BANKBILL$ are shown to be one-direction from $SPREAD$ to $BANKBILL$. No significant Granger-causality relationship is found between $SPREAD$ and VIX.

It is important to note that, even though b-directional causality tests were performed in this research, they have little influence on the overall analysis of this research

because it was established previously that the relationship between SPREAD and and the other independent variables were one-directional. Hence, mixing I(0) with I(1) variable in these causality test may not give spurious results.

6.6 Summary and conclusion

The chapter began with a description of the importance of recognising the stationarity in the model estimation process and the importance of establishing the co-integration relationship prior to undertaking regression. Thereafter it explained the method used for the selection of an appropriate lag length. Sections 4 and 5 presented the model specification and the description of variables used in this research. Then based on the results the following conclusions can be made.

WF spreads of Australian Banks are influenced by the movement of exchange rate. There is a negative relationship between the spread and the exchange rate implying an appreciation of exchange rate (quoted indirectly) leads to a decline in WF spreads. Furthermore, the WF market takes approximately 5-10 weeks to fully adjust to a given exchange rate shock ($H0_1$).

- WF spreads of Australian Banks are influenced by the bank bill rate. As predicted by the literature, the relationship between spreads and the bank bill rate is negative and the WF market takes over 10 weeks to fully adjust to a given change in the bank bill rate ($H0_2$).
- WF spreads of Australian Banks are influenced by the Volatility Index (VIX) which represents market volatility. Here too, the relationship between spreads and VIX is positive and the WF market takes over 10 weeks to fully adjust to a given change in the VIX. VIX is found to be the major driver of WF spreads ($H0_3$).
- In contract, WF spreads of Australian Banks are not influenced by the Cash Gap. In other words the Cash Gap has no significant impact on the WF spreads ($H0_4$).
- However, WF spreads of Australian Banks are influenced by the Bond Gap. The relationship between spreads and the bond gap is found to be positive and the WF market takes over 7 weeks to fully adjust to a given change in the

bond gap. The bond gap is found to be the second major driver of WF spreads ($H0_5$).

- Impulse Response Function on spread-to-spread relationship indicated that the market will take approximately 10 weeks to fully adjust itself for a given change in spreads.

It is important to note that the structural break would have had an impact on unit root tests. A time series may be I(1) when tested with a unit root test without structural breaks, such as ADF; while the same series may be identified as I(0) with unit root test with structural breaks. However, since ARDL is used in this research, it does not make any difference if the two methods (with or without structural breaks) give different results. Therefore the unit root test with structural breaks were not performed in this research.

Overall results indicate that the volatility index, bond gap, bank bill rate and the exchange rate are the prime drivers of WF spreads. The implications of these results on the WF markets are examined in the final chapter.

Chapter 7

Summary and Conclusions

7.1 Introduction

The first two chapters, Chapters 1 and 2, introduced the research question, the research hypotheses and investigated the size and scope of the Australian and global wholesale funding markets. Chapters 3 and 4 presented the bond issuance process of Australian banks and the theoretical and empirical literature on wholesale funding markets. Chapters 5 and 6 specified the research question and related hypotheses, the importance of prior testing to avoid potential issues of spurious regressions, and specified an appropriate model to derive estimates and rationale for selection of appropriate variables to be used in empirical estimations. The aim of this chapter is to provide a synthesis of this dissertation and to provide the summary and conclusions reached.

The remainder of this chapter consists of 5 sections including the introduction. The next section provides an overview of the thesis. Section 2 highlights the significance of research on drivers of wholesale funding spreads and examines the implications of results. Section 3 identifies research limitations. The penultimate section identifies future research opportunities. The final section provides a summary of conclusions.

7.2 Research review

Chapter 1 identified a gap in the existing literature on drivers of bank wholesale funding spreads through providing background information and prior research trends, which led to the introduction of the research question:

What drives bank wholesale funding spreads?: Empirical evidence from Australia.

The question is examined by developing 5 hypotheses:

$H0_1$ *Wholesale funding spreads of Australian banks are influenced by the movement of the official exchange rate.*

$H0_2$ *Wholesale funding spreads of Australian banks are influenced by the bank bill rate.*

$H0_3$ *Wholesale funding spreads of Australian banks are influenced by the Volatility Index (VIX) which represents market volatility.*

$H0_4$ *Wholesale funding spreads of Australian banks are influenced by the Cash Gap which is the difference between the domestic cash rate and the foreign interest rate.*

$H0_5$ *Wholesale funding spreads of Australian banks are influenced by the Bond Gap which is the difference between the domestic 5-year domestic Government bond yield and the foreign Government bond yield.*

