IMPACT OF HIGHER CAPITAL REQUIREMENTS ON BANK FUNDING COSTS: AUSTRALIAN EVIDENCE

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STATEMENT OF CANDIDATE

This is to certify that to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes. I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Dieu Linh Nguyen

SYNOPSIS

In response to the experience of the 2007-2009 global financial crisis, capital requirements have been raised for banks across many jurisdictions. With the highly concentrated nature of the Australian banking sector and the implementation of an imputation tax system, an ideal natural experimental environment is available to empirically examine the impact of higher capital requirements on bank funding costs in a small open economy that is heavily reliant on banks for funding economic growth. This study examines the extent to which the risk premium on bank equity decreases as more equity is added to a bank's capital structure, as predicted by the Modigliani-Miller (M-M) theorem. The results suggest that the M-M offset effect on equity risk is realised to around 25% to 30% of the extent it would be if the M-M theorem held exactly. A reduction in the equity risk premium helps cushion the impact of higher equity capital requirements on bank funding costs. Therefore, a doubling in bank market capital from 10% to 20% of total assets would have a relatively mild impact on bank funding costs in the long-run, ranging from 18 basis points (bps) to 55 bps for small banks and from 36 bps to 94 bps for large banks. The cost to banks of maintaining higher risk-based regulatory capital ratios is further reduced when the risk weightings on bank assets are less than one and the bank equity trades at market-to-book ratios greater than one.

Contents

Chapter 1

Introduction

In the aftermath of the financial crisis of 2007-2009, the international regulatory framework for banks, known as the Basel Accord, was revised in response to deficiencies in financial regulation revealed by the crisis. New capital requirements under the Third Basel Accord (Basel III) have forced banks to maintain higher levels of equity to enhance their loss-absorbing capacity, thereby improving financial stability and reducing the risk of spill-over from the financial sector to the real economy[1]. As capital requirements have been raised for banks in phases in member jurisdictions, an important question has arisen as to the potential consequences to the borrowing costs faced by bank customers. In this context, this study examines empirically how shifts in capital requirements affect the overall funding costs of banks in a small open economy. Australia represents a small open economy with a concentrated banking system. Hence, findings of this study are likely to be generalisable across other small open economies, such as New Zealand, Canada and Sweden, to a greater extent than those of studies from larger economies (for example, Miles et al., 2013, in the United Kingdom).

[1]For details of the Basel III capital framework, refer to the Basel Committee on Banking Supervisions publication, Basel III: A global regulatory framework for more resilient banks and banking systems, released in December 2010 and revised in June 2011 (Bank For International Settlements, 2011).

The few empirical studies conducted on the topic of optimal bank capital, including Dagher et al. (2016), Miles et al. (2013) and Riksbank (2011), suggest that the optimal level of bank capital should be even higher than the minimum level specified under Basel III. Despite these suggestions, from the perspective of banks, heightened equity requirements may increase their overall funding costs. As for policy-makers, when the industry is doing poorly, they worry that stricter capital requirements might harm the economy. However, when the industry is doing well, no one sees a need to do anything (Admati and Hellwig, 2014). This behavioural reaction may be due to misperceptions about potentially substantial costs imposed on individual institutions and economic output as a consequence of more stringent capital rules. In the context of the ongoing debate about capital requirements, this thesis aims to provide an empirical estimation of the real costs of regulatory changes to banks in Australia. Subsequently, it will compare the results obtained against those of major economies, including the United Kingdom and the United States, to identify whether distinct economies are affected differently. For comparison purposes, the UK and US results from studies conducted by Miles et al. (2013) and Kashyap et al. (2010) will be used as benchmarks. If different economic regimes lead to diverse impacts of stricter capital requirements on banks' funding costs and economic output, this will imply that the costs and benefits of the Basel III capital reforms vary by country. Furthermore, the differences in outcomes between jurisdictions will have significant implications for economic policy, such that it may be reformed to complement the aims of prudential regulation for banks.

In theory, according to the Modigliani and Miller Theorem (henceforth M-M), the amount of equity capital included in a firm's capital structure has no effect on its overall cost of funding because any increase in capital cost from using more equity is exactly offset by induced decreases in both the cost of equity and cost of debt as a consequence of the associated decline in risk. The total risk to which all investors are exposed does not change and is determined by the risk that is inherent in the firm's asset returns. Miles et al. (2013) identify two potential violations of the M-M assumptions in the banking context: interest tax shields and public subsidies for debt financing. However, when using data on UK banks, they find that the M-M theorem holds to a certain extent, making the costs of stricter capital requirements relatively small. Similarly, research conducted by Kashyap et al. (2010) on US bank data also validates the offset effect predicted by M-M.

Since most of the current research is based solely on UK and US banks, the objective of this study is to expand the scope to Australia, a small, open economy that has significantly different tax and government subsidy treatments compared to these two major economies. Historically, Australia has a dividend imputation system that narrows the differential tax treatments of debt and equity relative to other countries. However, it is argued that the marginal cost of equity for Australian banks may be determined by international investors who cannot utilise the dividend imputation credits accompanying bank dividends, resulting in a tax disadvantage associated with the need for additional equity (Siau et al., 2015). Moreover, the concentrated nature of the Australian banking industry, compared to the large and diverse banking industries of the UK and US may contribute to perceptions that authorities will intervene in the event of a banking crisis. In effect, there is likely to be an increased level of implicit government support for bank debt (International Monetary Fund, 2012). At the time of writing, Standard & Poor's upgrades the Australian major banks' credit ratings by two notches due to implicit government support[2]. These circumstances might mean that increased capital requirements have greater implications for bank funding costs in Australia than have been suggested by studies from larger economies.

[2]As at July 2016, Australia's major banks have S&P credit ratings of AA- (S&P Global Ratings, 2016), which are upgraded two notches from their single A stand-alone credit profiles on the assumption of extraordinary government support (Eyers and Shapiro, 2015). For more details about Australian major banks' credit ratings, see Standard & Poor's Ratings Services (2016).

