Effect of Too-Big-to-Fail Subsidies on Bank Borrowing Costs: Australian Evidence

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Synopsis

The recent global financial crisis raises the concern that large banks are too big to be allowed to fail, thereby distorting risk taking incentives, market discipline of banks' business activities and competitive dynamics. With the highly interconnected and concentrated nature of the Australian banking sector, an ideal natural experimental environment is available to examine the too-big-to-fail subsidies in a small open economy that is heavily reliant on banks for funding economic growth. By analysing primary bond market data from 2004 to 2015, this research suggests large banks realise a funding advantage in the form of implicit government guarantees after including different control variables in the analysis. In addition, bond investors are found to be less sensitive to large banks' risk, which is consistent with perceptions of possible government support in the event that the bank becomes financially distressed. Further, this study provides an early indication of whether the Basel III capital framework is effective in mitigating too-big-to-fail effects. I find evidence that the funding advantage of large banks is reduced since Basel III implementation. This result will be of interest to jurisdictions implementing the new capital framework in subsequent years.

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Contents

Chapter 1

Introduction

The 2007-2009 global financial crisis highlighted the ”too big to fail” (TBTF) problem as one of its most troubling legacies. The TBTF perception exists because some large financial institutions are seen as systemically important and their failure would threaten the health of the whole economy. It is likely to be believed by market participants that the governments of many countries, including Australia, will bail out these institutions, for example, by providing liquidity or funding support during a crisis. These perceptions of government bailout derive from implicit guarantees, the existence of which distorts the competitive dynamic, causes moral hazard problems in financial decision-making and exposes taxpayers to additional risk. Due to the recent debates of regulatory reforms on mitigating TBTF perceptions, a growing number of studies examine the TBTF-associated lower funding costs realised by large banks. However, these studies mostly focus on the United States and the European countries, and they only look at bond observations up to 2012. After this period, there have been substantial efforts conducted by international prudential regulators to address TBTF concerns, including introducing the Basel III capital framework to improve the banking sector’s loss absorbency during a market downturn. Using Australian primary bond market data, this study examines the TBTF subsidies realised by the four large Australian banks and the extent to which bond default risk is priced for these banks. In addition, a by-product of this study is the provision of an early view of the impact of the Basel III capital reforms on large banks' ability to capture TBTF subsidies.

With assets more than three times GDP, Australia's financial sector is highly concentrated and interconnected. As four of the most profitable banks in the world, the four large Australian banks hold 80 percent of banking assets and 88 percent of residential mortgages, which is significantly higher than the equivalent level in most of other jurisdictions (International Monetary Fund, 2012). Since the 2007-2009 global financial crisis, the four large banks appear to grow faster than before. The "cliff effect" characteristic of Australian banking system make it a better natural experimental environment for study TBTF problem, because the boundary between large and small banks is distinct and unconditional compare with other countries.[1] In addition, the four large banks have similar business models and rely extensively on wholesale funding from offshore markets. The concentrated and interconnected nature of the Australian banking industry is likely to increase the value of implicit subsidies, which makes Australia an important sample for studying the TBTF problem.

As discussed in the Murray Financial System Inquiry (FSI), even though Australia did not suffer as seriously as other countries during the recent financial crisis, its impact on GDP and a long period of increasing unemployment still heighten the concerns for strengthening resilience of the Australian financial institutions (Australian Treasury, 2014a). It is necessary to minimise the imposition on individual taxpayers and remove the impediments of efficient resource allocation and investment. It is contended by the FSI that it is necessary to remove the perception of implicit guarantees, in order to enhance resilience in the banking sector and reduce distortions stemming from taxpayers' support. However, few academic studies explore the nature of the implicit government guarantees in a small open economy of this nature. Ueda and Weder di Mauro (2013) measure im-

[1] According to the four indicators introduced by Australian Prudential Regulation Authority (2013) for assess domestic systemic importance, there is a significant wide gap between the four large banks and other banks across all dimensions. This "cliff effect" unambiguously determines the four large banks systemic importance.

plicit subsidies realised by large banks based on an international sample, which provides an estimate for Australian large banks among others. However, their estimation is based on credit ratings of all sample banks together and does not consider differences between large banks and small banks. To address this shortcoming, this paper examines funding advantages by comparing large banks with small banks, which provides a more direct measure for TBTF subsidies.

In addition, this study is the first to use bond pricing as a direct measure of funding costs for Australian banks. Two prominent studies conducted by Acharya et al. (2014) and Santos (2014) have analysed funding cost differentials by looking at market spreads on bonds issued by the US financial institutions. Their results provide empirical evidence for the lower borrowing costs that are realised by systemically important institutions due to TBTF perceptions. Building on these previous studies, this study seeks to examine more recent evidence on funding advantages in the Australian banking sector to better guide future financial reforms. To be specific, this study looks at issue yields to maturity of bonds issued by Australian banks from August 2004 to July 2015. The primary market yields represents the cost of wholesale debt for banks, which is a more direct measure than secondary market yields used by Acharya et al. (2014) and United States Government Accountability Office (2014). This paper presents evidence that the four large Australian banks are perceived as TBTF and benefiting an implicit subsidy. The results are consistent with expectations of potential government support being embedded in the funding costs of these four banks when they issue bonds. Using a number of control variables to disentangle effects on bond spreads apart from implicit guarantees, the evidence suggests that the four large Australian banks realise a funding advantage due to the perception of potential government support in addition to any advantage they obtain from their better diversification and economies of scale.

Furthermore, to better explore the cause of the implicit guarantee, this study then examines the relationship between the risk of large banks and their bond yield spread. This study find evidence that the bond spread-risk relationship is significantly flatter for the four large banks than for the other banks. This evidence suggests that investors are not concerned about the risk of large banks, therefore they demand lower compensation when they purchase large banks' debt. Because of the lower compensation the large banks pay to investors for their risk exposure, the TBTF perceptions give those banks a funding advantage. Further, to address the potential concern that the large banks are essentially less risky than small banks, the relationship between bank size and its risk is also tested. However, there is insufficient evidence to conclude that large banks are less risky than small banks. Combining these findings, the results suggest that TBTF perceptions distort investors' assessment of large banks' risk and may lead to moral hazard in the banking sector.

In 2010, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) was introduced and implemented in the United States. Previous research has investigated the effect of the Dodd-Frank Act on resolving TBTF problems, and the results show that it does make significant progress in the short term, but has not eliminated the TBTF perceptions over a longer horizon. (United States Government Accountability Office, 2014; Acharya et al., 2014). However, existing research does not examine whether reforms to bank capital regulation as part of Basel III have had a material impact in reducing TBTF perceptions among investors in bank debt. To my knowledge, this study is the first to examine the effectiveness of Basel III capital framework on reducing perceptions of potential government support. As Basel III capital reforms are implemented in advance of the international timetable, Australia provides a unique opportunity for assessing the effects of Basel III implementation on bank funding costs.[2] The results suggest that the implementation of Basel III capital reforms reduces the differential in credit spreads between four large banks and small banks. This study provides empirical evidence that higher capital requirements do help mitigate perceptions of potential government sup-

[2]At the beginning of 2013, Australian Prudential Regulation Authority (APRA) required ADIs to meet its new increased capital requirements for Tier 1 Capital and Common Equity Tier 1 as part of Basel III, which is three years ahead of the Basel Committee phase-in deadline. The new framework increased the minimum proportion of regulatory capital of Common Equity Tier 1 and Tier 1 Capital to 4.5 per cent and 6 per cent of risk-weighted assets, compared to 3 per cent and 4 percent respectively under Basel II. The other features of the reform will begin to phase in from 1 January 2016.

port. This evidence supports moves by prudential regulators to enhance existing capital regulation for systemically important banks.

The remainder of this dissertation is organised as follows. Chapter 2 reviews the related literature for the TBTF hypothesis and associated moral hazard problems and the effectiveness of policy responses. Gaps in previous studies are identified. Chapter 3 presents the policy framework for addressing TBTF problem at both the global and national level within Australia. Methodology and data source are presented in Chapter 4. Chapter 5 discusses the empirical testing results. Chapter 6 suggests potential policy implications. Chapter 7 concludes this study.

Chapter 2

Causes and Consequences of Too-Big-to-Fail Subsidies

The previous chapter outlined the main purpose of this thesis which is to examine the impact of the TBTF perceptions on bank funding costs in the absence of explicit government support, and assess the impact on implicit subsidies with the implementation of Basel III capital reforms. This chapter presents an overview of the literature related to TBTF subsidies with reference to the 2007-2009 financial crisis, the moral hazard problem potentially caused by TBTF problem, a review of alternative methodologies for estimating TBTF effects and the efficacy of government policies for addressing this issue. Unanswered questions that this thesis proposes to resolve are identified.

2.1 Banking Crisis and Government Responses

The 2007-2009 financial crisis started with a dramatic downturn of house prices in the US at the beginning of 2007. The default rate of sub-prime mortgage loans increased dramatically and severely affected the whole economy. With borrowers defaulting on their mortgages, mortgage holders and mortgage-backed security investors started to suffer significant losses (Cummings and Wright, 2015). At the peak of the crisis, banks refused to lend to others except at extraordinary high rates because the banking sector was not able to absorb loan losses. Many banks lost their investors' confidence in their solvency and liquidity. Subsequently, the crisis in the banking system spread to other sectors of the economy and financial markets froze. Australia was not immune from the crisis and the spillovers from overseas markets affected local banks and institutions. With governments in many counties stepping in with unprecedented injections of liquidity, capital support and guarantees, taxpayers' funds were exposed to significant risk.

As argued by Strahan (2013), it is believed by policy makers that the short-run benefits of bailout exceed the long-run costs (moral hazard). They perceive that the failure of financial institutions would not only harm their customers but also other financial firms. A series of studies have documented the significant costs of banking crises. Bernanke (1983) suggests that a drop in credit and assets on balance sheets are key causes of bank runs and failures, which may lead to the collapse of money stock. Using data from global arenas and long time period, Rogoff and Reinhart (2008) provide supporting evidence for this idea. Other influential studies using micro data within individual case studies unveil the high costs to borrowers (Ashcraft, 2005; Khwaja and Mian, 2008; Paravisini, 2008). Historical evidence has also demonstrated the output losses from the financial crisis and associated public debt increases in advanced economies (Laeven and Valencia, 2013). The large fall in GDP, disruption of investment activities and rise in unemployment indicate how broad the range of the crisis effects can be.

Consequently, governments cannot credibly commit not to intervene in the financial system and dampen the damaging effects of a banking crisis. In the recent crisis, both the US Federal Reserve and European Central bank provided short-term credit to restore liquidity and market confidence (Bernanke, 2011). These actions did not resolve the financial crisis from its underlying causes. However, they did help rebuild market liquidity and economic activities. In addition, historical records document that governments use taxpayers' funds to rescue insolvent financial institutions, which has been criticised for putting taxpayers' funds at risk (Australian Treasury, 2014b). Nevertheless, in the circumstance of such a crisis, this is the fastest and most efficient choice to avoid spillover economic damage caused by the failure of systemically important financial institutions.

Several high-profile and controversial government interventions occurred in the financial crisis. Several new emergency programs had to be provided to individual large financial institutions globally. Notably, in March 2008, due to the concern that the failure of Bear Stearns, one of the largest investment banks, would harm other financial institutions, the US Federal Reserve and Treasury authorised emergency assistance by brokering a purchase by JPMorgan Chase. However, 6 months later, when Lehman Brothers faced similar circumstances, the intervention was proposed again but was abandoned due to the instruction from the US Treasury. At that time, neither the US Federal Reserve Board nor other agencies claimed they had the jurisdiction to afford the capital to rescue Lehman Brothers(Sorkin, 2010; United States Government Accountability Office, 2011b).

The outcome for Lehman caused confusion and panic among investors, who had believed the government bailout to systemic financial institutions was unconditional. The failure of Lehman exacerbated the financial chaos and ultimately resulted in extended blanket bailouts provided by governments to all sizes of financial institutions globally (Laeven and Valencia, 2008; Brunnermeier and Pedersen, 2009; Strahan and Tanyeri, 2012). The very day of Lehman's bankruptcy announcement, the US Federal Reserve and Treasury publicly supported the AIG with $85 billion US dollars of credit assistance (United States Government Accountability Office, 2009). At the end of 2008, which is the peak of the crisis, the central banks of many countries, provided broad-based liquidity to the interbank market and governments initiated emergency preventative measures to avert for the failure of large financial institutions (Labonte, 2014). The government authorities then faced a dilemma between supporting systemically important institutions on a short-term basis or declaring the support to be unequivocal. With the potential growth of TBTF perceptions, the large banks in a number of advanced economies kept expanding. The complexity and interconnectedness of such large financial institutions are much greater than expected before the crisis. With the low quantity and poor quality of their capital base, these systemic financial institutions are not able to withstand an extended market downturn. Their failure can trigger a chain reaction in the whole financial system and through to the real economy.

The lack of focus on systemic risk, in turn, caught the attention of prudential regulators. The moral hazard problem caused by TBTF perceptions emphasized how governments' fiscal position can be eroded. As one of the major implications of the global financial crisis, the fiscal deterioration with expanding government debt and contingent liabilities is pervasive in advanced economies such as US and European countries. For G20 countries, the fiscal balance decreased by 8 per cent of GDP on average, and government debt rose by 20 per cent of GDP from 2008 to 2009 (International Monetary Fund, 2009). The increased debt reflects government support given to the financial sector and revenue losses caused by the crisis in advanced economies, as well as the implementation of counter-cyclical fiscal policies. It is argued that the debt-to-GDP ratios will continue to increase under current policies (International Monetary Fund, 2009).

2.2 Consequences of Too-Big-to-Fail Problem

As a consequence of mitigating systemic risk from a micro perspective, investors perceive possible bailout from government in the presence of spillover effects of bank failure. This perception leads to the hypothesis that some banks are TBTF and may receive an implicit government guarantee (Noss and Sowerbutts, 2012). The existence of an implicit government guarantee distorts not only market participants' risk evaluation, but also banks' risk taking behaviour. It also has the potential to negatively affect efficient allocation of financial resources. The literature related to this issue can be grouped into four main areas which are presented below.