Chapter 2 reviewed the size and scope of the wholesale funding market from global and Australian perspectives leading up to the 2008 financial crisis and post-financial crisis. The chapter examined the structure, conduct and performance of wholesale funding markets in particular, Australian banks. In addition, the chapter discussed the nuance of wholesale funding options available to banks, in particular short and long term, and the respective composition of this funding on their balance sheets, and analysed the significant increase in wholesale funding spreads of Australian banks that was mainly attributable to the 2008 financial crisis. An analysis of the distribution of bond issuance in Australia between banks, securitisers (mainly banks), corporations, federal and state governments and the rest of the world found Australian banks to be the largest bond issuers by volume in the world.

Chapter 3 provided an overview of the bond issuance process by the Big Four Australian banks. The chapter began with an analysis of corporate debt within Australia and found that approximately 75% of this debt was issued by the Big Four banks. The chapter then examined the wholesale funding strategies of the Big Four banks including level of diversification of bond issuance across currency, maturity, investor type, geographical locations and debt product types. It was found that their funding strategies were ubiquitous.

The chapter then analysed information on the pre-issuance of bond financing. This included selection of advisors, corporate finance analysis, cash flow forecasting, capital structure planning and assessing the funding sources available to the Big Four banks. Structuring the issue was analysed, which included appointing advisors, financial advisor, underwriter, legal counsel and external auditors and simultaneously, designing the bond characteristics. This includes the principal amount, par value, maturity, coupon rate, currency denomination, redemption, convertibility, covenants, security and the level of seniority. Finally, regulatory limitations are applied. This includes quotation requirements in Australia, capital adequacy requirements set by the Australian Regulation Authority, and regulatory limitations for issuance into the US private placements market. Finally executing the transaction was considered and consisted mainly of placement, registration and listing on the relevant exchange.

Chapter 4 incorporated the theoretical and empirical literature on wholesale funding markets. The chapter reviewed the research available on wholesale funding markets and developed a sound framework for analysing the research questions. The chapter also analysed empirical evidence and industry practices and their implication for the size and scope, as well as the growth, of wholesale funding markets. In addition, Chapter 4 integrated the theoretical and empirical literature on wholesale funding markets and reviewed the research available on wholesale funding markets to develop a sound framework for analysing the research questions. The chapter also analyses empirical evidence and industry practices, and their implication for the size and scope, as well as the growth, of wholesale funding markets.

Chapter 5 reviewed the literature related to the role of wholesale funding markets in order to justify the development of the hypotheses. It then specified the research question and related hypotheses. Thereafter it highlighted the importance of prior testing to avoid potential issues of spurious regressions. Finally it specified an appropriate model to derive estimates and rational for selection of appropriate variable to be used in empirical estimations to be performed in Chapter 6.

Chapter 6, the penultimate chapter, provided an explanation of the stationarity in the model estimation process and the significance of forming the co-integration relationship prior to undertaking regression. Following this, it explained the method

used for the selection of an appropriate lag length. Sections 6.4 and 6.5 presented the model specification and description of variables used in this research. Overall, the results indicate that the Volatility Index, bond gap, bank bill rate and exchange rate are the prime drivers of wholesale funding spreads. The Cash Rate Gap displayed no significance as a driver of wholesale funding spreads.

7.3 Implications of results

In line with prior research, the statistical evidence suggests the key drivers of Australian bank wholesale funding spreads are the VIX, the 10-year bond gap, the bank bill rate and the exchange rate. The RBA's cash rate however displayed no statistical significance as a driver of wholesale funding spreads and it is these findings that are particularly intriguing given the contrasting views of the Reserve Bank of Australia.

7.3.1 Wholesale funding spreads and the exchange rate

Strong significance is observed in the case where wholesale funding spreads of Australian Banks are influenced by the movement of the exchange rate. The relationship is found to be negative implying an appreciation of exchange rate (quoted indirectly) leads to a decline in wholesale funding spreads, and the wholesale funding market takes approximately 5-10 weeks to fully adjust to a given exchange rate shock.

As outlined in Chapter 5, the evidence suggests a significant relationship between exchange rates and funding spreads (Thuraisamy et. al 2008 and Riedel et. al. 2013). By logical extension, Riedel et. al. (2013) and Thuraisamy et. al. (2008) suggest this positive relationship may, in large part, be attributable to the fact that the local exchange rate approximates the country's specific risk and thus an increasing exchange rate reduces country specific risk and vice versa.