In this study, the overarching research question is: "How will increasing capital requirements affect banks' cost-of-equity and overall funding costs in a small open economy such as Australia?" To answer this question, I investigate the three following component questions: (i) To what extent do M-M offsets work for Australian banks to lower equity risk when leverage is reduced? (ii) What is the capital - cost-of-equity relationship for Australian banks? (iii) What are the likely implications for the borrowing costs faced by bank customers associated with increasing equity levels relative to debt for Australian banks? The analysis presented in this thesis demonstrates the extent to which the economic impacts of capital requirements are subject to several caveats related to the corporate tax regime and dividend imputation tax system. Lastly, the results obtained are benchmarked against results from studies undertaken in the UK and US to assess the effects of tax and government implicit guarantee factors.

The remainder of this thesis is structured as follows. Chapter 2 reviews relevant previous literature. Chapter 3 sets the theoretical context for the research. In chapter 4, descriptions of the sample data and empirical tests of the M-M theorem are presented. Chapter 5 discusses the economic implications of the results. Concluding remarks are presented in chapter 6.

Chapter 2

Capital requirements and bank behaviour

The previous chapter outlined the main purpose of this thesis, which is to examine the impact of heightened capital requirements on bank funding costs, allowing for interest tax shields and public subsidies for debt financing that prevail in a small open economy. This chapter presents an overview of the rationale for bank capital requirements with reference to the current capital regulation for Australian banks. Unanswered questions that this thesis proposes to examine are further clarified.

2.1 The rationale for bank capital requirements

Banks typically operate with highly leveraged balance sheets. The average ratio of total assets to shareholders' capital is about three for non-financial companies, but it is six times that figure for banking firms (Bank For International Settlements, 2010). Because of the highly leveraged nature of banks, capital adequacy requirements to ensure banks' capacity to absorb losses are a central feature of banking regulation.

Bank capital is of central importance for financial stability, which is of great concern to policy-makers because financial crises have significant real effects (Thakor, 2015). Based on historical evidence, in any given country, banking crises occur on average once every 20 to 25 years (Bank for International Settlements, 2010). As can be witnessed from past epidemic failures of banking institutions, such as the savings and loan crisis of the 1980s and the financial crisis of 2007-09, banking crises generate massive economic losses that tend to burden not only one but multiple generations of taxpayers. Additionally, in a recent study, Laeven and Valencia (2013) construct a banking crises database comprising 147 banking crises and find that output losses and increases in public debt resulting from banking crises tend to be larger in advanced economies. Commonly, the larger economic losses are driven by more interconnected banking systems, which make a banking crisis more severe. Moreover, in the era of globalised banking with various financial contagion channels, a crisis can be easily transmitted across borders.

To reduce the probability of a banking crisis and its adverse impact on economic output, regulators are mandated to respond to externalities associated with financial intermediaries on behalf of the community. Berger et al. (1995) assert that bank capital adequacy is important to prudential regulators. First, higher capital requirements help regulators protect themselves against the costs of financial distress, agency problems associated with prudential supervision and the reduction in market discipline caused by implicit guarantees. In the aftermath of the financial crisis of 2007-09, in a number of countries including Australia, the government is technically the largest uninsured creditor of banks because, in the event of bank failure, it pays off guaranteed depositors and shares the bank's losses along with other uninsured creditors. Second, due to systemic risks, a failure of a bank could set off a chain reaction that undermines the stability of the whole country's financial system. Pessimistic market sentiment from an event of this nature, together with other types of uncertainties, will affect other institutions. This, in turn, can lead to markets ceasing to function and damage investor and depositor confidence. Requiring higher capital ratios to achieve a greater degree of safety for banks can help minimise the broader economic costs from a systemic crisis. Using a structural model that is calibrated using banking data, Gauthier et al. (2012) find that a properly designed capital requirement can reduce the probability of a systemic crisis by 25 per cent.

New capital requirements under Basel III require common equity to be at least 7 per cent of risk-weighted assets. However, it is worth noting that even under these stricter capital requirements, banks are still able to fund up to 97 per cent of their assets with debt. Although the primary concern of regulators is to ensure that banks have enough capital to absorb losses, which will save them from future crises, they are also concerned that increased equity requirements might come at a high cost and compromise banking sector efficiency. Banks may be discouraged from maintaining higher capital ratios by the nature of competition in the financial services industry, which effectively compels them to keep funding costs at a minimum (Fonseca and González, 2010; Hanson et al., 2011).

Opponents of increased capital requirements argue that they might significantly heighten the cost of bank credit and hinder economic activities (Institute of International Finance, 2010). For example, when assessing the effects of minimum capital rules on banks' risk-taking behaviour, Blum (1999) finds that the requirements may increase a bank's riskiness due to two reasons. First, a tighter capital restriction lowers the expected profits of a bank, which consequently reduces its incentive to avoid default. Second, under a regime of binding capital requirements, equity tomorrow is more valuable, i.e., costly to a bank; hence, to raise the amount of equity tomorrow it may be optimal for a bank to increase risk today. The strongest opponents, after all, are often bankers. In general, banks have a strong aversion to capital and resist calls to maintain larger capital buffers. They argue that since equity is more expensive than debt, more of it raises the overall cost of capital. Pfleiderer (2012) quotes Josef Ackermann, CEO of Deutsche Bank from a November 20, 2009 interview: "More equity might increase the stability of banks. At the same time, however, it would restrict their ability to provide loans to the rest of the economy. This reduces growth and has negative effects for all." Jokipii and Milne (2011) find that when banks experience negative exogenous shocks to their capital, they reduce lending.

On the other hand, supporters of stricter regulations point to the risks associated with high bank leverage and the exorbitant costs of the global financial crisis. Banks with higher capital appeared to take less risk prior to the crisis (Beltratti and Stulz, 2012). Furthermore, Berger and Bouwman (2013) find evidence to support an economic role of capital in improving bank performance during financial crises. They reveal that capital not only helps small banks increase their probability of survival and market shares, but also enhances the performance of medium-sized and large banks during banking crises, especially in cases where there is limited government intervention. The effects of pre-crisis capital appear to be realised through growth in non-core funding, relationship lending and off-balance-sheet guarantees.

In related literature, Miles et al. (2013) compare the costs of having banks become better capitalised with the benefits of lowering crisis probability and suggest that the minimum level should be 16-20 per cent of risk-weighted assets. Using a different approach to calibrating the ideal capital level, Dagher et al. (2016) reassess the benefits of bank capital in terms of its ability to absorb losses. They find that capital of 15-23 per cent of risk-weighted assets would have been sufficient to absorb losses in the majority of past banking crises. Taken together, these findings suggest that the minimum level of bank capital requirements should be at least doubled.