2.2.1 "Too big to fail" distorts the risk-yield relationship for large banks

Over the years, studies have explored the variations in borrowing costs in relation to bank size after controlling for bank risk. Some studies have also looked at how the sensitivity of yield to risk measures changes with size. Early studies find little evidence for the sensitivity of borrowing costs on certificates of deposit (CDs) to measures of risk for large banks (Avery et al., 1988; Hannan and Hanweck, 1988). However, examining data from 1980, Ellis and Flannery (1992) identify that uninsured CDs do present risk sensitivity in some cases. Using sample data on subordinated debt issues, Flannery and Sorescu (1996) document a positive relationship between yields and bank risk becomes flatter with bank size increase. Acharya et al. (2014) using more recent data and provide supporting evidence that the bond spread-risk relationship flatten with perceptions of government bailout.

In addition, whether perceptions of government support influence rating agencies' judgements on risk assessments has been a topic of interest. Overall credit ratings are divided into two parts, a stand alone rating and a support rating that embeds the possible support from both holding companies and governments. Rime (2005) provides evidence that the component measuring external support in credit ratings increases with TBTF status. This impact on credit ratings might lead to distortions in investors' sensitivity to bank risk and their decisions when they lend to the bank. According to Standard & Poor (2014), government support to the four major Australian banks is currently worth two rating notches, providing a rating advantage to these banks.

2.2.2 "Too big to fail" distorts large banks' risk-taking incentives

Studies have found, with perceptions of government intervention reducing market discipline, investors no longer monitor the risks the banks are taking, which encourages the TBTF bank to take on more risks (Alessandri and Haldane, 2009). According to a study by Demsetz and Strahan (1997), large banks do have better diversification than smaller banks; however this advantage does not mean less risk but greater leverage. The better diversification potentially encourages the large banks to pursue riskier lending. Further, Strahan (2003) also reports a negative relationship between capital-to-assets ratio and bank size. These studies provide evidence for large banks' risk-taking incentives with reference to TBTF perceptions.

After the recent financial crisis, a number of studies draw attention to the link between TBTF status and large banks' risk-taking behaviour. Gropp et al. (2010) find supporting evidence for this idea by looking at bank balance sheet data. They report that the competitor banks take on more risk because of the government guarantee, however the protected banks' risk-taking incentives do not increase due to the public guarantee. Gadanecz et al. (2008), in the meantime, reach a similar conclusion by focusing on the international loan market. Using Fitch Ratings' support rating floors (SRFs) on more than 200 banks from 45 countries, Afonso et al. (2014) find a positive relationship between impaired loans and government support, which suggests that guaranteed large or complex banks are more willing to take greater risks with the perception of future public rescues. These studies provide evidence of heightened asset risk in particular cases and demonstrate the significance of TBTF status in affecting banks' lending policies.

2.2.3 "Too big to fail" encourages banks to grow larger

In order to exploit the benefit from the TBTF subsidy, guaranteed banks are likely to expand at the expense of non-guaranteed banks (Freixas and Rochet, 1998). Studies that focus on bank mergers and acquisitions provide relevant evidence. Kane (2000) documents that for mergers with large banks as either target or acquirer, the acquirer stock prices go up when the merger is announced. By comparison, for mergers happening within smaller banks, the stock returns are negative on average. Penas and Unal (2004) present evidence that the diversification gains of merge-related bondholders are associated with TBTF status. Molyneux et al. (2014) investigate mergers and acquisitions in nine European Union economies during the period 1997 to 2007 and find a positive relationship between safety net subsidy derived from mergers and acquisitions deals and the likelihood of government rescue.

Brewer and Jagtiani (2013), in the meantime, focus on the merger premium that banks would pay to become TBTF and document that both stock and bond prices positively react to TBTF merger deals. Based on data during the period 1991 to 2004, which is the merger boom, this paper uses the merger premium to estimate TBTF subsidies from eight merger deals. They report at least $15 billion dollars of excess premium from merger deals which would add $100 billion dollars of assets to the organisations. This study provides strong evidence that part of merger behaviour is related to increasing TBTF status.

2.2.4 "Too big to fail" distorts competitive dynamic

The TBTF subsidy gives large banks a funding advantage and distorts the nature of competition between banks. Berger et al. (2005) suggest that small banks have an advantage over large banks because they are more able to collect and rely on soft information about local borrowers. Indeed it has been illustrated that the extent to which small banks act more effectively when providing lending services depending on relationships with borrowers (Loutskina and Strahan, 2011; Cortés, 2012). However, government support provides a funding advantage to large banks over small banks, which leads to reduction in the supply of credit to small banks. Gropp et al. (2010) report that the franchise value of competing banks is negatively impacted when their competitors are implicitly guaranteed by the government. This unfair competitive dynamic is also seen as a key trigger for the 2000-2006 housing boom in the US. The unregulated investment banks aggressively invested in subprime mortgage lending and related securities, which are seen as high risk investments. With government support being provided to large investment firms, this distorts competition in the prime mortgage markets, thus driving the small banks to expand into the subprime markets.

2.3 Different Approaches to Examining Too-Big-to-Fail Subsidies

Due to the significant moral hazard problems potentially caused by TBTF subsidies, this topic has come to the forefront in recent regulatory debates. A growing body of research has attempted to identify the nature of TBTF perceptions among market participants and how implicitly guaranteed banks behave with the expectation of government bailout. As reviewed by Kroszner (2013), recent attempts can be generally categorised into four broad approaches, based on credit ratings, deposits, bond pricing and credit default swap (CDS) spreads respectively. This section reviews the prior literature employing these different approaches.

2.3.1 Credit ratings

Studies that focus on credit ratings try to quantify the probability of government support embedded in the ratings for large banks. There are two types of ratings provided by the three major rating agencies, Moody's, Standard & Poor's and Fitch. The first type of rating is a standalone rating, which assigns a rating in a standard way using banks' balance sheet ratios, management competency, probability of default, individual risks, etc. The second type of rating is a support rating. This rating reflects the rating agency's view of the probability of external support. The margin between the standalone rating and support rating is defined as the rating uplift.

Morgan and Stiroh (2005) and Resti and Sironi (2005) demonstrate the use of ratings as a proxy to determine the value of implicit subsidies on bank debt. By generating the "notches" of rating uplift and converting them into basis points as advantage on debt issue, several studies apply this credit rating approach to estimate the difference in bond yields when banks realise the benefit of government support (Soussa, 2000; Rime, 2005; Morgan and Stiroh, 2005; Haldane, 2010, 2012; Hoenig, 2011; Ueda and Weder di Mauro, 2013). For instance, Rime (2005) provides evidence that bank size and market share positively affect the rating uplift of large banks. Based on a sample of domestic banks, global banks and building societies in the United Kingdom, Haldane (2010) estimated rating uplifts between 1.5 and 4 notches from 2007 to 2009. Applying a similar method and based on a large world wide sample of banks, Ueda and Weder di Mauro (2013) explore the embedded perception of state support in credit ratings by testing the long-run average value of the support rating over the standalone rating. This study quantifies the value of the structural subsidy at 60 and 80 basis points at the end of 2007 and the end of 2009, which is at the beginning of, and at the peak of, the financial crisis respectively. This study also provides estimates for the value of the implicit subsidy realised in the Australian banking sector. However, there is a limitation is that they do not examine the differences in subsidies between large banks and small banks.

Subsequently, Schich and Kim (2013) find that the implicit guarantee declined between 2010 and 2012 in many countries (not including Australia) due to the development and implementation of bank failure resolution regimes. They also document that bond holders do not typically suffer from losses, which demonstrates there is reduced incentive for bond holders to monitor the activities of banks. Their results are consistent with studies that suggest a muted bond spread-risk relationship for systemically important financial institutions.

The credit rating approach has been used by both the banking sector and academic researchers to calculate the funding cost advantage. However, this approach has been judged by some studies as problematic, due to questions the accuracy and timeliness of rating agencies' decisions. Some rating agencies were criticised after the market downturn during the financial crisis for the inaccuracy of their ratings (United States Government Accountability Office, 2014). Furthermore, the accuracy of the credit ratings aside, this method can only be reliable when rating uplift actually reflects the savings in issue costs. Also this approach is based on the assumption that market participants price the debt based on support ratings instead of standalone ratings, which, in some cases, overestimates the funding advantage (Kroszner, 2013).

In addition, it is demonstrated in a study by the United States Government Accountability Office (GAO) that the link between the expectation of government support and credit ratings is potentially weak. Not only do their interviews with large investors provide evidence that the impacts of credit ratings are limited, but credit ratings may change with a particular rating agency's idiosyncratic response to the passage of a new policy (United States Government Accountability Office, 2014). Furthermore, studies apply different ratings which might generate different results and results that are not generalisable beyond a single rating agency. Consequently, the rating based approach has significant limitations compared to other methods that can directly examine banks' funding costs.

2.3.2 Deposits

A second method used to determine the implicit subsidy is based on deposits. This approach assumes that the lower interest rates paid on uninsured deposits by large banks compared to the others is because of, and only because of, the perception of government intervention. Baker and McArthur (2009) document that the average cost of deposits for banks with total assets more than $ 100 billion is lower than that for smaller banks. This study also focuses on the period from the fourth quarter of 2008 to the fourth quarter of 2009, and finds that the lower funding cost realised by large banks is accentuated during this period. In another prominent study, Jacewitz and Pogach (2011) explore differences in interest rates offered by money market deposit accounts (MMDAs) between large and small banks at the branch level. They provide evidence that large banks tend to offer lower interest rates and pay a lower risk premium by about 15 to 40 basis points from 2005 to 2008. After controlling for other possible benefits contributing to the funding advantage, their study reports approximately 39 basis points advantage on risky deposits realised by large banks compared to smaller banks.

This approach, however, has been criticised for the assumption that the difference in interest rates can be isolated as the only attributable to the perception of a government guarantee. There are other factors that might influence deposit interest rates, for example, availability of various services related to deposits, lower cost of service, access to external funding sources, and other risks not associated with the likelihood of government intervention. Studies that use the deposit approach include controls and attempt to isolate the relationship between interest rates on deposits and potential government guarantees. However, it is difficult to cast off the influence of other factors, some of which are unobservable. This limitation makes deposit rates a noisy measure of TBTF subsidies.

2.3.3 Credit default swap spreads

Other studies use CDS spreads to approximate bond funding costs. This method examines the difference between observed and hypothetical CDS spreads using a theoretical model, the "Merton model" (Merton, 1974), which estimates the risk of default on debt based on the volatility of bank stock returns. Using this approach, Demirgüç-Kunt and Huizinga (2013) present evidence that the limits to the financial safety net for banks are negatively related to a country's public finances, which is reflected in bank valuation and CDS spreads. Tsesmelidakis and Merton (2012) apply a structural model to estimate the funding advantage of large banks using CDS spreads. They provide evidence that large banks shift to short-term fixed-rate debt to gain more benefit from their TBTF status.

Although this approach has some advantages over other methods, it is not certain whether the market pricing of CDS spreads is reliable during market turbulence (United States Government Accountability Office, 2014). A further limitation is that the data for CDS spreads tends only to be available for the largest banks, thus precluding the development of benchmarks for small banks.

2.3.4 Bond pricing

A number of studies attempt to determine the TBTF subsidy by examining the bond yield spread, a method this thesis employs. This approach uses the difference between interest rates paid by large banks and small banks when issuing bonds as a measure of the funding advantage benefiting large banks due to expectations of government intervention. For example, Flannery and Sorescu (1996) find that the yield spreads of subordinated debt issued by the United States banks are not risk sensitive after the public rescue of Continental Illinois bank in 1984. However, their evidence suggests TBTF perceptions weakened over time supporting conjecture that government guarantees no longer protect the debentures of most banks. With the passage of Federal Deposit Insurance Corporation Improvement Act (FDICIA) in 1991, the results of the study suggest that the expectation of government guarantees are eliminated. Sironi (2003) obtains similar results by looking at European banks from 1991 to 2001. Due to the European Union budget constraints and national central banks monetary policy levels, the TBTF perception is found to be reduced in the late 1990s with the bond yield spread becoming increasingly sensitive to specific bank risks. These findings suggest that the perceptions of implicit government guarantees change along with regulatory policy changes and the occurrences of particular interventions by governments and regulatory agencies.

Other studies find conflicting results regarding the government guarantee perception and spread-risk relationship. Balasubramnian and Cyree (2011) provide evidence that, after the rescue of Long-Term Capital Management in 1998, the relationship between bond yield spreads and risks of TBTF banks flattened. This finding is also supported in a study by Morgan and Stiroh (2005), who find that the spread-risk relationship on bank-issued bonds is flat during the rescue of Continental Illinois and even after the passage of FDICIA. Subsequently, Acharya et al. (2014) document a similar flat relationship for the largest financial institutions after the implementation of the Dodd-Frank Act.

Nevertheless, these studies focus mostly on the US market and the European markets, and their data do not cover recent years. Thus, the studies do not capture the TBTF subsidy changes over time. This dissertation uses a different market as the research environment, and by adopting bond pricing as the methodology, the TBTF subsidy experienced by Australian large banks will be examined. In comparison with the other approaches, primary market bond yields are used as a more direct measure of funding costs. A range of results by previous prominent studies suggests the bond yield spread as the most appropriate measure for this research (Acharya et al., 2014; Santos, 2014; United States Government Accountability Office, 2014). Furthermore, bond data are available for a reasonable number of issuers, which provide a sufficient sample of risk-yield information to support an empirical analysis of the TBTF subsidy in Australia. This study will use primary market yields in contrast to secondary market bond yields employed by Acharya et al. (2014) and United States Government Accountability Office (2014), which is the most direct measure of the cost of raising wholesale debt for banks.

2.4 Efforts by Regulators to Resolve "Too Big to Fail"

At the post-crisis stage, new regulatory strategies are introduced and implemented by governments globally to address the TBTF problem and mitigate the expectation of government support for depository institutions. Following the debate on regulatory reform, a number of studies attempt to evaluate the existing financial regulations with reference to empirical evidence. This sub-section will present the existing literature on financial regulations enacted to address TBTF problems.