After the 2008 financial crisis, central banks of the developed countries had reduced their policy rates to almost zero. These low rates sent yields on government and investment grade debt instruments to record lows and in some countries to a negative rate. Given the high positive correlation between the RBA's cash rate at the

AUD/USD exchange rate, as the cash rate increases, this invariably impacts the exchange rate and attracts "yield seeking" international investors into Australian dollar denominated assets and thus, Australian bank wholesale funding instruments, triggering a fall in wholesale funding spreads.

7.3.2 Wholesale funding spreads and the bank bill rate

As predicted in the literature, wholesale funding spreads of Australian banks are influenced by the bank bill rate. The relationship between spreads and the bank bill rate is negative and the wholesale funding market takes over 10 weeks to fully adjust to a given change in the bank bill rate. The results are consistent with Longstaff & Schwartz (1995) where they employed a two-factor valuation model for valuing corporate bonds with reference to the effects from interest rates and the firm's asset value. These authors implied that funding spreads are negatively related to interest rates.

Further support was found in the work of Pynnonen et. al. (2006). Accordingly, the authors employed an implied equilibrium correction procedure into their modelling on three main variables: interest rate; firm asset volatility; and the firm asset return correlation with changes in the risk free rate. Convincing evidence suggested that the interest rate factor had the over-riding influence on funding spreads. Further consistent evidence from Batten et. al. (2005); Riedel et. al. (2013); Thuraisamy et. al (2008); Ito (2007) and Duffee (1998) on funding spreads driven by interest rates was systematically presented in Chapter 5.

Longstaff & Schwartz (1995) provide a justification for the inverse relationship between interest rates and funding spreads. They suggest that an increase in the interest rate increases the drift of the risk-neutral process, which in turn makes the risk-neutral probability of a default lower.

7.3.3 Wholesale funding spreads and the VIX

As expected, a strong significant relationship is found between wholesale funding spreads and the VIX. The relationship is found to be positive between spreads and takes over 10 weeks to fully adjust to a given change in the VIX. The VIX is found to be the major driver of wholesale funding spreads. This relationship is consistent

with the work of Zoli (2013); Elton et.al (2001); Batten et. al. (2005) and Riedel et. al. (2013). Given the VIX measures global volatility, the index represents market expectations of near term volatility and is calculated using the implied volatility of call and put options trading on the S&P 500 index. By logical extension, as the VIX increases investors become more risk averse and thus require an increased return in the form of higher spreads from bank bonds.

7.3.4 Wholesale funding spreads and the cash rate

There is no statistical significance in the relationship between bank wholesale funding spreads and the RBA's cash rate because the null hypothesis in this case was rejected. In other words, the Cash Gap has no significant impact on wholesale funding spreads. Thus, this thesis provides no statistical evidence that suggests Australian wholesale bank funding spreads are driven by changes in the RBA's cash rate.

As discussed in Chapter 5, there is consistent evidence particularly from the United States that suggests a gradual disconnect from central bank policy rates and long term market interest rates. Accordingly, during the 2007 financial crisis, wholesale bank funding spreads increased to record highs over benchmark interest rates. Since then, credit markets have begun to free up subsequently decreasing domestic and international funding spreads. In the years after the crisis, central banks around the world began to implement expansionary monetary policy. Following this, liquidity was forced into the financial markets by central banks thus pushing policy rates down and in most of the developed world these rates were very close to zero. In Australia the RBA was very quick to reduce the cash rate too. Reducing the cash rate should according to the RBA, reduce banks' funding costs and as a result reduce lending rates, particularly the banks' standard variable mortgage rate.

According to the RBA (2012), comments on determinants of wholesale bank funding spreads were as follows:

> *"The level of the cash rate set by the Reserve Bank is a primary determinant of the level of intermediaries' funding costs and hence the level of lending rates. It is the short-term interest rate benchmark that anchors the broader interest rate*

structure for the domestic financial system. However, there are other significant influences on intermediaries' funding costs, such as risk premia and competitive pressures, which are not affected by the cash rate. At various points in time, changes in these factors can result in changes in funding costs and lending rates that are not the result of movements in the cash rate. The Reserve Bank Board takes these developments into account in its setting of the cash rate to ensure that the structure of interest rates in the economy is consistent with the desired stance of monetary policy."

In contrast to the RBA, a 2013 publication by the Australian Bankers Association found that after the 2007 financial crisis, global events had a greater influence on the cost of wholesale bank funding and thus is a main driver of overall interest rates in the market. In fact, since 2007, they suggested the cash rate has no predicative power on bank wholesale funding costs in Australia.