Against this background, this thesis contributes to the current debate on banking regulation with empirical evidence to address three issues: (i) the extent to which a bank's cost of equity is reduced when the bank has more equity in its capital structure (consistent with the M-M theorem); (ii) the size of the private cost to banks of higher capital requirements; and (iii) whether these private costs for banks are more pronounced in a small open economy with a concentrated banking sector.

2.2 Capital regulation for Australian banks

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 2.1, in Australia, APRA's application of the Basel III capital framework came into force on 1 January 2013, three years before the phase-in deadline for countries adopting the Basel III rules according to the international timetable (APRA, 2012). Building on the Basel II risk-sensitive capital framework, the reforms raise both the quality and quantity of the regulatory capital base. In particular, the new framework increases the minimum proportion of regulatory capital that must be met by common equity tier 1 (CET1) capital from 3 per cent to 4.5 per cent of risk-weighted assets (RWA). Further, tier 1 capital (which includes common equity) must be at least 6 per cent of RWA compared to 4 per cent under Basel II. Meanwhile, the minimum requirement for total capital remains unchanged at 8 per cent of RWA.

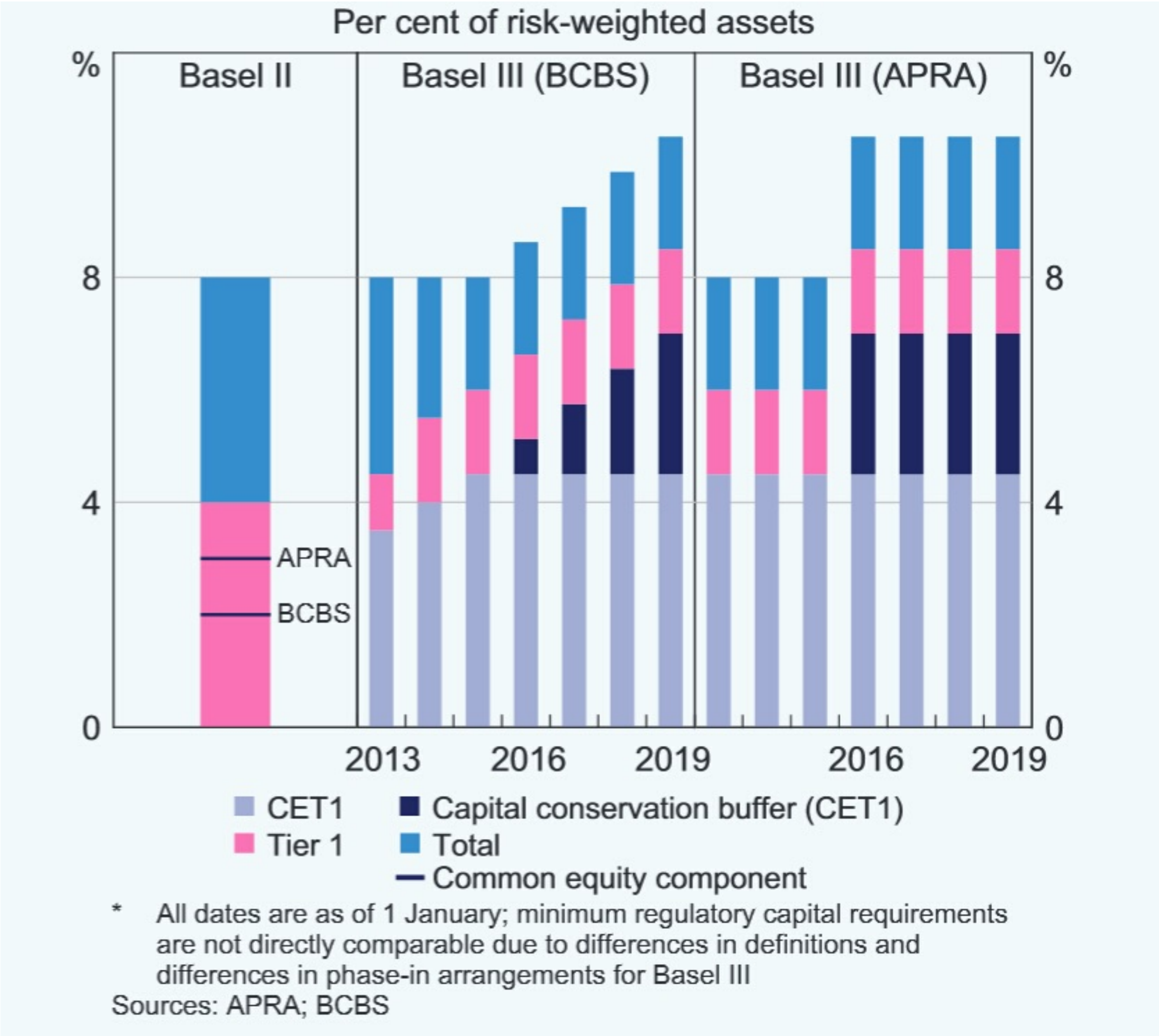
Since 1 January 2016, the new framework has additionally implemented a conservation buffer for common equity of 2.5 per cent of RWA; this buffer can be drawn down in periods of stress. This addition, hence, brings the minimum requirement for common equity plus the buffer to 7 per cent of RWA. Moreover, as an extension of the capital conservation buffer, a Domestic Systemically Important Bank (D-SIB) surcharge of 1 per cent of RWA in CET1 capital is imposed on the four major Australian banks from

1 January 2016 (APRA, 2013). When capital levels fall within the buffer range, banks are subject to distribution constraints that increase in severity as the buffer is reduced. The regulator has the discretion to impose a counter-cyclical buffer of up to 2.5 per cent of RWA to protect the banking sector from periods of excess credit growth.

In its final report, the Australian Treasury (2014) Financial System Inquiry (FSI) recommends that Australian banks be required to have higher capital levels. It asserts that further increasing capital requirements for Australian banks will deliver significant benefits to the economy at a low cost. In addition, the report notes that although equity funding is typically thought to be more expensive than debt funding, a greater use of equity funding reduces bank failure risk and therefore would lower investors' required return on equity and the cost of borrowing for banks. In response to the FSI's report, APRA (2015) conducted an international capital comparison study confirming that Australia's major banks are not in the top quartile of their international peers for their common equity tier 1 capital ratios. In its study, APRA also reaffirms the FSI's recommendation that the capital ratios of Australian authorised deposit-taking institutions should be "unquestionably strong".