2.4.1 FDIC Improvement Act

In 1991, the United States congress passed the FDICIA in response to the significant costs generated by support for depositors in response to an increasing number of bank failures in the 1980s. After approximately 1300 commercial bank failures since the Federal Deposit Insurance Corporation(FDIC) was first enacted in 1934, the FDIC started to close down insolvent financial institutions and became severely under-capitalised by 1991 (Mishkin, 1997). Meanwhile, the crisis in the thrift industry contributed to the motivation for introducing the FDICIA. The implementation of regulatory changes in FDICIA attempted to ensure the resilience and stability of both the banking and thrift industries and to reduce taxpayers' burden of financial system losses (Mishkin, 1997; Wall, 2010). The overarching provisions were "prompt corrective action" and "least cost resolution" implemented in 1994 (Spong, 2000). When ADIs' capital declines, the prompt corrective action provision requires the federal banking agencies to take early intervention and to act more vigorously to minimise the losses.

Using a simultaneous equation model, Aggarwal and Jacques (2001) investigate the impact of prompt corrective action on bank capital and credit risk and the results show that the capital ratios increase in the US banks without leading to offsetting increases in risk, which demonstrates the effectiveness of FDICIA. The least cost resolution provisions were also designed to deal with the TBTF problem. By limiting the loss-absorbing capacity of FDIC, this provision reduces the cost of reimbursing uninsured depositors (Eisenbeis and Wall, 2002). However, the least cost resolution provisions actually provide a systemic risk exception for large banks, which in effect declares a bank as TBTF to protect its depositors due to concerns about significant damage to the wider economy. This exception is only allowed with additional safeguards.[1]

Some studies also provide evidence that the implementation of FDICIA had a positive impact on the stability of the banking sector (Flannery and Sorescu, 1996; Benston and Kaufman, 1997). Flannery and Sorescu (1996) document that the TBTF perception weakened after implementation of FDICIA. However, other studies find conflicting evidence, namely that the TBTF problem has not been resolved by the passage of FDICIA, especially after the test of the recent financial crisis. GAO questions the effectiveness of prompt corrective action when financial conditions are severely stressed (United States Government Accountability Office, 2011a). In addition, Morgan and Stiroh (2001) report a flat risk-yield relationship for bonds issued by banks after the implementation of FDICIA. These concerns about FDICIA result in the passage of new financial regulation, the Dodd-Frank Act.

[1]This systemic risk exception is only allowed with agreements of a two-thirds majority of the Board of Governors of the Federal Deposit Insurance Corporation, a two-thirds majority of the Board of Governors of the Federal Reserve System, and the Secretary of the Treasury.

2.4.2 The Dodd-Frank Act

In 2010, the Dodd-Frank Act was implemented in the United States with a purpose of creating a new mechanism to resolve the TBTF problem. This placed new restrictions on the financial assistance provided by emergency authorities, allowing the FDIC to impose the cost of losses on creditors and shareholders and enhancing the perception that the creditors need to absorb the losses when bank runs occur (United States Government Accountability Office, 2014). The Dodd-Frank Act attempts to clarify which investors will bear bank losses, which may be essential in stressed markets (Sprayregen and Hessler, 2010). It also requires systemically important financial institutions to develop their own resolution plans to reduce the potential disruption to creditors, counterparties and customers when systemically important financial institutions face difficulties (Kroszner and Shiller, 2011).

The Dodd-Frank Act attempts to build into the new regulatory framework a clearinghouse which is permanently effective to deal with financial crisis and bankruptcy of large institutions (Kroszner, 2010). Some scholars believe the Dodd-Frank Act reduces the likelihood of government intervention but that it does not eliminate it. Acharya et al. (2014) report that the Dodd-Frank Act brings down the yield spread differential when the new regime is first implemented. However, when the authors examine a longer implementation period, this effect becomes insignificant, which suggests that the implementation of the Dodd-Frank Act does not reduce investors' perception of government support. By reviewing credit rating agencies' assumption about government rescue and applying qualitative approaches, a study by GAO reaches to similar conclusions (United States Government Accountability Office, 2014).

2.4.3 Basel III Capital Framework

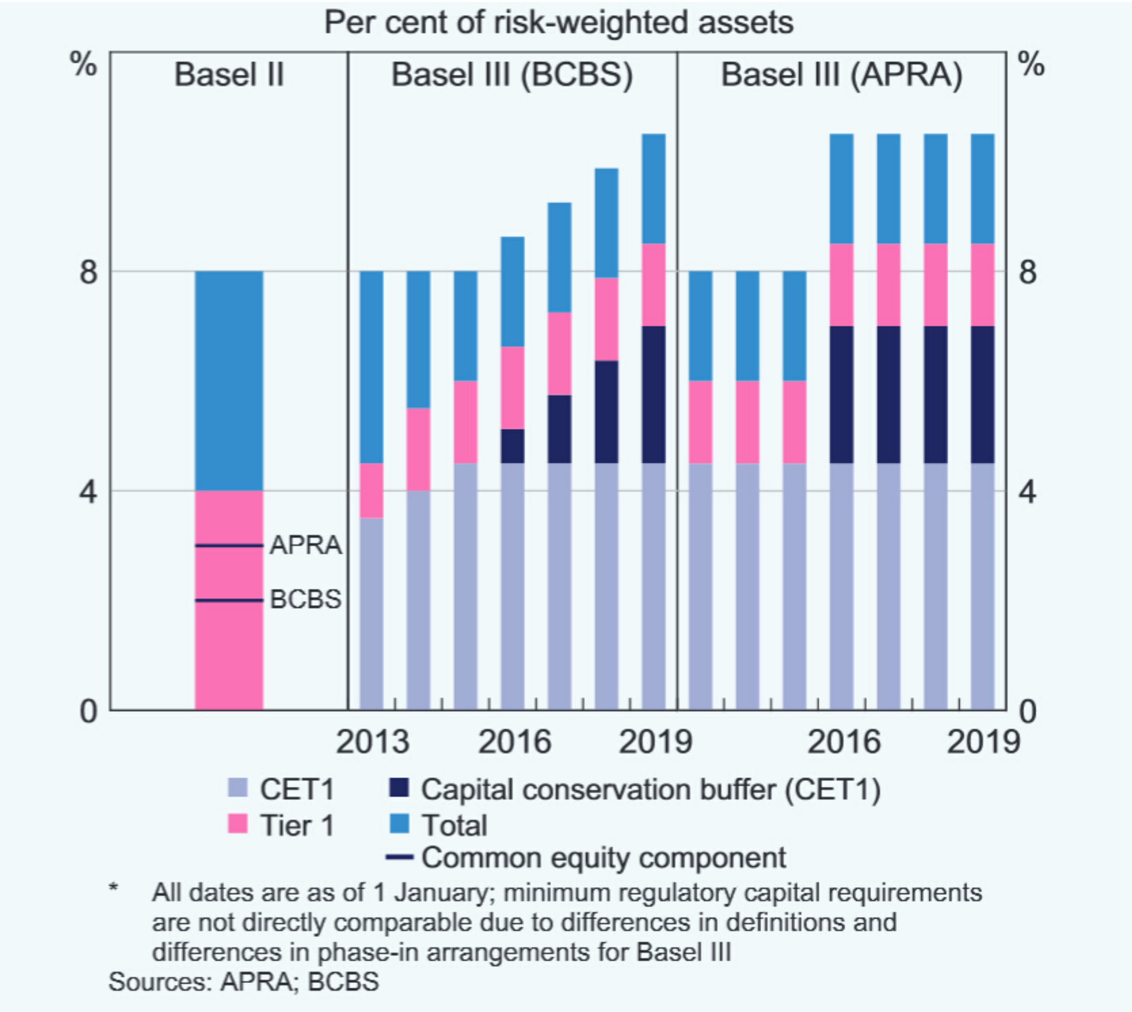
Bank capital is an essential element in financial soundness and a safety buffer for the banking system (Berger et al., 1995). Higher capital helps maintain bank confidence with investors and reduces the likelihood of bank failure. By internalising financial distress costs within the bank, higher capital requirements may help resolve distortions caused by the perception of implicit government guarantees. Mehran and Thakor (2010) document the positive relationship between bank value and bank capital in the cross-section, which is consistent with the benefit of a higher capital requirement in encouraging banks to manage credit risk more effectively. Berger and Bouwman (2013) find that capital affects bank performance and enhances the possibility of survival for small banks at any time, while for medium and large banks, the positive impact of capital is mainly evident during a banking crisis. Thesis studies support the idea that maintaining higher capital requirements contributes to building a more resilient financial system and mitigating the likelihood of a financial crisis.

In response to the weaknesses identified in the capital framework during the recent financial crisis, the Basel Committee on Banking Supervision proposed the Basel III capital reforms to improve the loss-absorbing ability of the banking sector when encountering stressed financial market conditions. The reforms are claimed to help reduce spillover to the whole economy (Basel Committee on Banking Supervision, 2010). The reforms increase the proportion of Common Equity Tier 1 capital to 4.5 percent of risk-weighted assets (RWA), which was 3 percent under Basel II. In addition, the requirement of Tier 1 capital becomes 6 percent of RWA, which was 4 percent under Basel II, while the total capital requirement remains unchanged at 8 percent of RWA.[2]

[2]Basel III capital framework adopt a stricter qualifying criteria for deductions from capital base, for instance in relation to intangible assets and non-consolidated subsidiaries. A stricter approach to regulatory adjustments requires most deductions to be made from common equity rather than non-common equity under Basel II.

The Basel III capital reforms also introduce new features that will be phased in from 1 January 2016. These new features include a conservation buffer for common equity of 2.5 per cent of RWA. In addition, to prevent the banking sector from periods of excess risk growth, regulators have the discretion to enforce a countercyclical capital buffer, which is up to 2.5 per cent of RWA. Moreover, Basel III proposes a simple maximum leverage ratio, which is 3 per cent of Tier 1 capital, to prevent the build up of excessive on- and off-balance sheet leverage. This simple maximum leverage ratio is introduced to enhance the risk-based approach to regulatory capital requirements.

Figure 1: Minimum Regulatory Capital Requirements: Timetable for transitioning to Basel III



To complement stronger capital requirements, a strengthened liquidity rules are proposed to promote banking sector stability. The Basel Committee proposes internationally harmonised liquidity standards to fill the gap in this area. The liquidity framework establishes two minimum standards for measuring and monitoring bank liquidity. The first standard is the Liquidity Coverage ratio, which is introduced to build short-term resilience in the banking sector by maintaining high quality liquid resources. The second standard is the Net Stable Funding Ratio, which is proposed to promote resilience by encouraging banks to gather more stable funding on an advancing structural basis. Following quantitative impact assessments conducted by the Basel Committee since 2011, the Liquidity Coverage Ratio and the Net Stable Funding Ratio are scheduled to be introduced on 1 January 2015 and 1 January 2018 respectively.

As a member of the Basel Committee, the Australian Prudential Regulation Authority (APRA) played a role in formulating the Basel III rules. As shown in Figure 1, on 1 January 2013, APRA implemented key components of the Basel III capital framework, which is three years before the phase-in deadline for countries adopting the Basel III rules according to the international timetable (Australian Prudential Regulation Authority, 2012). APRA required ADIs to meet the new standards for Common Equity Tier 1 capital and Tier 1 capital in entirety from 1 January 2013, which makes Australia a suitable jurisdiction for examining the effectiveness of the new regulation in resolving the TBTF problem. By comparing the funding advantages of large banks before and after the Basel III implementation, this thesis investigates whether early implementation of the Basel III capital framework contributes to mitigating the TBTF problem.

2.5 Summary

The review of the related literature presented in the section has disclosed unanswered research questions regarding the causes, consequences and the effectiveness of policy responses relating to TBTF theory. The methodology applied to attempt to answer the research questions and the data that will be used are described subsequently.

A large number of early studies demonstrate that the risk-yield relationship varies with bank size and explore the sensitivity of how funding costs change with bank size by looking at CDs and subordinated debt (Avery et al., 1988; Hannan and Hanweck, 1988; Ellis and Flannery, 1992; Flannery and Sorescu, 1996). After the recent financial crisis, a set of studies draw attention to the moral hazard created by the expectation of government support, affecting risk-raking incentives. The studies document empirical evidence to support this idea (Gropp et al., 2010; Gadanecz et al., 2008; Afonso et al., 2014). In addition, studies that focus on mergers and acquisitions report that benefits from TBTF status have become part of the motivation for mergers and acquisitions (Freixas and Rochet, 1998; Kane, 2000; Penas and Unal, 2004; Molyneux et al., 2014; Brewer and Jagtiani, 2013).

Studies apply different approaches to investigate the nature of the TBTF subsidies, and some try to quantify the funding advantage. More inspiring studies like Ueda and Weder di Mauro (2013) use a credit rating approach and quantify the structural subsidy in basis points by mapping against the rating uplifts of large banks. Other studies use deposits and CDS spreads to measure the TBTF subsidy (Baker and McArthur, 2009; Jacewitz and Pogach, 2011; Merton, 1974; Demirgüç-Kunt and Huizinga, 2013; Tsesmelidakis and Merton, 2012). This dissertation uses data on bond yield spreads to examine the TBTF subsidy realised by the four large Australian banks, as this method has been used by recent papers and been demonstrated to provide a more direct measures of implicit subsidies compared to other methods (Santos, 2014; Kroszner, 2013; United States

Government Accountability Office, 2014; Acharya et al., 2014). Compared with the other studies conducted in the United States and the European countries, this study provide a richer picture by looking at differences between large banks and small banks in a different market and more recent data.

In addition, in response to TBTF hypotheses, an event study linked to the early implementation of Basel III capital reforms in Australia is carried out. The Australian implementation of these reforms provides a natural experiments as to whether higher capital requirements change investors' TBTF expectations.

This dissertation addresses three research questions left unresolved in the existing literature:

Q1: Do large banks realise a cost advantage when they issue bonds courtesy of the perception of "too big to fail"?

Q2: How much implicit subsidies do large banks benefit from in the context of a highly concentrated domestic banking industry?

Q3: Does too-big-to-fail status affect assessments by bond investors of bank risk?

Q4: Do increases in Common Equity Tier 1 and Tier 1 capital requirements make it more difficult for large banks to capture implicit subsidies?