7.3.5 Wholesale funding spreads and the bond gap

Wholesale funding spreads of Australian banks are influenced by the Bond Gap consistent with the prior research discussed in Chapter 5. The relationship is found to be positive and the wholesale funding market takes over 7 weeks to fully adjust to a given impact from the Bond Gap. The Bond Gap is found to be the second major driver of wholesale funding spreads. According to the literature, this relationship is due in large part to global risk aversion. Given the Bond Gap measures the spread between the Australian Government 10-year bond and the US 10-year Treasury bond, as investors become more risk averse this creates a sell off in the Australian Government bond market pushing bond prices down and consequently pushing their yields up resulting in higher bank wholesale funding spreads. In contrast to this, as a result of global risk aversion US Treasury bonds would increase in price therefore decreasing their yields.

7.4 Limitations

Although this study provides a comprehensive range of research contributions and implications, it is however constrained by several limitations. Firstly, wholesale funding spread data was collected on all domestic issued Australian bank

denominated debt and not on debt issuance from an off-shore perspective. As pointed out in Chapter 2, offshore funding accounts for approximately half of the banks wholesale funding requirements. Whilst accounting for off-shore wholesale funding spreads would provide a broader range of observations, the impact on funding spreads would be somewhat negligible given the efficiency and liquidity in global debt markets and after accounting for cross currency swaps and other transaction costs involved in debt issuance, arbitrage opportunities would force both domestic and off-shore funding spreads into alignment.

Secondly, wholesale funding spread data in this study was aggregated between the Big Four banks. Disaggregating funding spreads between the banks could be useful in determining whether an individual bank had a competitive advantage on wholesale funding spreads over another. Again, the variances would be rather inconsequential given the similarities between their credit ratings, market share and appetite for wholesale funding.

Finally, this study focused only on the Big Four banks wholesale funding spreads. As pointed out in Chapter 1, Australian banks operate within a two tier banking structure. The upper tier represents the largest banks (The Big Four) which account for approximately 90 per cent of the mortgage market and are similar in terms of market capitalisation, asset size and credit ratings. The second tier includes rural and community banks. The lower tier banks are similar also in terms of market capitalisation, asset size and credit ratings. Given the lower tier banks are also active in the wholesale funding markets; it would be interesting to see whether the macro-economic factors provided in this study had the same impact on wholesale funding spreads as the upper tier banks.

7.5 Suggestions for future research

To begin, future research might profit from an investigation into the relationship between wholesale bank funding spreads and key capital ratios including risk weighted capital on bank assets (mainly residential mortgages) and other liquidity reforms mandated by regulatory authorities (the new global capital and liquidity reforms, BASEL III) – that is, do banks that are required to hold higher levels of

capital, pay higher spreads on WF? For instance, researchers could examine WF spread impact on liquidity and capital adequacy ratios including Common Equity Tier 1 (CET1) of individual banks to determine whether one bank has a funding cost advantage over another. Furthermore, an examination into the impact of WF spreads and required levels of risk weighted capital would be of particular interest given the upper tier banks (the Big Four) can adopt their own internal risk-weighted capital requirements against assets once a rigorous review by the regulator of their data capture and risk measurement practices has been undertaken, whereas the lower tier banks (regional and community) usually adopt the regulatory body standard, which arguably adds more to the cost of providing the assets to the borrower.

The above areas for suggested research could also be extended to include other sources of funding such as shorter term WF funding instruments and rates paid on retail deposits. This would provide significant implications given banks rely heavily on short term WF instruments and their deposit base accounts for up to half of their funding compositions.

Secondly, on the asset side of the banks' balance sheet, an analysis into determinants of interest rate pricing, particularly the standard variable rate on the macro economic variables analysed in this thesis, would be merited. The implications from this would provide a superior foundation for interest rate price setting on key bank assets.

Finally, studies in the area of 'crowding out' have been conducted extensively throughout the United States and Europe and although this thesis provided an analysis on the literature on 'crowding out', future research may benefit in examining 'crowding out' and its impact on Australian banks' WF spreads. This would prove especially purposeful given the record amount of debt the Australian government has issued in the years after the financial crisis and the heavy reliance from Australian banks' on domestic and international WF markets.

7.6 Conclusion

The chapter began with a review of the research question, the related hypotheses and a review of all the chapters within this thesis. Next it provided an examination into

the implications of results from the hypotheses carried out in Chapter 6 and found WF spreads were driven by exchange rates, the bank bill rate, the VIX and the spread between the 5-year Australian Government bond rate and the 5-year US Treasury bond. However, this thesis found no statistical relationship between the RBA's cash rate and WF spreads. Thereafter it specified the research limitations. Finally the chapter explored potential areas for future research.

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