In its latest comparison of the capital position of Australias big banks against their global peers, APRA (2016) finds that the big banks have undertaken significant capital raising since the 2015 study; this has significantly improved their capital adequacy position relative to international peers. However, it notes that given the trend of international peer banks strengthening their capital ratios, forthcoming international policy developments will likely mean that Australian banks need to continue to improve their capital ratios in order to at least maintain, if not improve, their relative positioning.

Figure 2.1: Minimum Regulatory Capital Requirements: Timetable for Transitioning to Basel III



Source: Financial Stability Review - Reserve Bank of Australia (2013)

Chapter 3

Capital structure and the cost of equity

One of the central concerns about capital adequacy requirements has been the possibility that the requirements affect bank funding costs, and hence lending rates and economic activity. Opponents of higher capital requirements argue that since equity is more expensive than debt, more of it raises the overall bank funding cost. In this context, the starting point for the analysis is the M-M theorem, which asserts that under certain idealised conditions, the amount of equity included in a firm's capital structure has no effect on its funding cost (Modigliani and Miller, 1958). Under the M-M theorem, as more equity capital is used, the volatility of the return on that equity falls and the safety of debt rises, so that the required rate of return on both sources of funds falls. It does so in such a way that the weighted average cost of capital is unchanged. Therefore, the relevant question for capital requirements is whether the cost of bank equity decreases alongside increases in the proportion of equity capital as the M-M logic predicts. Miller (1995) argues that the basic considerations underlying the M-M theorem should apply in banks as well as in other industries; however, he acknowledges that the underlying assumptions are not satisfied in reality (in particular, the assumptions of zero corporate taxes and zero public subsidies for debt funding).

3.1 Violations of the M-M conditions

The essence of the M-M theorem is that the return on equity contains a risk premium that is likely to fall if a company has a higher proportion of equity in its capital structure. Thus, when all of the idealised conditions set out by M-M hold, the cost of levered equity can be expressed as being equal to the cost of unlevered equity plus a premium that is proportional to the debt-equity ratio (measured using market values), as follows:

$$r_E = r_U + \frac{D}{E} \times (r_U - r_D)$$

where r_E is the expected return on levered equity, r_U is the expected return on unlevered equity and r_D is the expected return on debt.

The idealised conditions considered by M-M assume an efficient and integrated capital market - absent taxes and other distortions. Because these conditions do not truly represent the real capital markets, which contain frictions and inefficiencies, the validity of M-M's capital structure irrelevance argument for banks remains unclear, with limited direct empirical evidence.

Miles et al. (2013) identify that two potential distortions of the M-M theorem in the banking context are interest tax shields and public subsidies for debt financing; however, they argue that the M-M propositions still hold for banks to a certain extent. Using data on UK banks, Miles et al. (2013) find that the M-M offset on the cost of equity is between 45% and 90% as large as it would be if the M-M theorem held exactly. Their results further indicate that the M-M effect softens the impact of heightened capital requirements on a bank's overall funding cost. Even with a doubling of bank equity capital (such that banks still finance more than 90% of their assets with debt), their estimates suggest that the average cost of bank funding would increase by only around 10-40 basis points.

Kashyap et al. (2010) examine the impact of the imposition of substantially higher capital requirements on large US financial institutions and find that measures of equity risk decrease alongside increases in the equity-to-asset ratio. On that basis, they estimate that the long-run steady-state impact on borrowing costs faced by bank customers from increases in external equity finance are modest, in the range of 25-45 basis points for a 10 percentage-point increase in the ratio of equity capital to bank assets.

3.2 The Australian circumstances

With assets more than three times gross domestic product, the Australian financial sector is highly concentrated and interconnected. As four of the most profitable banks in the world, the four large Australian banks hold 80 per cent of banking assets and 88 per cent of residential mortgages; these levels are significantly higher than those in most other jurisdictions (International Monetary Fund, 2012). The extent to which the M-M prediction applies to Australian banks may be restricted by two major factors: debt tax shields and public guarantees for bank debt. In the discussion that follows, these two factors are assessed in comparison to their treatments in the UK and the US.

In most jurisdictions, the corporate tax regime makes debt a relatively cheaper form of finance than equity, because both banks and non-financial companies can utilise interest payments as an expense that reduces taxable income at the company level[3]. Moreover, most countries tend to employ a classical corporate tax system, which places

[3]The effect of the tax deductibility of interest payments can be reduced if returns to shareholders in the form of dividends and capital gains are taxed less heavily at the personal level than interest receipts.

a double-tax on company profits with one tax at the corporate level in the form of corporate income tax and a second tax at the individual level in the form of individual income tax on dividends and capital gains. Desai et al. (2004) and Weichenrieder and Klautke (2008) find that tax distortions have a significant influence on financial structure; such that an increase in the corporate income tax rate provides an incentive for firms to increase their debtasset ratios. In Australia, an imputation tax system was implemented in 1987 to relieve double taxation by providing individual shareholders with a tax credit for corporate tax paid. This imputation tax credit can subsequently be used by the shareholders to offset their personal tax or claim any excess as a refund. As a result, imputation encourages greater use of equity financing. However, under the current system, dividend imputation credits are only available for use by resident taxpayers in Australia; thus, they provide little or no benefit to non-resident investors in Australian companies. The Australian Treasury (2015) suggests that the marginal investor in Australia is likely to be a non-resident, who will invest in business opportunities in Australia only if they achieve an after-tax return that matches their target rate of return. To the extent that marginal investors in the equity of Australian banks are foreign investors, they may demand an additional return to compensate for their disadvantaged tax position. Therefore, in Australia, although the tax advantage of debt financing is reduced by dividend imputation, it might not be eliminated because franking credits cannot be fully utilised by all investors. In that case, stricter capital requirements would mean that banks are less able to exploit the favourable tax treatment of debt.