Chapter 3

Domestic systemically important banks in Australia

In 2014, the FSI re-evaluated the financial system and reviewed its performance during the period of financial crisis from 2007 to 2009 (Australian Treasury, 2014b). Although the Australian economy did not suffer from the financial crisis to same extent as elsewhere and was more resilient than other countries, it was still not immune from the impacts of the financial crisis. Inter alia, the TBTF problem has become one of the top concerns raised by policy makers and regulators. This section will discuss the TBTF framework at both the global level and the national level.

In the aftermath of the recent financial crisis, the Basel Committee developed a framework to deal with global systemically important banks (G-SIBs) in response to the consequences of public intervention during the financial crisis. The TBTF problem followed the bailout provided by government authorities when systemically important financial institutions had a destabilising influence, leading to concerns about broader effects of the economic recession. The intervention by authorities possibly exacerbated the moral hazard associated with the expectation of government guarantees and consequent misallocation of financial resources. The Group of Twenty (G20) leaders, including Australia, expressed their view that there should be no TBTF institutions in any country and taxpayers should not have to pay for the cost of public bailouts (Financial Stability Board, 2013).

Furthermore, using data at end-2013, the Financial Stability Board (FSB) updated the list of global systemically important banks (G-SIBs). Thirty banks on that list were identified as requiring greater capacity to absorb losses by maintaining higher capital (Financial Stability Board, 2014). Even though there is no Australian bank on the list, the TBTF problem exists in Australia at the national level. As suggested by the Basel Committee, banks that are less important internationally than G-SIBs but still significantly affect the domestic economy are deemed domestic systemically important banks (D-SIBs) (Basel Committee on Banking Supervision, 2012). After the Basel Committee introduced the principles of the D-SIB framework, APRA commenced implementing the D-SIB framework in Australia. As determined by APRA, this framework in Australia is limited to large banks. Other authorised deposit-taking institutions (ADIs), such as building societies and credit unions, lack the scale and scope of major banks. Even though some of them contribute to the competitive landscape in Australia, they are not included in the D-SIB framework (Australian Prudential Regulation Authority, 2013).

Following the four key indicators of systemically important financial institutions proposed by the Basel Committee, APRA built its own guidelines to determine the D-SIBs. The four indicators of systemic importance are size, interconnectedness, substitutability, complexity. After applying APRA's methodology to assess Australian institutions, the four big banks had the highest ranking according to the four indicators with a "cliff effect" above the other banks on all indicators. The four banks determined as D-SIBs in Australia are: Australia and New Zealand Banking Group Limited; Commonwealth Bank of Australia; National Australia Bank Limited; and Westpac Banking Corporation.

Chapter 4

Data and Methodology

The sample data sourced for examining the TBTF subsidies consists of corporate bonds issued by Australian banks. This study focuses on ten domestic banks operating in Australia between August 2004 and July 2015. Table 1 reports the sample banks, comprising the four banks been identified by APRA as domestic systemic important banks (D-SIBs) and six banks that are relatively smaller domestic banks. The analysis is restricted to licensed domestic Australian banks that maintain a required capital level. Branches of foreign banks, building societies and credit unions are excluded from the sample.

Table 1: Sample Australian banks

This table presents the sample Australian domestic banks included in the analysis. According to APRA, four banks are classified as domestic systemic important banks (D-SIBs).

Bank Name	Bank Type
Commonwealth Bank of Australia	D-SIB
National Australia Bank Limited	D-SIB
Australia and New Zealand Banking Group Limited	D-SIB
Westpac Banking Corporation	D-SIB
Bendigo and Adelaide Limited	non-D-SIB
Bank of Queensland Limited	non-D-SIB
Suncorp-Metway Limited	non-D-SIB
St. George Bank Limited	non-D-SIB
AMP Bank Limited	non-D-SIB
Macquarie Bank Limited	non-D-SIB

Information on all bonds including their issue date, maturity, coupon type, credit ratings, issue amount and yield to maturity at issue date are obtained from Bloomberg. In order to distinguish the impact of implicit guarantees from explicit government support, bonds issued under explicit government guarantee schemes are excluded from the sample. Moreover, due to the additional credit cover from dedicated collateral and more advanced bond characteristics, covered bond are excluded from the analysis following Packer et al. (2007). The analysis is separated into two segments for fixed-rate bonds and floating-rate bonds. All the primary bond issue data are collected from August 2004 to July 2015, as August 2004 being the earliest time credit market and bond-specific data are available on Bloomberg. The application of these criteria leaves a sample of 806 bonds, of which 373 are fixed-rate bonds and 433 are floating-rate bonds. Of the 373 fixed-rate bonds, 342 bonds are issued by the four large banks and 31 bonds are issued by the smaller banks. For floating-rate bonds, 270 bonds are issued by the four big banks and 163 bonds are issued by the smaller banks.

Noticeably, both large and small banks regularly issue bonds denominated in Australian dollars. However, only large banks consistently issue bonds denominated in foreign currencies. Therefore, this study focuses only on Australian-dollar issues in order, to be able to compare differences in yield spreads between large banks and small banks. Data for Australian Government bonds are collected from Bloomberg, while Bank Bill Swap rates (BBSW) are obtained from the Reserve Bank of Australia. In addition, to disentangle the TBTF effect from the impact of bank risk and operating efficiency, bank financial data are collected from Bloomberg, Morningstar and APRA. Lastly, the Markit 5-year Australian iTraxx index values are collected from Bloomberg.

To answer the question about how bond spreads vary with bank size, the empirical research begins with the following regression analysis:

$$
\begin{aligned}
Spread_{i,b,t} = & \alpha + \beta_1 BankSize_{i,t-1} + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} \\
& + \beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t + YearFE_t + \varepsilon_{i,b,t}
\end{aligned} \tag{1}
$$

Subscripts *i, b* and *t* denotes individual banks, individual bonds and the bond issue date respectively. Analyses are conducted separately for fixed-rate bonds and floating-rate bonds. For fixed-rate bonds, *Spread* is the bond yield to maturity at the time of bond issue over the yield to maturity of Australian Government bonds with the closest maturity. For the floating-rate bonds, *Spread* is the discount-adjusted margin over the bank bill swap rate at the time of issue. *BankSize* is the main variable in equation 1 that represents the effect of being TBTF. This study includes two measures for bank size effects: the four D-SIBs identified by APRA and the logarithm of total assets of each bank. A dummy variable *D-SIB* is set up that equals to 1 for bonds issued by the four D-SIBs and equal to 0 for bonds issued by the other banks. It is expected that, after controlling for risk-related factors, the coefficient on *BankSize* is significantly negative if the four big banks realise a funding cost advantage in bond issuance compared with the other smaller banks. In addition, although elements that make a bank TBTF are not limited to size, it is argued by Australian Prudential Regulation Authority (2013) that the size of the assets of a financial institution significantly drives the contribution to systemic risk. Even without significant interconnectedness, large firm size implies significant political influence (Johnson and Kwak, 2011). Therefore, the logarithm of total assets of an individual bank minus one billion Australian dollars (*LogTA*) is also included to better capture the variation of bond spread associated with bank size.

In order to distinguish the TBTF effect from endogenous characteristics of the bonds themselves, two bond characteristics, *Maturity* and *IssueSize* are included in the equation. The bond issue size is calculated as the logarithm of bond issue size minus log of one million Australian dollars. *Maturity* is the time to maturity of the bond in years. The maturity effect is included to control for differences in issue yields associated with greater risks of longer-maturity bank bonds.

Following previous studies that apply the bond pricing approach to examine TBTF effects (for example Acharya et al. (2014) and Santos (2014)), this study also includes several risk measures (*AssetRisk*) to control for differences in risk between large banks and smaller banks. Equity return volatility (*Volatility*) is used as the main risk measure in the analysis. Theoretically, the inverse of the volatility of equity returns can be used to estimate the likelihood of a firm's insolvency (Atkeson et al., 2014). After collecting daily bank stock prices from Bloomberg, equity return volatility is computed as the standard deviation of daily returns over the past 90 days.

To address the concern of misestimating bank risk, an alternative measure of risk is added to verify the result. To start, an accounting measure of risk, z-score (*Zscore*) is calculated as the sum of return on assets (ROA) and the ratio of book value of equity to total assets, averaged over the past 4 years, divided by the standard deviation of ROA over four years, then divided by 100. A z-score measures how many multiples of standard deviation that the ROA can drop before the financial firm runs into insolvency. A higher z-score suggests less likelihood of failure. This variable is used by Acharya et al. (2014) and Bertay et al. (2013). Further, the ratio of non-performing assets (NPA) to total assets (*NPA*) is used to capture credit risk. A bank with a high NPA ratio is likely to be exposed to higher credit write-offs in the short to medium term. Lastly, trading securities of each individual bank divided by its total assets (*TradSec*) is the fourth risk measure included in the tests.

In order to disentangle TBTF effects from other characteristics of individual banks, the spread model presented in equation 1 includes micro controls: return on assets (ROA), leverage ratio and maturity mismatch. A macro control is also included: the Markit 5-year Australian iTraxx. Following the methodology utilised by Flannery and Sorescu (1996), Sironi (2003) and Acharya et al. (2014), ROA, leverage ratio and maturity mismatch are included to separate the TBTF effects from the effects of bank operating efficiency and financing decisions. To start, ROA is the ratio of net income to total assets. ROA represents the profitability of an institution, which reflects the efficiency of management to generate earnings and realise any economies of scale. Then, leverage ratio computed as total assets divided by total shareholders' equity, which represents the level of financial risk taken on by the bank.[1] Finally, maturity mismatch is computed as short-term debt minus cash divided by total liabilities, which can be used to estimate a bank's liquidity position. A higher maturity mismatch suggests greater tendency of a bank to have more short-term debt than short-term assets, which reflects the bank's ability to pay obligations in a timely manner and under stressed market conditions. To address the concern of a market risk effect on bank funding costs, the Markit 5-year Australian iTraxx, which is a CDS index that indicates systematic credit risk, is added to the analysis. The 5-year Australian iTraxx is composed of the 25 equal-weighted most liquid investment grade entities listed on the Australian Stock Exchange, which have 5-year CDS frequently traded in the market.

After including bond characteristics, risk proxies, firm-level and macro-level controls, the negative significant coefficient on *D-SIB* or *logTA* would indicate a subsidy accruing to large banks representing funding advantage. To compute the annual implicit subsidy, this study includes interaction terms between *D-SIB* and year fixed effects to reveal the changes in the TBTF perception over time.

In an attempt to examine the effect of early implementation of Basel III capital reforms on the TBTF subsidy, equation 1 is expanded into the following model of bond spreads:

$$\begin{aligned} Spread_{i,b,t} = &\alpha + \beta_1 BankSize_i + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} + \\ &\beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t + \beta_7 Basel3 + \beta_8 Basel3 \times BankSize_i + \varepsilon_{i,b,t} \end{aligned} \tag{2}$$

[1]Leverage ratio remains in the equation when add in different risk proxies except equity volatility, because equity volatility incorporates a leverage-induced component.

This specification is an extension of the specification in equation 1, where *Basel3* is a dummy variable equal to 1 for bonds issued since the implementation of Basel III capital reforms in Australia from 1 January 2013. A negative and significant coefficient on *Basel3* would indicate that the implementation of Basel III capital reforms help improve the resilience of the banking sector from an investor's perspective. In addition, the interaction of *Basel3*$\times$ *BankSize* is the key variable of interest that indicates the impact of Basel III on large banks ability to capture a funding advantage. A positive significant coefficient on *Basel3* $\times$ *BankSize* would provide evidence that the TBTF subsidy realised by the four big Australian banks is reduced after the imposition of higher equity capital requirements.

Chapter 5

The Empirical Evidence

In this chapter, the empirical evidence is presented to demonstrate the extent to which TBTF expectations affect the costs when banks issue bonds. The descriptive statistics and correlation between variables are reported first. Then the question of whether the four big Australian banks are perceived as being TBTF is answered and discussed. This is followed by an exploration of whether the bond spread-risk relationship varies with bank size effect. Lastly, tests of the impact of Basel III capital reform on TBTF subsidies are presented.

5.1 Descriptive Statistics

Table 2 reports the descriptive statistics for the sample bank bond-issue observations. Variables in this table are presented in annual terms. *Spread* is reported in basis points. It can be seen that the average spread of fixed-rate bonds is 116 basis points and that of floating-rate bonds is 86 basis points. For bond characteristics, the mean value of fixed-rate bond years to mat‘urity (*Maturity*) is around 2 years longer than that of floating-rate bonds. With regard to bond issue amount (*Issuesize*), it can be observed that banks

Table 2: Descriptive statistics for bond-issue observations

This table presents summary statistics for bond issue observations, in which Panel A for fixed-rate bonds, while Panel B for floating-rate bonds. The sample period is from August 2004 to July 2015. *Spread* is in basis points. For fixed-rate bonds, *Spread* is the difference between bond yield to maturity at origination with maturity-matched government bond. While for floating-rate bonds, *Spread* is measured by discount margin over 3-month BBSW. *TA* is total assets of individual bank. *Maturity* is years to maturity for individual bond. *IssueSize* is the issue amount of individual bond. *ROA* is the return on assets, computed by net income before interest expense divided by total assets. *Leverage* is measured by total assets over total shareholders equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Z-score* measures financial distress, which is calculated as sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *NPA* is the ratio of non-performing assets to total assets. *TradSec* represents trading securities of individual bank over its total assets. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk.