The second distortion that may create a cost to banks associated with using less debt arises from under-priced state insurance. Miles et al. (2013) suggest that deposit insurance, unless it is charged at an actuarially fair rate, may give banks an incentive to substitute equity finance with deposit finance. If governments insure banks' non-deposit debt, either implicitly or explicitly, the cost of that financing will be lower relative to equity. In relation to Australia's circumstances, the International Monetary Fund (2012) notes that the concentrated nature of the Australian banking industry may further contribute to perceptions that authorities will intervene in the event of a banking crisis, thereby increasing the level of implicit government support for bank debt. When estimating the implicit subsidy across a variety of countries using a rating approach based on Fitch ratings[4], Ueda and di Mauro (2013) find that the level of government support for banks in Australia is near the average for countries with major banking centres, even before the introduction of explicit guarantee schemes for deposits and wholesale debt. In particular, as at the end of 2007 (before the Australian Government introduced the Guarantee Scheme for large deposits and wholesale funding in November 2008), Ueda and di Mauro find implicit government support for banks in Australia to be worth between 2.6 and 3.1 rating notches. Using average debt spreads for different rating categories from 1920-1999, this translates to a funding cost advantage of about 60 basis points when a bank issues a five-year bond.

Overall, considering both the influence of international investors who cannot utilise imputation credits and the concentrated nature of the banking industry in Australia, increased capital requirements may have greater implications for banks' funding costs than are suggested by studies from larger economies such as the UK and the US.

[4]Fitch issues two credit ratings for a bank: a stand-alone rating and a (higher) support rating. Although both ratings reflect an external assessment of the probability of a bank defaulting on its debt, only the latter includes the possibility of a bank receiving government support (FitchRatings, 2016).

Chapter 4

Does M-M hold for Australian banks?

The discussion in chapter 3 suggests that if the M-M theorem holds, increasing the required proportion of equity financing relative to debt financing should lower the returns demanded by equity-holders because the reduced leverage lessens volatility and thus the systematic risk of equity returns. In other words, there should be a positive relationship between a bank's equity risk and its leverage. In this chapter, I examine empirically the relationship between banks' estimated equity risk and a measure of leverage that is affected by regulatory capital rules using data on listed Australian banks.

4.1 Data and methodology

This study focuses on 13 listed banks operating in Australia with at least 12 half-years of relevant data in the period from June 1992 to December 2015. In particular, the analysis is restricted to licensed banks, which are required to maintain capital in Australia. These include only domestic banks, as foreign subsidiary banks are not listed in

Australia. Branches of foreign banks are not obliged to maintain capital in Australia; hence, these banks are excluded from the sample. Building societies and credit unions are in most cases unlisted (customer-owned) and these depository institutions are also excluded from the sample. The sample includes 9 out of 11 domestic banks currently listed on the Australian Stock Exchange (ASX) and 4 banks that merged with other banks during the sample period. AMP Ltd. and Suncorp Group are excluded from the sample since they are overwhelmingly life and general insurance companies, respectively. Therefore, the sample represents about 80 per cent of the number and 98 per cent of the total assets of current Australian listed banks.

Given the concentrated nature of the Australian banking system, the primary sample of banks is broken down into two sub-samples according to the size of total resident assets. Table 4.1 presents the sample banks, comprising the five largest banks (four of which are in the ASX10 and Macquarie Bank in the ASX50) in panel A and eight smaller banks in panel B. As reported in the table, the 5 large banks occupy 82 per cent of total banking resident assets as at December 2015. Thus, they closely represent the market in dollar-weighted terms. The purposes of dividing the sample banks are to control for bank size and bank diversification levels, as well as to identify whether increased capital requirements affect large and small banks differently.

Table 4.2 reports average estimates of equity beta, market leverage, book leverage, market-to-book equity ratio, deposit-to-asset ratio, RWA-to-asset ratio and CET1 capital-to-RWA ratio for each sample bank. The five largest banks appear to have the highest average equity beta even though the average leverage levels among the sample banks, except for Rural Bank (ELD), are quite similar. Rural Bank has substantially lower leverage than other sample banks. During the sample period, Rural Bank was a division of Elders Limited that provided farm products alongside financial services to the farming community[5]. Hence, it was less leveraged than other commercial banks. To avoid spurious associations led by outliers, Rural Bank is excluded from the sample used for industry-wide analysis and panel regressions. All banks in the sample have average market-to-book equity ratios greater than 1.

Daily data on the S&P/ASX 200 Accumulation Index[6], banks' adjusted share price[7], as well as semi-annual data on banks' balance-sheet liabilities, preference equity, total book assets, common equity tier 1 (CET1) capitalisation, RWA and market capital for all sample banks are collected from Bloomberg[8]. In addition, daily BAB90 rates (Bank Accepted Bills - 3 months) acquired from the Reserve Bank of Australia are used as a proxy for the risk-free interest rate.

Since equity risk is unobservable, the Capital Asset Pricing Model (CAPM) is used to estimate a proxy measure for equity risk. There has been a continuing debate in the asset-pricing literature as to the superiority of multi-factor models, such as the Fama-French three-factor model or the Carhart four-factor model, over the CAPM. Although the multi-factor models have received good empirical support from tests in the US equity market, their tests in the Australian market have yielded inconclusive findings (Brailsford et al., 2012a). Therefore, following previous related studies (Kashyap et al., 2010; Miles et al., 2013), I employ the equity beta (β_{equity}) obtained under the CAPM as a proxy for equity risk. Semi-annual bank equity betas are obtained by regressing daily excess stock returns on daily S&P/ASX 200 excess returns over discrete periods of six months as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{4.1}$$

[5] In December 2010, Rural Bank became a fully-owned subsidiary of the Bendigo and Adelaide Bank Group (BEN).

[6] The S&P/ASX 200 Accumulation Index assumes reinvestment of dividends.

[7] Banks' historical pricing is adjusted to reflect both normal and abnormal cash dividends, such as regular cash, interim, special cash, liquidation and capital gains.

[8] Data of CET1 capital and RWA are not entirely available on Bloomberg for small banks. In this study, missing data on CET1 capital and RWA on Bloomberg are manually collected from the Pillar 3 - capital adequacy and risks disclosures published quarterly by each bank.

where, for every bank i at time t, R_{it} is daily excess stock return over the bank bill rate, R_{mt} is daily excess market return proxied by the excess return on the S&P/ASX200 accumulated index and β_i is the estimated semi-annual equity beta, which is a proxy for equity risk.

A relevant measure of leverage is one derived from the definition of capital for which regulators set requirements. Under the Basel III agreement, the definition of the capital-adequacy ratio is based on total risk-weighted assets (RWA) and the ultimate form of loss-absorbing capital is Common Equity Tier 1 (CET1) capital. However, due to regular changes in the definitions of RWA and CET1 over time from Basel I to III, it is difficult to obtain time series of consistent measures of RWA and CET1. Previous studies, such as Kashyap et al. (2010) and Miles et al. (2013), define leverage as a bank's total assets over its equity based on book values. Although it may be a reference point for regulated capital-adequacy, using this measure to test the M-M theorem in the banking context can be problematic. The main problem is that whereas capital requirements are based on book values, the M-M theorem is based on market values. Therefore, to address this issue, I employ two proxies for leverage: one calibrated using the book value of equity and the other using the market value of equity.

4.2 Preliminary observations

Basel III requires that banks have CET1 capital equal to at least seven per cent of their RWA by 1 January 2019. According to table 4.2, the average ratio of RWA to the book value of total assets for Australian banks ranges from 0.33 to 0.60 over the Basel I, Basel II and Basel III periods. These low RWA-to-asset ratios suggest that banks on average could finance up to 97.5 per cent of their book assets with debt, since minimum equity requirements could be as low as 2.5 per cent (i.e., 0.33*7%) of total assets[9]. However, banks tend to maintain capital buffers over minimum capital requirements that they can draw on during stressed periods. Australian banks have average book leverage and market leverage of around 16 and 10 respectively (table 4.2). These figures indicate that banks in Australia on average have 6.25 per cent (i.e., 1/16) of their assets funded by equity based on book values. Using market values, this proportion is slightly higher at 10 per cent (i.e., 1/10). Compared to the UK and US banks' average book leverage ratios reported by Miles et al. (2013) and Kashyap et al. (2010), Australian banks are only half as leveraged as UK banks, but have similar leverage ratios to US banks. Fan et al. (2012) find that the dividend imputation system, which removes the double taxation of corporate earnings, reduces the cost of equity and so contributes to the general decline in leverage among non-financial corporations in Australia. Against this background, it is unclear whether the dividend imputation system has provided Australian banks sufficient incentive to lower leverage compared with other jurisdictions. Furthermore, it can be witnessed that banks apparently prefer using deposits to finance their assets. The five big banks have an average deposit-to-asset ratio of more than 50 per cent, except for Macquarie Bank (MQG), which is predominantly an investment bank. The proportion of deposits is even greater, close to 80 per cent, among the smaller banks.

Table 4.3 reports recent statistics of the equity beta, market leverage, book leverage, market-to-book equity ratio, deposit-to-asset ratio, RWA-to-asset ratio and CET1 capital-to-RWA ratio for each currently-listed sample bank. As at March 2016, major Australian banks have common equity tier 1 capital ratios of around 10 per cent except for the two major banks, ANZ and WBC, whose CET1 capital ratio has increased to

[9]The Basel III agreement introduces a leverage ratio of three per cent of total exposures to complement the risk-based capital requirements. This will prevent banks from financing more than 97 per cent of their assets with debt.

15 per cent of RWA. This level of common equity tier 1 capital cannot be considered extraordinarily high given that the minimum requirement for common equity plus the buffer has been set to 7 per cent of RWA under Basel III. In addition, all of the sample banks trade at recent market-to-book ratios greater than 1, in the range of 1.08 to 2.44.

Figure 4.1 shows time-series of the average betas paired with time-series of the two proxies of leverage across the five large banks (in panel A) and the eight small banks (in Panel B) between 1993 and 2015. In panel A, there is no clear visible positive relationship between equity beta and the two proxies of leverage, except for the period between 2007 and 2010. This timing pattern suggests that equity returns are more sensitive to leverage during financial turmoil. Besides, from 1993 to 2006, as the market-value-based leverage decreased and remained low, equity beta responded slowly but correspondingly, declining in 2001 and 2006 to substantially below its mean level across the sample period. As the large-bank beta series appears to be stationary, fluctuating around a mean level of close to 1, it is expected that the beta estimate will fall eventually if market leverage continues to decline after 2015. Meanwhile, in panel B, the small-bank beta estimate does not seem to follow a stationary process, shifting from a mean of around 0.4 to 0.7 following the crisis of 2007-2009. Noticeably, between 2009 and 2012, as the book-value-based leverage declined, the equity beta of the small banks declined at the same time. Since 2012, the equity betas of the small banks appear to move more closely with the market-value-based leverage. These pieces of graphical evidence support the existence of the M-M offset effect to some extent.

Table 4.1: Sample Banks

Panel A: Large listed banks

	Bank name	Period	Total resident assets ($m)	Share of industry assets (%)
ANZ	Australia & New Zealand Banking Group	1992–2015	554,495	16.70
CBA	Commonwealth Bank of Australia	1992–2015	707,829	21.32
MQG	Macquarie Bank Limited	1997–2015	81,865	2.47
NAB	National Australia Bank Limited	1992–2015	620,785	18.69
WBC	Westpac Banking Corporation	1992–2015	762,677	22.97

Panel B: Small listed banks

	Bank name	Period	Total resident assets ($m)	Share of industry (assets (%)
ABA	Auswide Bank Ltd	1995–2015	2,390	0.07
ADB	Adelaide Bank Limited	1993–2007	16,960	NA
BEN	Bendigo and Adelaide Bank Limited.	1993–2015	58,099	1.75
BOQ	Bank of Queensland Limited	1992–2015	45,856	1.38
BWA	Bank of Western Australia Ltd	1996–2003	28,814	NA
ELD	Rural Bank Limited	1992–2010	4,078	NA
MYS	MyState Bank Limited	2009–2015	3,501	0.11
SGB	St.George Bank Limited	1993–2009	129,968	NA

Total resident assets refers to all assets on the banks' domestic books that are due from residents. Reported figures are a simple average of the amounts as at the end of each period. Share of industry assets refers to the percentage of the banks' total resident assets over that of all authorised deposit-taking institutions in Australia as at December 2015. The symbol NA represents unavailable values, which are applicable for banks no longer listed in 2015. The total amount of Australian banking resident assets is about AUD 3.3 trillion as at December 2015. Source: Monthly Banking Statistics - Back Series, APRA.