Panel A: Fixed-rate bonds

Variable	**N**	**Mean**	**Standard deviation**	**Lower quartile**	**Medium**	**Upper quartile**
Spread (bps)	373	116.20	82.32	65.20	113.50	163.30
TA ($bil)	373	560.20	213.30	425.10	625.50	703.00
Maturity (year)	373	6.30	4.99	3.00	5.00	7.00
Issuesize ($mil)	373	199.60	311.40	21.00	85.50	225.00
ROA (% pa.)	373	0.88	0.37	0.71	0.94	1.03
Leverage	373	17.74	2.58	15.95	17.90	19.47
Mismatch (%)	372	5.41	7.57	0.34	3.05	9.17
Volatility (%)	371	21.03	10.75	13.90	17.25	24.98
NPA (%)	370	0.57	0.29	0.31	0.62	0.80
Zscore	373	0.76	0.60	0.37	0.55	0.85
TradSec (%)	367	7.14	4.50	4.18	5.25	9.56
Itrx (bps)	351	112.20	48.15	86.72	108.20	139.00

Panel B: Floating-rate bonds

Variable	**N**	**Mean**	**Standard deviation**	**Lower quartile**	**Median**	**Upper quartile**
Spread (bps)	433	86.01	82.95	31.00	74.00	110.00
TA ($bil)	433	383.60	287.50	88.36	401.70	653.90
Maturity (year)	432	4.26	3.28	1.00	3.00	5.00
Issuesize ($mil)	433	452.10	634.50	50.00	150.00	500.00
ROA (% pa.)	433	0.83	0.47	0.66	0.91	1.03
Leverage	433	17.46	4.23	15.63	16.99	19.84
Mismatch (%)	425	7.60	13.05	-0.17	2.53	10.34
Volatility (%)	432	22.30	11.66	14.17	18.28	27.06
NPA (%)	410	0.49	0.33	0.21	0.43	0.70
Zscore	429	0.76	0.63	0.35	0.58	0.90
TradSec (%)	372	7.67	5.03	4.15	5.50	11.02
Itrx (bps)	403	102.70	55.22	81.27	102.60	128.90

issue a larger size of floating-rate bonds compared to fixed-rate bonds. In addition, for bank specific variables and the market-wide risk variable *Itrx*, the summary statistics are different for fixed-rate bonds and floating-rate bonds due to different numbers and timing of bond observations.

Figure 2 presents the mean value of the bond spreads (*Spread*) for D-SIBs and other banks on a yearly basis for combing fixed-rate bonds and floating-rate bonds from August 2004 to July 2015. From the bar chart, the average bond spread increases dramatically with the onset of the recent financial crisis, especially for non-D-SIBs. The credit spreads for smaller banks are consistently wider than for D-SIBs over the sample period. The difference increases abruptly from 2009 to 2011 after the peak of the financial crisis, then diminishes since 2013 coinciding with implementation of the Basel III capital reforms.

Table 3 presents the correlations between the bond-issue observations in the sample. The *D-SIB* dummy variable and *LogTA* are positively correlated with *ROA*, which indicates that the larger banks may have better operating efficiency and realise economies of scale. Larger banks are less risky based on the accounting z-score and trading asset measures, but bank size is not significantly related to equity volatility and non-performing assets. These descriptives provide a mixed picture of the riskiness of large Australian banks relative to small banks.

Figure 2: Bond spreads at issue, D-SIBs versus non-D-SIBs

This figure shows the yearly average spreads of all bond observations for the four D-SIBs identified by APRA and the other smaller banks. *Spread* (y-axis) is in basis points. For fixed-rate bonds, *Spread* is the difference between yield on a bank's bond at origination and maturity-matched government bond. While for floating-rate bonds, *Spread* is measured as discount margin over 3-month BBSW. The time period (x-axis) is from August 2004 to July 2015. The sample excludes covered bonds and bonds guaranteed under the Australian Government Wholesale Guarantee Scheme from 2008 to 2010.

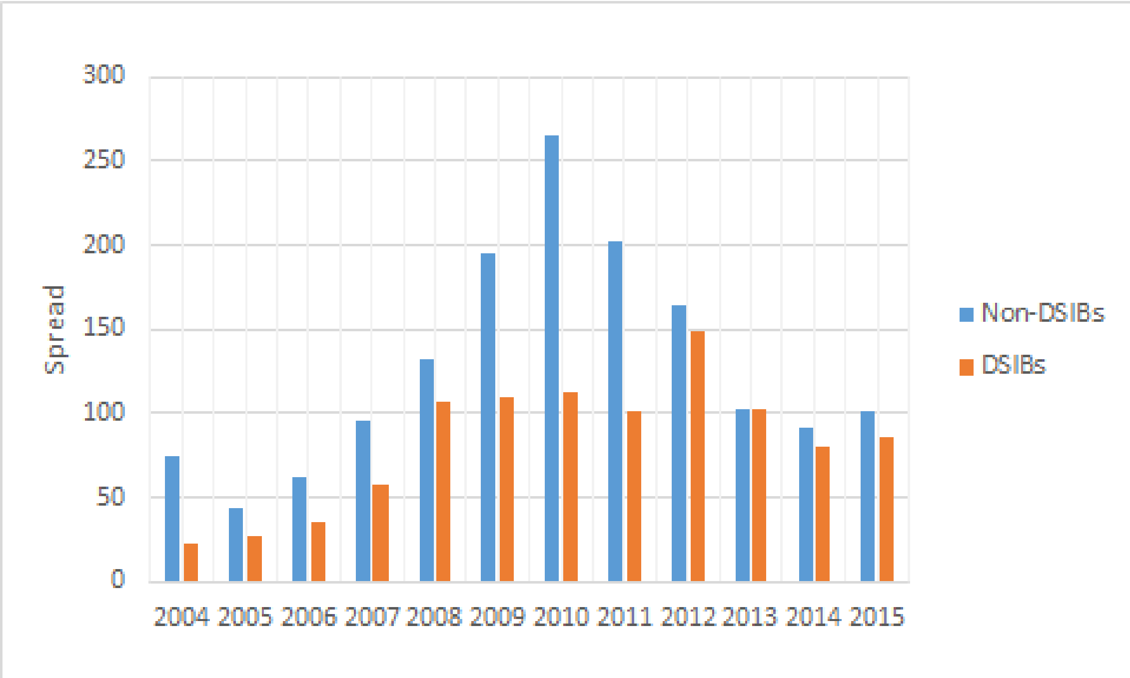


Table 3: Pearson correlation coefficients for the bond-issue observations

D-SIB is a dummy variable equal to one if a given bank is one of the four D-SIBs of Australia classified by APRA and zero otherwise. *LogTA* is the difference in logarithm between total assets and one billion Australian dollars. *Maturity* is years to maturity for individual bond. *IssueSize* is the logarithm of issue amount minus log of one million Australian dollars. *ROA* is the return on assets, computed by net income divided by total assets. *Leverage* is measured by total assets over total shareholders equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Zscore* measures financial distress, which is calculated by sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *NPA* is the ratio of non-performing assets to total assets. *TradSec* represents trading securities of individual bank over its total assets.

	D-SIB	logTA	Issuesize	Maturity	ROA	Leverage	Mismatch	Itrx	Volatility	Zscore	NPA
logTA	0.90***										
Issuesize	0.11***	0.12***									
Maturity	0.06*	0.05	-0.20***								
ROA	0.24***	0.18***	0.06*	-0.01							
leverage	0.18***	0.03	-0.03	0.05	-0.09***						
Mismatch	-0.25***	-0.16***	0.04	-0.14***	0.13***	-0.43***					
Itrx	0.18***	0.32***	-0.02	-0.03	-0.21***	0.07**	-0.11***				
Volatility	-0.04	-0.02	-0.01	-0.09***	-0.04	0.30***	0.05	0.46***			
Zscore	0.13***	0.04	0.04	0.00	0.21***	0.09***	0.03	-0.07*	0.03		
NPA	0.03	0.23***	-0.04	0.05	-0.45***	-0.40***	0.14***	0.37***	-0.18***	-0.33***	
TradSec	-0.21***	-0.12***	-0.04	0.04	-0.51***	0.40***	-0.05	0.16***	0.29***	-0.24***	0.10***

5.2 Tests of Too-Big-to-Fail Cost Savings

To determine whether investors expect government intervention for the four large Australian banks, this study examines the extent to which the size of a bank affects the credit spreads of its bonds at the time of issue. The use of a long sample period may give rise to the concern of macroeconomic changes and introduction of new regulations, for example, the 2007-2009 financial crisis, and the new prudential regulations such as Basel II and Basel III. These events might change the compensation investors demand when investing in banks. To address this concern, year fixed effects are included in all the regressions in this table.

To start, Table 4 presents the empirical results of *Banksize-Spread* regressions for fixed-rate bonds (Panel A) and floating-rate bonds (Panel B) respectively. The explanatory variable, *D-SIB* is set up as a proxy for bank size that identifies the effect of TBTF expectations in the regression, which is a dummy variable equal to one if a bank is one of the four D-SIBs as classified by APRA and zero otherwise. According to the result, *D-SIB* has significantly negative impact on *Spread*, with larger institutions issuing bonds with lower effective borrowing costs. This result suggests that the four large banks in Australia realise implicit subsidies due to the perceptions of government support. Investors may demand lower compensation provided by D-SIBs because they perceive these four banks as TBTF and potentially would be supported by government before become insolvent. This evidence is consistent with previous literature that supports the TBTF hypothesis based on the United States and international evidence (Acharya et al., 2014; Ueda and Weder di Mauro, 2013; Santos, 2014; United States Government Accountability Office, 2014). With the main risk variable *Volatility* included in the regression, the four large banks benefit from estimated average 25 and 42 basis points cost savings compared with small banks when issuing fixed-rate and floating-rate bonds respectively.

Table 4: BankSize-Spread Regressions

This table reports the regression results for the model $Spread_{i,b,t} = \alpha + \beta_1 BankSize_{i,t-1} + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} + \beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t + YearFE_t + \varepsilon_{i,b,t}$. For fixed-rate bonds, *Spread* is the difference between bond yield to maturity at origination and maturity-matched government bond. While for floating-rate bonds, *Spread* is measured as discount margin over 3-month BBSW. TBTF effect (*BankSize*) is measured by two different proxies. *D-SIB* is a dummy variable equal to one if a given bank is one of the four D-SIBs of Australia classified by APRA and zero otherwise. *LogTA* is the difference in logarithm between total assets and one billion Australian dollars. *Maturity* is years to maturity for individual bond. *IssueSize* is the logarithm of issue amount minus log of one million Australian dollars. *ROA* is the return on assets, computed by net income divided by total assets.*Leverage* is measured by total assets over total shareholders' equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk. *AssetRisk* of individual bank is measured by *Volatility*, *Zscore*, *NPA* and *TradSec*. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Zscore* measures financial distress, which is calculated by sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *NPA* is the ratio of non-performing assets to total assets. *TradSec* represents trading securities of individual banks over their total assets. Robust t-statistics in parentheses are based on standard errors clustered at the issuer level. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

PANEL A: Fixed-rate bonds

Variables	Model1 Spread	Model2 Spread	Model3 Spread	Model4 Spread	Model5 Spread	Model6 Spread	Model7 Spread	Model8 Spread
D-SIB	-0.0025**		-0.0032**		-0.0023*		-0.0022**	
	(-2.63)		(-2.78)		(-2.16)		(-2.65)	
LogTA		-0.0010**		-0.0014***		-0.0011**		-0.0011***
		(-3.10)		(-3.54)		(-3.26)		(-4.01)
Issuesize	0.0004***	0.0004***	0.0004***	0.0004***	0.0003***	0.0004***	0.0004***	0.0004***
	(4.88)	(4.79)	(4.10)	(4.38)	(4.00)	(4.11)	(4.36)	(4.54)
Maturity	0.0008***	0.0008***	0.0008***	0.0008***	0.0008***	0.0008***	0.0008***	0.0008***
	(6.80)	(6.81)	(6.83)	(6.95)	(6.93)	(7.03)	(6.59)	(6.67)
ROA	-0.7352***	-0.7358***	-0.6343**	-0.6136**	-0.8072***	-0.7882***	-0.4440	-0.3917
	(-4.55)	(-4.30)	(-2.66)	(-2.51)	(-4.49)	(-4.68)	(-1.34)	(-1.17)
Leverage			0.0002	0.0002	0.0002	0.0002	0.0000	0.0000
			(1.33)	(1.47)	(1.47)	(1.77)	(-0.02)	(0.17)
Mismatch	0.0121***	0.0134***	0.0128***	0.0145***	0.0103**	0.0113**	0.0101**	0.0105**
	(3.92)	(3.98)	(4.88)	(4.56)	(2.41)	(2.52)	(3.13)	(3.30)
Itrx	-0.0722	-0.0755	-0.0333	-0.0302	-0.0316	-0.0316	-0.0318	-0.0312
	(-1.50)	(-1.57)	(-1.02)	(-0.96)	(-0.74)	(-0.75)	(-1.11)	(-1.11)
Volatility	0.0046	0.0051						
	(0.83)	(0.94)						
Zscore			0.0002	0.0003				
			(-0.58)	(-0.84)				
NPA					-0.0017	-0.0019		
					(-0.60)	(-0.68)		
TradSec							0.0170	0.0188
							(1.07)	(1.15)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	349	349	350	350	344	344	346	346
R square	0.4500	0.4489	0.4497	0.4499	0.4499	0.4469	0.4484	0.4492

PANEL B: Floating-rate bonds

Variables	Model1 Spread	Model2 Spread	Model3 Spread	Model4 Spread	Model5 Spread	Model6 Spread	Model7 Spread	Model8 Spread
D-SIB	-0.0042***		-0.0042***		-0.0040**		-0.0047***	
	(-3.51)		(-4.19)		(-3.26)		(-4.47)	
LogTA		-0.0017**		-0.0017***		-0.0016**		-0.0023***
		(-3.23)		(-3.54)		(-2.76)		(-5.12)
Issuesize	0.0005	0.0005*	0.0004	0.0005*	0.0004*	0.0005*	0.0003	0.0003
	(1.79)	(2.09)	(1.62)	(1.89)	(1.90)	(2.17)	(0.87)	(1.13)
Maturity	0.0019***	0.0018***	0.0019***	0.0019***	0.0019***	0.0019***	0.0020***	0.0019***
	(9.13)	(8.95)	(9.39)	(9.17)	(10.15)	(9.89)	(7.23)	(7.31)
ROA	-0.3121**	-0.2630**	-0.3192***	-0.2621**	-0.4923***	-0.4510**	-0.2711**	-0.1414
	(-2.87)	(-2.32)	(-3.65)	(-2.44)	(-3.81)	(-2.92)	(-3.31)	(-1.29)
Leverage			-0.0002*	-0.0001	-0.0002	-0.0002	-0.0004*	-0.0003
			(-2.20)	(-1.44)	(-1.77)	(-1.48)	(-1.98)	(-1.35)
Mismatch	-0.0012	0.0007	-0.0037	-0.0009	0.0016	0.0045	-0.0090**	-0.0063*
	(-0.45)	(0.28)	(-1.36)	(-0.42)	(0.48)	(1.62)	(-2.44)	(-1.89)
Itrx	0.1993*	0.1790*	0.3146***	0.3080***	0.2769***	0.2659***	0.3411***	0.3311***
	(2.16)	(1.94)	(3.45)	(3.32)	(3.73)	(3.55)	(4.54)	(4.39)
Volatility	0.0101**	0.0108**						
	(2.54)	(2.66)						
Zscore			0.0009	0.0011				
			(-1.42)	(-1.59)				
NPA					-0.6221***	-0.6456***		
					(-3.55)	(-3.95)		
TradSec							0.0111	0.0130
							(1.24)	(1.40)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	393	393	391	391	381	381	348	348
R square	0.7657	0.7647	0.7660	0.7641	0.7751	0.7923	0.7886	0.7950

Although the relative size position of the four big banks is unchanged during the sample period, to better assess whether bank funding costs change with bank size, the logarithm value of total assets scaled by subtracting the logarithm of one billion Australian dollars (*LogTA*) is employed to replace the dummy variable *D-SIB*. It can be seen that with all the control variables included in the regression, the coefficients on *LogTA* stay negative and statistically significant. These testing results provide evidence for the idea of narrower credit spreads are associated with larger bank size, which support the hypothesis of investors' perception of implicit government guarantees to systemically important banks.