Table 4.2: Average statistics of main variables and ratios for each sample bank

Bank	N	Beta	Market Lev.	Book Lev.	Market-to-Book	Deposit/Assets	RWA/BV(A)	CET1/RWA
ANZ	47	1.09	10.85	16.47	1.70	0.57	0.60	0.10
CBA	46	0.89	8.65	16.04	2.09	0.58	0.49	0.09
MQG	37	1.22	8.69	15.62	2.48	0.22	0.33	0.09
NAB	47	1.02	9.74	14.78	1.56	0.51	0.55	0.10
WBC	47	1.04	9.55	15.94	1.90	0.55	0.53	0.10
ABA	40	0.19	9.86	15.39	1.63	0.62	0.35	0.11
ADB	27	0.64	13.91	22.04	1.61	0.73	0.35	NA
BEN	44	0.73	12.62	15.70	1.33	0.84	0.52	0.08
BOQ	47	0.69	11.23	15.68	1.51	0.78	0.54	0.10
BWA	14	0.63	10.96	22.59	2.19	0.58	NA	NA
ELD	38	0.82	2.63	2.53	1.37	NA	NA	NA
MYS	12	0.20	10.39	12.44	1.24	0.70	0.36	0.12
SGB	31	0.71	9.55	14.81	1.71	0.67	0.51	NA

This table presents average statistics of equity beta, book leverage, market leverage, market-to-book equity ratio, deposit-to-asset ratio, RWA-to-asset ratio and common equity tier 1 capital (CET1) to RWA ratio for the 13 sample banks. The sample period varies across banks between 1992 and 2015 (refer to table 4.1). *N* is the number of observations. *Equity Beta* is the proxy for equity risk obtained under the CAPM by regressing daily excess stock returns on daily S&P/ASX 200 excess returns over discrete periods of six months. *Market Lev.*, the market-value-based leverage, is total assets divided by total equity based on market values, where total assets equals the sum of the market value of ordinary shares and the book value of preference shares plus debt; and equity equals the sum of the market value of ordinary shares plus the book value of preference shares. *Book Lev.*, the book-value-based leverage, is total assets divided by total equity based on book values, where total assets equals the sum of the book value of ordinary shares, preference shares plus debt; and equity equals the sum of the book value of ordinary shares plus preference shares. *Market-to-Book* is the market value of equity divided by the book value of equity. *Deposit/Assets* is deposits divided by total assets based on book values. *RWA/BV(A)* is risk-weighted assets divided by total assets based on book values. *CET1/RWA* is common equity tier 1 capital divided by risk-weighted assets. *NA* represents unavailable values. Data on CET1 capital are only available from the March quarter 2013.

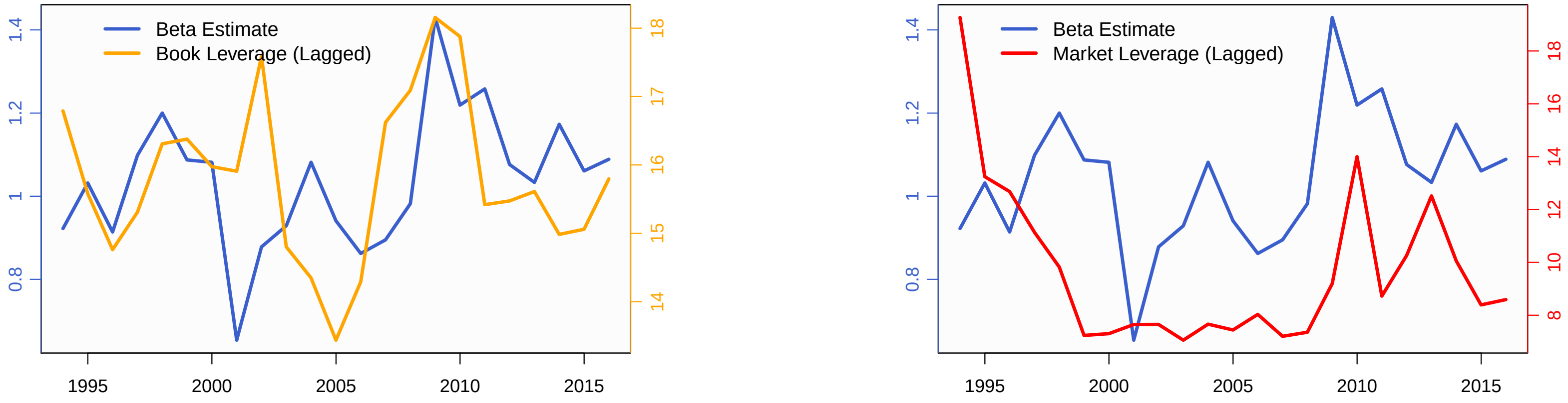
Table 4.3: Recent statistics of main variables and ratios for the currently existing banks in the sample

Period	Bank	Beta	Market Lev.	Book Lev.	Market-to-Book	Deposit/Assets	RWA/BV(A)	CET1/RWA
Mar-16	ANZ	1.39	13.26	15.86	1.21	0.59	0.43	0.15
Dec-15	CBA	1.12	6.77	15.09	2.44	0.61	0.43	0.10
Mar-16	MQG	1.12	9.04	12.55	1.44	0.27	0.48	0.10
Mar-16	NAB	1.31	12.26	16.33	1.30	0.49	0.42	0.13
Mar-16	WBC	1.29	8.64	14.35	1.75	0.59	0.44	0.15
Dec-15	ABA	0.05	13.01	14.00	1.08	0.69	0.41	0.12
Dec-15	BEN	1.06	12.07	13.05	1.09	0.82	0.53	0.08
Feb-16	BOQ	1.13	12.67	14.14	1.13	0.72	0.55	0.09
Dec-15	MYS	0.36	10.80	14.71	1.40	0.92	0.37	0.11

This table presents the most updated balance sheet statistics of equity beta, book leverage, market leverage, market-to-book equity ratio, deposit-to-asset ratio, RWA-to-asset ratio and CET1-to-RWA ratio for the nine sample banks that remain in operation as at 31 March 2016. *Equity Beta* is the proxy for equity risk obtained under the CAPM by regressing daily excess stock returns on daily S&P/ASX 200 excess returns over discrete periods of six months. *Market Lev.*, the market-value-based leverage, is total assets divided by total equity based on market values, where total assets equals the sum of the market value of ordinary shares plus the book value of preference shares plus debt; and equity equals the sum of the market value of ordinary shares plus the book value of preference shares. *Book Lev.*, the book-value-based leverage, is total assets divided by total equity based on book values, where total assets equals the sum of the book value of ordinary shares, preference shares plus debt; and equity equals the sum of the book value of ordinary shares plus preference shares. *Market-to-Book* is the market value of equity divided by the book value of equity. *Deposit/Assets* is deposits divided by total assets based on book values. *RWA/BV(A)* is risk-weighted assets divided by total assets based on book values. *CET1/RWA* is common equity tier 1 capital divided by risk-weighted assets.