Further, in order to better isolate the TBTF effect reflected in *D-SIB* and *LogTA*, different risk variables are included in the regression. Following Acharya et al. (2014), equity return volatility (*Volatility*) is included as a risk measure. According to Atkeson et al. (2014), the inverse of a firm's equity return volatility can be used to estimate its distance to failure. In addition, motivated by previous literature (De Nicolö, 2001; Čihák and Hesse, 2010; Worrell et al., 2007) and in common with Acharya et al. (2014) and Bertay et al. (2013), Z-score (*Zscore*) is employed to detect financial distress, with a high Z-score indicating low probability of bank insolvency. In addition, the non-performing assets ratio (*NPA*) is the third risk variable which is a me tric of bank asset quality. A non-performing assets to total assets ratio is acknowledged by the Basel Committee as a predictor of bank failure built on bank credit risk management policies and loan underwriting practices (Basel Committee on Banking Supervision, 2015). *NPA* is included to capture the impact of default risk in the bank's asset portfolio. Lastly, trading securities to total assets ratio (*TradSec*) is the fourth risk variable. Trading securities are debt or equity securities traded in the short term for profits, they are reported on the balance sheet at fair value. Securities like mortgage backed securities and asset backed securities are included in trading securities, together with equities and fixed income assets, which expose a bank to significant risks. The larger portion of trading securities in total assets, the higher the likely level of overall risk inherent in the bank's asset portfolio.

It can be seen from most models that the estimated coefficients on risk variables are not statistically significant, which may suggest that investors are not sensitive to bank specific risk, a situation that might contribute to the idea of moral hazard existing in the banking sector. In addition, with different risk variables, the coefficient on *D-SIB* in all the regressions is consistently negative and statistically significant. That is, the results with respect to bank size are robust to the inclusion of the various asset risk proxies.

The other control variables, bond characteristics *Issuesize*, *Maturity*, firm-level controls *ROA*, *Leverage* and the macro-level control Markit 5-year Australian iTraxx (*Itrx*) are included to control for effects other than bank size that might impact on bond yield spreads (*Spread*). Because of the leverage effects on equity volatility, *Leverage* is not included in columns 1 and 2. In Panel A, the coefficients on *Issuesize* are positive and statistically significant, which indicate larger issues do not reflect narrower credit spreads due to improved trading liquidity of the issues in the secondary market. On the contrary, the positive coefficients suggest that larger issues of fixed-rate bonds result in wider spreads. This result is in common with Acharya et al. (2014). However, the coefficients on *Issuesize* in most regressions for floating-rate bonds do not present the same significance. A positive coefficient on bond issue size *Issuesize* for fixed-rate bonds suggests that market impact costs dominate any potential liquidity benefits associated with larger issue sizes. There is no evidence of market impact costs in the yield spreads for floating-rate bonds.

In addition, the significantly positive coefficient on *Maturity* indicates that bonds with longer issue terms carry higher credit spreads, which may compensate investors for bearing higher risks associated with longer term bonds. To address the concern that large banks may issue shorter term bonds which translates to lower funding costs, the mean values of *Maturity* for large banks and small banks have been tested and present insignificant differences.

With reference to firm-level controls, return on assets (*ROA*) is included to control for bank profitability and economies of scale. Operational efficiency may be enhanced with a greater scale of operation, which leads to lower funding costs. The coefficient on *ROA* is negative and statistically significant, which indicates a bank with better profitability or that realises economies of scale has lower credit spreads on the bonds it issues. To further explore whether the four large banks have higher ROA, regressions between *ROA* and *D-SIB* are also conducted (not reported). The results suggested that the four large banks have better operational efficiency than the other banks, contributing to narrower credit spreads. In Table 4, the coefficient on *D-SIB* stays significantly negative after including the control for *ROA*, which distinguishes the effect of bank profitability from purely size effects on bank funding costs. Even though the four big banks appear to realise better economies of scale and operational efficiency, there is still significant evidence that the credit spread differential can be attributed to a bank's TBTF status.

In addition, the leverage ratio (*Leverage*) is included to control for the financial leverage of a bank. The measure of leverage ratio is part of the DuPont analysis which break down return on equity (Groppelli and Nikbakht, 2000; Zane et al., 2004). As a direct measurement of a company's financial leverage, an asset to shareholders' equity ratio is used. According to the regression results, the coefficients on leverage are insignificant for fixed-rate bonds, while the coefficients are negative and statistically significant in the four regressions for floating-rate bonds. This latter result is surprising, but consistent with Acharya et al. (2014). A high leverage ratio may not only indicate the high financial risk of a bank, it might also apply to banks that have less risky asset portfolios. This possibly means that bank specific risks are not fully captured by the direct bank asset risk variables. Part of bank asset risk may be inadvertently captured by the control variable *Leverage*.

Further, maturity mismatch (*Mismatch*) is added to control for banks' liquidity positions, which reflect a bank's ability to obtain sufficient funds within a reasonable term to meet obligations as they come due. It can be seen that the spreads of fixed-rate bonds are related positively and significantly to maturity mismatch. Investors appear to surmise that more liquid banks are better placed to meet their fixed rate obligations. The positive coefficients on this variable for floating-rate bonds are statistically insignificant.

The Markit 5-year Australian iTraxx (*Itrx*) is included as a macroeconomic control to detect whether the credit spread varies with market-wide credit conditions. It can be seen from Table 4 Panel A that for fixed-rate bonds, the estimated coefficient on *Itrx* is insignificant. Compared with the significance of *mismatch*, the results suggest that the yield of fixed-rate bonds is more sensitive to bank-specific liquidity risk rather than market-wide credit risk. Contrary to the the insignificance of *Itrx* in the fixed-rate bond regressions, *Itrx* in the floating-rate bond regressions (Panel B) presents a significantly positive relationship with bond spreads. With very low sensitivity to liquidity risk, investors of floating-rate bonds are evidently more sensitive to systematic credit risk.

In summary, the results in Table 4 present significant evidence for the idea that the four large Australian banks are perceived as TBTF, with an implicit government guarantee that contributes to lower funding costs. The results of the control variables for fixed-rate bonds and floating-rate bonds suggest that investors have different sensitivities to market and bank specific risks, however, the results for the TBTF effect are robust. Consequently, with different types of coupon and sensitivity to risks, the empirical results indicate that the perception of government support for the TBTF banks is in evidence.

5.3 Spread-Risk Relationship

Arguably, the funding advantages realised by the four large Australian banks are because the perceptions of government intervention distort investors' risk assessments for these large banks. To better understand why lower spreads are evident when D-SIBs issue debt, it is necessary to answer the question of whether there is a relationship between bank size and investors' sensitivity to bank specific risks. In this section, interaction terms for bank size and risk variables added to the regression specified in equation 1 to test whether investors are less sensitive to the asset risk of large banks on account of their TBTF status.

The empirical results are reported in Table 5, with Panel A for fixed-rate bonds and Panel B for floating-rate bonds.

If investors disregard risk in relation to large banks when investing in primary bond issues due to the banks' TBTF status, the coefficient of the interaction term between bank size and the risk variable can be expected to have the opposite sign to the main risk effect. An opposite-signed coefficient on interaction term would present evidence that investors believe the large banks are supported against the risk of failure. In this exercise, four risk measures and four interaction terms are used in the regression.

As shown in Table 5, for fixed-rate bonds (Panel A), the coefficient on the interaction term between *Volatility* and *D-SIB*, has a significantly negative coefficient while the coefficient on *Volatility* is positive and significant. This provides some evidence that investors are less sensitive to the risks when dealing with TBTF banks. However, when other risk proxies are substituted for *Volatility*, the coefficients for both the main risk variables and the interaction terms are insignificant. Thus, the results based on the other three risk proxies do not provide support for the lower sensitivity of investors to the risks of large banks.

However, the results for floating-rate bonds provide considerably more consistent evidence for a flat spread-risk relationship for TBTF banks. As shown in Table 5 Panel B, in column 1 the coefficient on the main risk variable *Volatility* is positive and statistically significant. The coefficient on *D-SIB*×*Volatility* presents a significantly negative relationship with bond spread, which is opposite to the sign of the coefficient on *Volatility*. The results suggest that, for floating-rate bonds, the investors are less sensitive to the risks that the TBTF banks are exposed to and are prepared to downplay bank risk when purchasing debt issued by large banks. These results may be attributed to the perceptions of potential government bailout should D-SIBs become financially distressed, which further suggests the four large Australian banks are perceived as TBTF.

Table 5: Spread-Risk regressions

This table reports the regression results for the model $Spread_{i,b,t} = \alpha + \beta_1 BankSize_i + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} + \beta_5 BankSize_i \times AssetRisk_{i,t-1} + \beta_6 MicroControls_{i,t-1} + \beta_7 Itrx_t + YearFE_t + \varepsilon_{i,b,t}$. For fixed-rate bonds, *Spread* is the difference between bond yield to maturity at origination and maturity-matched government bond. While for floating-rate bonds, *Spread* is measured as discount margin over 3-month BBSW. TBTF effect (*BankSize*) is measured by the dummy variable *D-SIB*. *Maturity* is years to maturity for individual bond. *IssueSize* is the logarithm of issue amount minus log of one million Australian dollars. *ROA* is the return on assets, computed by net income divided by total assets. *Leverage* is measured by total assets over total shareholders' equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk. *AssetRisk* of individual bank is measured by *Volatility*, *Zscore*, *NPA* and *TradSec*. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Zscore* measures financial distress, which is calculated by sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *NPA* is the ratio of non-performing assets to total assets. *TradSec* represents trading securities of individual bank over its total assets. Interaction term of *D-SIB* and *AssetRisk* is also included in the regression to detect spread-risk relationship for TBTF banks. Panel A and Panel B reports regression results for fixed-rate bonds and floating-rate bonds respectively. Robust t-statistics in parentheses are based on standard errors clustered at the issuer level. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

PANEL A: Fixed-rate bonds				
Variables	Model 1 Spread	Model 2 Spread	Model 3 Spread	Model 4 Spread
D-SIB	0.0011	-0.0043*	-0.0038	-0.0024
	(0.84)	(-2.00)	(-1.78)	(-1.46)
Issuesize	0.0004***	0.0004***	0.0004***	0.0004***
	(5.07)	(4.07)	(4.01)	(4.25)
Maturity	0.0008***	0.0008***	0.0008***	0.0008***
	(6.79)	(6.8)	(6.61)	(6.44)
ROA	-0.7819***	-0.6586**	-0.6800**	-0.4366
	(-6.84)	(-3.07)	(-2.90)	(-1.25)
Leverage		0.0002	0.0002	0.0000
		(1.28)	(0.99)	(-0.05)
Mismatch	0.0097**	0.0130***	0.0138***	0.0100**
	(2.82)	(4.67)	(4.66)	(3.03)
Itrx	-0.0433	-0.0305	-0.0370	-0.0316
	(-0.94)	(-0.98)	(-0.78)	(-1.09)
Volatility	0.0193**			
	(2.43)			
D-SIB×Volatility	-0.0168**			
	(-2.79)			
Zscore		0.0025		
		(-0.82)		
D-SIB×Zscore		0.0025		
		(0.82)		
NPA			-0.1591	
			(-0.63)	
D-SIB×NPA			0.1670	
			(0.49)	
TradSec				0.0149
				(0.77)
D-SIB×TraSec				0.0026
				(0.12)
Year FE	Y	Y	Y	Y
Observations	349	350	349	346
R square	0.4525	0.4502	0.4475	0.4484

PANEL B: Floating-rate bonds				
Variables	Model 1 Spread	Model 2 Spread	Model 3 Spread	Model 4 Spread
D-SIB	0.0006	-0.0060***	-0.0018	0.0014
	(0.34)	(-3.90)	(-1.14)	(0.88)
Issuesize	0.0005*	0.0004	0.0004*	0.0002
	(1.87)	(1.31)	(2.06)	(0.74)
Maturity	0.0019***	0.0019***	0.0019***	0.0020***
	(9.72)	(9.53)	(11.28)	(7.44)
ROA	-0.4365***	-0.3851***	-0.3454**	-0.5182***
	(-3.29)	(-4.59)	(-3.11)	(-6.28)
Leverage		-0.0002**	-0.0001	0.0000
		(-2.67)	(-0.49)	(-0.05)
Mismatch	-0.0002	-0.0036*	-0.0005	0.0018
	(-0.07)	(-1.90)	(-0.15)	(0.57)
Itrx	0.3290***	0.3111***	0.2354**	0.3407***
	(3.37)	(3.52)	(2.74)	(5.07)
Volatility	0.0197***			
	(3.53)			
D-SIB×Volatility	-0.0201**			
	(-2.64)			
Zscore		0.0032**		
		(-2.57)		
D-SIB×Zscore		0.0031*		
		(2.15)		
NPA			-0.3155	
			(-1.73)	
D-SIB×NPA			-0.6021	
			(-1.67)	
TradSec				0.0418**
				(2.36)
D-SIB×TraSec				-0.0682**
				(-3.12)
Year FE	Y	Y	Y	Y
Observations	393	391	381	348
R square	0.7797	0.7737	0.7809	0.8101

To check the robustness of the results, in place of *Volatility*, other risk measures *Zscore*, *NPA* and *TradSec* are substituted in the regression to capture bank specific risk. *Zscore* measures how many standard deviations a bank's ROA can fall in a single period before the bank fails. It can be seen from column 2 that the *Zscore* is significantly negatively correlated with credit spread, which indicates a higher z-score that signals a lower probability of bank failure. Contrary to the negative relationship between z-score and bond spread, the coefficient on *D-SIB*×*Zscore* is significantly positive. This result is consistent with the evidence reported in column 1 regarding risk measure *Volatility*. The result reported in column 4 that employs trading securities over total assets (*TradSec*) as the risk variable provides similar evidence. With a positive coefficient on *TradSec* suggesting a greater proportion of trading securities is related to wider credit spreads, the negative coefficient on the interaction term *D-SIB*×*TradSec* is consistent with the regression results based on equity return volatility and Z-score and provides evidence for investors' lower sensitivity to large banks' risk.

On the other hand, the alternative risk proxy, non-performing assets to total assets ratio (*NPA*) does not present a significant relationship with credit spread. It is expected that the interaction term between *NPA* and *D-SIB* will have the opposite sign to the coefficient on *NPA*. However, the results in column 3 cannot be seen as evidence that supports investors' lower risk sensitivity for large banks. Except for the regression with *NPA*, the results from the other three regressions are statistically significant, providing support for the hypothesis that investors perceive large banks to be less risky and demand lower compensation due to this perception.[1]

Considering the results relating to the risk variables in Table 4 Panel B and Table 5 Panel B together, it can be seen that the coefficients on the risk variables in Table 4 are not significant but turn to be significant in Table 5 after including the interaction with the TBTF effect. These results suggest that spread-risk relationships for all Australian banks

[1] NPA may be an incomplete measure of bank-specific risk, which is backward-looking and can only captures risk in a bank's credit portfolio.

are not evident without considering differences between TBTF banks and other banks. As the interaction term between bank risk and bank size is included in the regression to detect investors' incremental risk sensitivity for D-SIBs, the main effect risk variable in the regression captures risk sensitivity for the smaller banks. The significant but opposite-signed relationships with the main effect risk variable and the interaction term suggests that the spread-risk relationship for investors in small banks is clearly evident, while the spread-risk relationship for large banks is non-existent.

With Australian banks' preference for issuing floating-rate bonds, the percentage of floating-rate bonds issued by smaller banks is higher than for fixed-rate bonds. With a more balanced sample, the estimations can be expected to be more accurate. In this exercise, with more even proportions in the sample of floating-rate bonds between large banks and smaller banks, the results for floating-rate bonds are likely to be more representative than those for fixed-rate bonds. Therefore, from the above results, it can be suggested that the bond investors of large Australian banks do not accurately price risk, consistent with investors perceiving that government intervention would protect them from potential losses. This lower sensitivity to large banks' risk provides an explanation for the source of implicit subsidies that allow large banks to issue debt at lower yields.

The results so far lend themselves to possible interpretations. Given that the credit spread difference may itself be endogenous, it could be the risk perceptions and pricing decisions of bond investors are determined by some unobserved time-varying omitted variables. For example, features of the secondary market such as depth and liquidity for the bonds of the larger banks would impact on investors' risk perceptions and compensation they demand when investing in banks' debt. Nonetheless, further researches are required to test whether the omitted variables would impact on the bond credit spread.

With bond maturity included in the regressions as a control variable, it acts as a measure of secondary market liquidity. The empirical literature has explored how corporate debt market liquidity co-varies with the characteristics of the issuer as well as the issue.

One recurring finding is that a longer remaining time-to-maturity on a debt claim is often associated with lower liquidity in the form of higher transaction costs (Milbradt et al., 2012; Bruche and Segura, 2013). The positive coefficient on Maturity is consistent with the proposition that longer-term bonds are more illiquid in the secondary market. Further research may examine the interaction between secondary market liquidity and bank size for their impact on bond spreads.

5.4 Change In Too-Big-to-Fail Subsidies Over Time

As the above results suggest, the four large Australian banks may realise a funding advantage due to implicit government guarantees. By running the following regression, the estimation of the implicit subsidies is quantified on a yearly basis.

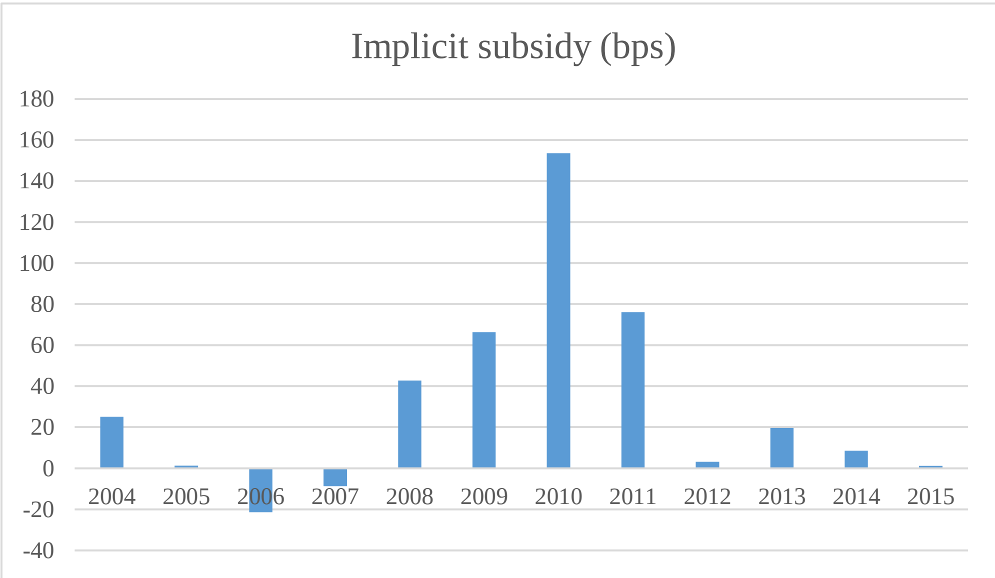
$$\begin{aligned} Spread_{i,b,t} =& \alpha + \beta_1 BankSize_{i,t-1} + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} \\ &+ \beta_4 AssetRisk_{i,t-1} + \beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t \\ &+ \sum_{y=2004}^{2014} \beta_y YearFE_t + \sum_{y=2004}^{2014} \beta_y YearFE_t \times BankSize_i + \varepsilon_{i,b,t} \end{aligned} \tag{3}$$

where the interaction term between *YearFE* and *BankSize* is the variable of interest, which is the spread difference in between each individual year and the year that is not included as a fixed effect. *BankSize* is measured by dummy variable *D-SIB* that capture the implicit subsidies. The estimated subsidy value is reported in Figure 3 on a yearly basis. The main risk variable *Volatility* is employed to capture bank asset risk (*AssetRisk*). Based on these estimates, the implicit subsidies provide the four large Australian banks with a funding advantage of approximately 33 basis points on average during the sample period 2004 to 2015.[2] It can be observed from the bar chart that the value of the implicit subsidies start to increase since 2008 and peak in 2010 at approximately 154 basis points.

[2] Due to the small number of fixed-rate bonds issued by small banks, these estimated implicit subisidies are averaged over fixed and floating rate bonds.

Figure 3: Quantification of yearly implicit subsidy

This figure shows the value of the implicit subsidy to the four large Australian banks due to the perception of government guarantee. The annual implicit subsidy is computed by running the following regression: $Spread_{i,b,t} = \alpha + \beta_1 BankSize_i + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} + \beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t + \sum_{y=2004}^{2014} \beta_y YearFE_t + \sum_{y=2004}^{2014} \beta_y YearFE_t \times BankSize_i + \varepsilon_{i,b,t}$ where the interaction term of *YearFE* and *BankSize* is the variable of interest, which is the spread between each individual year and the year that are not included as fixed effects. *BankSize* is measured by dummy variable *D-SIB* that capture the implicit subsidy. By adding the coefficient of *D-SIB* with *D-SIB*×*YearFE*, the implicit subsidies on a yearly basis for all bond observations are presented in this figure. *Volatility* is the risk variable included in the regression.



5.5 Implementation of Basel III capital framework

An early view of the impact of implementation of Basel III capital reforms in mitigating TBTF subsidies is reported in this subsection. As regulatory capital requirements are increased for Tier 1 capital and Common equity tier 1 to 6% and 4.5% of RWA respectively, the early implementation relative to other countries offers a natural experiment to assess changes in TBTF expectations due to this particular regulatory reform event. As higher capital requirements would better protect banks from insolvency, accordingly, it is expected that the early implementation would help make the bond market less sensitive to expectations of government support. Further, with bank risk reduced along with higher capital requirements, investors' TBTF expectations are hypothesised to diminished effect on bond spreads after the event occurs. To test this hypothesis, a dummy variable *Basel3* is included in the regression to detect the impact of implementation of Basel III on the whole banking sector, while an interaction term between *Basel3* and *D-SIB* is also included to capture the impact of Basel III on TBTF subsidies.

Given that in Table 5, *Volatility*, *Zscore* and *TradSec* present significant relationship with credit spread, this analysis employs these three variables as risk measures. The results are reported in Table 6, with columns 1, 2 and 3 reporting regression results for fixed-rate bonds while columns 4, 5 and 6 reporting regression results for floating-rate bonds. It can be seen that the coefficient on *Basel3* is negative and statistically significant in four of the six regressions. This result suggests that the implementation of Basel III capital reforms help bring down the credit spreads for all banks due to higher capital strengthening investors' confidence in banks' financial condition. With reference to the control variables, the significance of *Itrx* suggests that investors are sensitive to market credit risk, while the insignificance of the asset risk variables is consistent with Table 4 and indicates that investors are not sensitive to bank specific risks.

Table 6: Implementation of Basel III capital reforms

This table reports the regression results for the model $Spread_{i,b,t} = \alpha + \beta_1 BankSize_i + \beta_2 Maturity_{i,b,t} + \beta_3 IssueSize_{i,b,t} + \beta_4 AssetRisk_{i,t-1} + \beta_5 MicroControls_{i,t-1} + \beta_6 Itrx_t + \beta_7 Basel3 + \beta_8 Basel3 \times BankSize_i + \varepsilon_{i,b,t}$. For fixed-rate bonds, *Spread* is the difference between bond yield to maturity at origination and maturity-matched government bond. While for floating-rate bonds, *Spread* is measured as discount margin over 3-month BBSW. TBTF (*BankSize*) of an bank is measured using the dummy variable *D-SIB*. *Maturity* is years to maturity for individual bond. *IssueSize* is the logarithm of issue amount minus log of one million Australian dollars. *ROA* is the return on assets, computed by net income divided by total assets. *Leverage* is measured by total assets over total shareholders' equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk. *AssetRisk* of individual bank is measured by *Volatility*, *Zscore* and *TradSec*. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Zscore* measures financial distress, which is calculated by sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *TradSec* represents trading securities of individual bank over its total assets. *Basel3* is a dummy variable equal to 1 if bond issued since 1 Januanry 2013. Interactions term of *Basel3* and TBTF effect (*D-SIB*) are also included in the regression to detecting the effect of Basel III implementation. Columns 1, 2, 3 report regression results for fixed-rate bonds, columns 4, 5, 6 report regression results for floating-rate bonds. Robust t-statistics in parentheses are based on standard errors clustered at the issuer level. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

	Fixed-rate bonds			Floating-rate bonds		
Variables	Spread	Spread	Spread	Spread	Spread	Spread
D-SIB	-0.0050**	-0.0056**	-0.0046*	-0.0047**	-0.0044**	-0.0052**
	(-3.22)	(-2.99)	(-1.87)	(-2.96)	(-3.06)	(-2.89)
Issuesize	0.0000	0.0000	0.0000	0.0004	0.0004	0.0002
	(-0.05)	(-0.04)	(-0.14)	(1.58)	(1.66)	(0.76)
Maturity	0.0007***	0.0007***	0.0007***	0.0017***	0.0018***	0.0020***
	(6.18)	(6.21)	(6.34)	(7.16)	(7.72)	(7.04)
ROA	-0.5079***	-0.4069**	-0.0812	-0.7340**	-0.6647***	-0.5550***
	(-3.69)	(-3.19)	(-0.44)	(-2.80)	(-3.37)	(-3.64)
Leverage		0.0002*	-0.0001		-0.0003*	-0.0007**
		(2.01)	(-0.67)		(-2.04)	(-3.22)
Mismatch	0.0112**	0.0119**	0.0051	0.0012	-0.0024	-0.0100**
	(2.33)	(2.64)	(1.10)	(0.48)	(-0.69)	(-3.05)
Itrx	0.5351***	0.5582***	0.5384***	0.6908***	0.6852***	0.5704***
	(7.84)	(11.40)	(9.99)	(5.40)	(6.00)	(9.65)
Volatility	0.0025			0.0003		
	(0.55)			(0.06)		
Zscore		0.0003			0.0014	
		(-0.74)			(-1.72)	
TradSec			0.0316**			0.0187*
			(2.92)			(2.07)
Basel3	-0.0050**	-0.0043*	-0.0046	-0.0018	-0.0030*	-0.0050*
	(-2.39)	(-2.03)	(-1.60)	(-1.35)	(-1.98)	(-2.23)
Basel3 × D-SIB	0.0049*	0.0046*	0.0038	0.0033	0.0041**	0.0048*
	(2.16)	(1.89)	(1.22)	(1.77)	(2.32)	(2.11)
Constant	0.0094***	0.0052*	0.0056*	0.0010	0.0068**	0.0133**
	(4.51)	(2.18)	(2.04)	(0.35)	(1.82)	(3.24)
Year FE	N	N	N	N	N	N
Observations	349	350	346	392	391	346
R square	0.3514	0.3531	0.3592	0.6941	0.7155	0.7691

In light of the general effect of Basel III on the whole banking sector, how the implementation of Basel III capital reforms impacts on TBTF perceptions is captured by the interaction term *Basel3*$\times$*D-SIB*. The regression results based on most models suggest that the implementation of Basel III capital reforms in Australia help reduces the funding cost differential between large banks and smaller banks. The coefficient in front of the interaction term is significant statistically and economically. In all, the results suggest that since the Basel III capital reforms are implemented in Australia, there is significant evidence that higher capital requirements help reduce investors' perceptions of government support for D-SIBs.

In Table 6, the dummy variable *D-SIB* captures TBTF effects for the period before Basel III implementation. Compared with the results in Table 4, the coefficient on *D-SIB* is economically larger, which further indicates that the implementation of Basel III capital reforms helps reduce the cost advantage that large banks experience when they issue debt. The funding advantages realised by large banks may be attributable to potential government support when they are in financial distress. With the implementation of Basel III capital reforms, banks are perceived to be protecting themselves from failure by reserving a sufficient level of capital as required by APRA. The results reported in this section provide evidence that the raised requirements for common equity tier 1 and tier 1 capital make it more difficult for the four large Australian banks to capture the TBTF subsidy.

Chapter 6

Policy Implications

A funding advantages realised by the four large banks may be attributed to the investors reduced sensitivity to their risks, which may cause moral hazard and distort large banks' risk-taking incentives and the competition in the banking sector. Public support for large banks may result in a transfer of resources from other sectors of the economy. Because this kind of government guarantee is implicit, government does not allow for it in the federal budget. The process for transferring resources lacks transparency and accountability. Therefore, it may be necessary to resolve TBTF perceptions and restrain government actions that encourage TBTF expectations. This chapter will discuss the policy implications of this study and make recommendations that might help mitigate TBTF expectations. The implications are proposed to resolve the cross-border negative externalities posed by TBTF expectations.

First, this study provides evidence that the implementation of Basel III capital reforms reduces the TBTF subsidy benefiting the four big banks. During the recent financial crisis, Australian banks built a sound reputation for prudent risk management. As the characteristics of Australia's banking system for attracting foreign savings to fund domestic investment, it is essential to maintain the reputation of Australian banks to keep accessing foreign funding. However, with the implementation of Basel III globally, other jurisdictions keep increasing their capital levels while Australia has already largely complete the process. Consequently, the advantage of Australian ADIs may decline over time. Although the four major banks dominate the Australian banking sector, their capital levels are not in the top quartile compared with their international peers (Australian Treasury, 2014a). This suggests that there is still latitude for the four large Australian banks to increase their capital level.

Second, to minimise the costs of a TBTF bank's failure which may exposure taxpayers and the whole economy to losses, it is likely to be appropriate to impose additional capital requirements on the D-SIBs in Australia. Both the FSB and the FSI express the need to develop a loss absorbing and recapitalisation framework that facilitate the orderly resolution of ADIs without transferring the risk of banks to taxpayers. In line with the recommendation made by the FSI, it can be suggested that large banks be required to maintain additional loss-absorbing capital above existing requirements under Basel III. The funding advantage quantified by this study can be applied as a measure to help estimate the additional capital requirements. Noticeably, APRA already addresses this issue and imposes an additional 1 per cent Tier 1 capital on the four D-SIBs, however, the additional loss-absorbing capital is less onerous compared with other jurisdictions such as the United States and the United Kingdom. As it cannot be assumed the four large banks will never fail, the broader economy needs to be protected from this systemic risk. This policy may reduce the negative effects of a financial crisis, with minimal use of taxpayer funds. It may also mitigate the perceptions of implicit guarantees and restore competition neutrality in the banking sector.

Third, besides the funding advantage the four D-SIBs realise in the debt markets evidenced in this study, the different approach to measure risk weights between IRB banks and banks using the standardised approach also give them additional advantage. As suggested by the results of this study, higher capital requirements reduces the ability of large banks to capture the value of government guarantee. In addition, as the denominator to calculate capital ratios, the level of risk-weighted assets is also significant when determining a bank's capital requirement. It can be suggested to adjust the requirement for IRB banks when they calculate the risk weighting to narrow the difference. For instance, as IRB banks have lower average mortgage risk weights, they can use a smaller proportion of equity funding for mortgages. This lower risk weight becomes a funding advantage for IRB banks' mortgage business. In the final report of the FSI (Australian Treasury, 2014a), it is recommended to narrow the mortgage risk weight difference between ADIs using IRB risk-weights and those using standardised risk-weights. This recommendation is proposed to improve the competitive dynamics between ADIs by mitigating distortions caused by the risk weight differences at the same time as promoting an incentive for ADIs to strengthen their risk management capacity. In the wake of the recommendation proposed by the FSI, APRA requires IRB banks to increase their average risk weight on Australian residential mortgage exposures to at least 25 per cent (Australian Treasury, 2014a). As the residential mortgage portfolio is the largest credit exposure for ADIs, the reform of mortgage risk weights would reduce the likelihood that IRB banks underestimating risk. This reform of the IRB approach opens a new avenue for mitigating TBTF perceptions and their consequences. There is even more the prudential regulators can do to modify the IRB approach and increase the large banks' resilience.

Fourth, this study not only provides evidence of the existence of a TBTF subsidy realised by the four large Australian banks, but also provides estimates for the implicit subsidy value using bond yield spread as a direct measure. These estimates for the TBTF subsidy may indicate potential TBTF costs that might ultimately be paid by taxpayers in the event of a banking crisis. The estimates in this study can be used to help quantify a levy on TBTF banks bond issues for neutralizing the funding subsidy that the four big banks realise. In contrast to ex post tax proposed by Dodd-Frank Act on financial institutions in the United States, regulators may wish to consider a levy paid by the TBTF banks in their bond issuance to pay for potential rescue costs in the future. Such a levy on bond issues would compel TBTF banks to pay for the funding advantage due to the implicit government guarantees. Also, the levy on bond issuance paid by the TBTF banks can be accumulated by the government to provide funds for future rescue, which avoids exposing taxpayers to the cost of banking crisis.

Fifth, to better align risk and return for large banks, it is important to improve transparency through public disclosure and underlying prudential regulation because the TBTF problem is not only about bank size but interconnectedness. The four major Australian banks use their own internal models to determine risk weight for credit exposures since Basel II, the risk assessments and risk management of internal rating-based (IRB) banks is different compared to banks using the standardised approach. This causes comparability problems and requires stronger and more sophisticated risk management frameworks and prudential supervision. It can be required that ADIs upgrade their information systems to contribute to better accounting transparency. In all, to assess the risk profile of D-SIBs, the level of transparency of these large banks should be improved.

In summary, this study provides a measure for calibrating potential policy recommendations to mitigate TBTF subsidies. The funding advantage quantified in this study can be applied to introduce a levy on TBTF banks bond issues or additional loss-absorbing capital requirements, which can offset the implicit subsidies the four large Australian banks realise. The policy implications discussed in this chapter focus on reducing the possibility and impact of the failure of systemically important banks with minimal resource. The objective of higher capital requirements or a levy is to internalise stability costs within banks, rather than impose additional regulatory expense. In addition, it is necessary to improve the transparency of accounting disclosure and the effectiveness of prudential regulations.

Chapter 7

Conclusion

Based on Australian primary bond market data, this study examines the TBTF subsidies realised by the four major Australian banks in the period August 2004 to July 2015. The results suggest that the four large Australian banks benefit from a funding advantage when issuing debt because of the perception of potential government support. This evidence is consistent with previous studies such as Acharya et al. (2014), Ueda and Weder di Mauro (2013), United States Government Accountability Office (2014), Santos (2014), and supports the proposition that TBTF subsidies exist in the Australian banking sector. The average funding advantage the four large Australian banks realise during the sample period is estimated to be in the order of 25 basis points and 42 basis points for fixed-rate bonds and floating-rate bonds respectively. The funding advantage of large banks continues to be evident, when controlling for bank-specific asset risk, leverage and operating efficiency, bond characteristics such as maturity and issue size, together with credit market conditions.

To better explore the source of TBTF subsidies realised by the large banks, this study examines whether bond spread-risk relationship flatten with the perceptions of government support. The results for floating-rate bonds provide consistent evidence that investors are less risk sensitive to large banks' risks. The results suggest that most of he funding advantage accruing to large banks derives for this reason. Investors' relative ambivalence towards the risk of large banks may result in increasing incentives to take on more risks and distort the competition in the banking industry. Consequently, the moral hazard problem may be exacerbated by the perception of banks being TBTF.

Basel III capital reforms have been implemented in Australia since January 2013, which is 3 years earlier than the Basel Committee phase-in deadline. This makes Australia a suitable environment to examine whether increasing capital requirements makes it more difficult for large banks to capture TBTF subsidies by mitigating the likelihood of government intervention. This study provides empirical evidence that the raised Tier 1 capital and Common Equity Tier 1 requirements as part of the Basel III implementation help reduce the bond spread differential between large banks and small banks. As the first study addressing TBTF with Basel III data, the results provide an early view of the impact on TBTF subsidies of Basel III implementation in the other jurisdictions. This study does not suggest that higher capital requirements are the only solution for reducing TBTF expectations, but provides evidence that they have helped alleviate the problems associated with implicit guarantees in the Australian banking sector. The results in this study can provide a benchmark for prudential regulators to upgrade capital requirements for systemically important banks, which can offset the funding advantage they realise and minimise the exposure of taxpayers when large banks fail.

Appendix

Bank Size and Bank Risk Relationship

One additional test is conducted to address the potential for effects other than TBTF perceptions to impact on credit spreads. First, to disentangle the endogeneity concerns that the four large banks are less risky than the other banks, the relationship between bank size and risk is examined.

As been argued by some studies, recent regulatory changes result in a decrease in the cost of banks expanding in size (Stiroh, 2000; Berger and Mester, 1997). But there is a certain size threshold for banks to reach in order to realise economies of scale due to the cost and complexity of managing such large financial institutions (Laeven and Levine, 2007; Demirgüç-Kunt and Huizinga, 2013). It is suggested by the foregoing results that investors ignore the risks that the four large Australian banks take because of the perceptions of potential government guarantees. However, there are endogeneity concerns that advantages other than TBTF expectations such as better diversification, better investment opportunities or economies of scale may exist. Consequently, the level of large banks' risk may actually be lower compared with smaller banks.

To address the concern that large banks are less risky for reasons other than TBTF status, the following regression is employed:

$$AssetRisk_{i,t} = \alpha + \beta_1 BankSize_{i,t-1} + \beta_2 MicroControls_{i,t-1} + \beta_3 Itrx_t + YearFE_t + \varepsilon_{i,b,t}$$

where *BankSize* is measured by dummy variable *D-SIB*. Equity volatility (*Volatility*), z-score (*Zscore*), non-performing assets ratio (*NPA*) and trading securities to total assets ratio (*TradSec*) are used as the risk variables. The regression results are reported in Table 7, with columns 1, 2, 3, 4 for fixed-rate bonds and columns 5, 6, 7, 8 for floating-rate bonds. In the regression with *Volatility* as the risk proxy, the coefficients in front of *D-SIB* are negative and statistically significant. However, this relationship is insignificant for the other risk measures. Combining these results, there is limited evidence that the four large banks are less risky than the other banks. Over all, the empirical results do not provide evidence that large banks are less risky, which is consistent with previous literature conducted in other jurisdictions (Acharya et al., 2014; Demirgüç-Kunt and Huizinga, 2013). This evidence suggests that the results obtained in this thesis are not simply a consequence of them having less risky asset portfolios.

Table 7: Bank Size and Bank Risk Relationship

This table reports the regression results for the model $AssetRisk_{i,t} = \alpha + \beta_1 BankSize_i + \beta_2 MicroControls_{i,t-1} + \beta_3 Itrx_t + YearFE_t + \varepsilon_{i,b,t}$. *D-SIB* is a dummy variable equal to one if a given bank is one of the four D-SIBs of Australia classified by APRA and zero otherwise. *ROA* is the return on assets, computed by net income divided by total assets. *Leverage* is measured by total assets over total shareholders' equity. *Mismatch* represents maturity mismatch and is calculated as short-term debt minus cash divided by total liabilities. *Itrx* represents the Markit 5-year Australian iTraxx, which is a CDS index that indicate the systematic credit risk. *Volatility* is the annualised standard deviation calculated from daily stock returns of each corresponding bank. *Zscore* measures financial distress, which is calculated by sum of ROA and the book equity to total assets ratio, averaged over four years, divided by the standard deviation of ROA over past four years, then divided by 100. *NPA* is the ratio of non-performing assets to total assets. *TradSec* represents trading securities of individual bank over its total assets. Columns 1, 2, 3, 4 report regression results for fixed-rate bonds, columns 5, 6, 7, 8 report regression results for floating-rate bonds. Robust t-statistics in parentheses are based on standard errors clustered at the issuer level. ***, **, and * indicate significance at 1%, 5% and 10% levels, respectively.

	Fixed-rate bonds				Floating-rate bonds			
Variables	Volatility	Zscore	NPA	TradSec	Volatility	Zscore	NPA	TradSec
D-SIB	-0.0423***	0.2726	0.0312	-0.0289	-0.0475***	0.2267	0.0938*	-0.0418
	(-4.03)	(1.32)	(0.43)	(-1.15)	(-4.86)	(1.33)	(2.28)	(-1.46)
ROA	-4.9866**	64.4619*	-34.5267***	-12.0081**	0.4557	3.0161	-27.0029**	-6.5906
	(-2.28)	(1.94)	(-4.40)	(-2.93)	(0.20)	(0.08)	(-2.56)	(-1.33)
Leverage		0.0011	-0.0149	0.0117***		-0.0085	-0.0037	0.0098*
		(0.03)	(-0.76)	(3.75)		(-0.36)	(-0.36)	(1.98)
Mismatch	0.0415	-0.3648	0.0407	0.2189**	-0.0369	-0.0541	0.6293**	0.0764
	(0.72)	(-0.47)	(0.18)	(3.34)	(-1.68)	(-0.07)	(2.55)	(1.12)
itrx	9.6115***	17.8392	-3.7246*	-0.4394	9.7534***	23.3468	-6.5847**	-0.8313
	(16.12)	(1.72)	(-2.08)	(-1.04)	(7.44)	(1.53)	(-2.72)	(-1.70)
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	349	350	344	346	394	391	354	349
R square	0.8407	0.3491	0.8226	0.7216	0.7918	0.3529	0.7695	0.5651

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