Figure 4.1: Average Beta & Leverage for Australian Banks 1993-2015

Panel A: Large listed banks



Panel B: Small listed banks

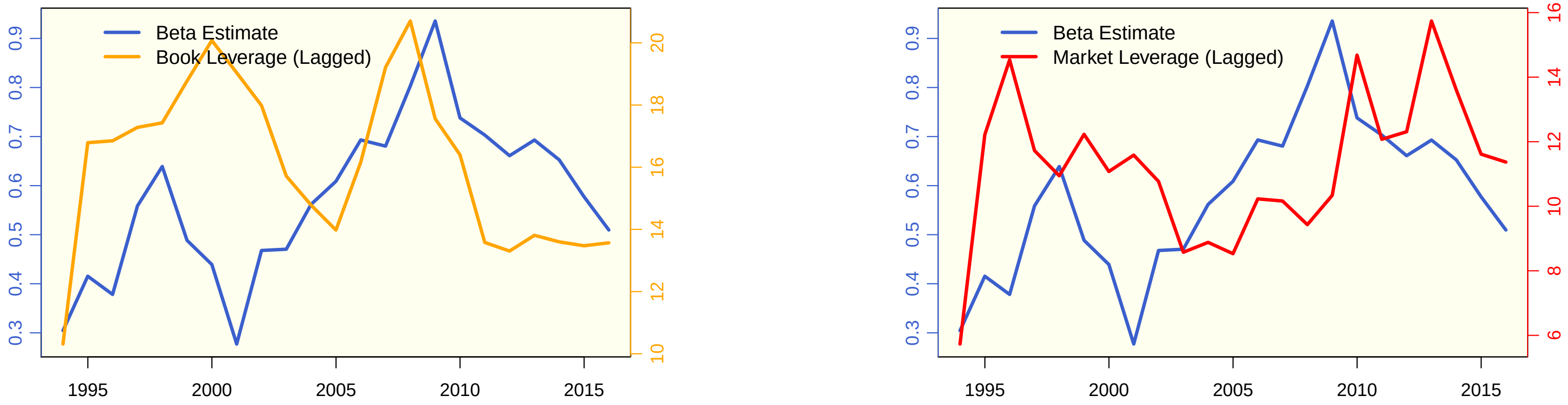


Figure 4.1 presents time-series of annual equal-weighted average beta estimates paired with series of annual equal-weighted average market leverage and book leverage across the five large banks (Panel A) and the eight small banks (Panel B) in Australia between 1993 and 2015.

4.3 Empirical evidence

The CAPM implies that the risks of bank assets (β_{asset}) can be decomposed into risks borne by equity holders (β_{equity}) and those borne by debt holders (β_{debt}), as follows:

$$\beta_{asset} = \beta_{equity}\frac{E}{E+D} + \beta_{debt}\frac{D}{E+D} \tag{4.2}$$

where D is the market value of debt of the bank; E is its market value of equity; (D+E)/E is its leverage. Assuming that the debt is roughly risk-less[10], i.e., $\beta_{debt} = 0$, equation (4.2) then implies the following:

$$\beta_{equity} = \frac{E+D}{E}\beta_{asset} = Leverage \times \beta_{asset} \tag{4.3}$$

Equation (4.3) shows the link between the CAPM and the M-M theorem which provides the foundation for testing the hypothesis that the M-M offset holds for Australian banks. It suggests that if the debt is roughly risk-less, the risk premium on equity should decline linearly with leverage. Following that, the main panel data regression to test the hypothesis is as follows:

$$\beta_{it} = X'_{it}b + \epsilon_{it}, \qquad \epsilon_{it} = \alpha_i + \mu_{it} \tag{4.4}$$

where, for every bank i at time t, β_{it} is the estimated semi-annual equity beta, X_{it} is a vector of regressors that includes (lagged) leverage and year dummies, b is a vector of parameters, α_i is a bank-specific effect and μ_{it} is an idiosyncratic disturbance.

In the first step, time series of bank betas and the two proxies of leverage (mar-

[10]This condition can be regarded as a conservative assumption in assessing how the cost of bank funds varies with leverage; this assumption is designed not to understate the increase in funding costs that lower leverage might bring. In fact, it assumes away any beneficial impact on the cost of debt from it being made safer as leverage falls, thus neutralising one of the routes through which the M-M effects might work (Miles et al., 2013).

ket leverage and book leverage) are tested for stationarity to determine whether data transformation is needed. If two series are non-stationary, a levels regression will likely generate a spurious link. The Im-Pesaran-Shin and Fisher-type unit-root tests for unbalanced panels are run on all four series in both subsamples. According to the augmented Dickey-Fuller (ADF) regression results under both unit-root tests, the null hypothesis that all panels contain unit roots is rejected at the 1% significance level for all series in the big-bank subsample. In the small-bank subsample, the null hypothesis is rejected at the 5% significance level for the leverage series; however, even at the 10% significance level, this decision cannot be applied to the beta series. These results confirm the preliminary observation that except for the small-bank beta estimate, all other series are likely to be trend stationary. Based on the results of the stationarity tests, I proceed to estimate the beta-leverage relationship using the levels regressions[11] as specified in equation (4.4).

In addition, year dummies (time-effects) are included in all specifications to pick up the influence of common effects on beta across banks over time. Moreover, since Im-Pesaran-Shin and Fisher unit root tests do not guarantee that all panels are stationary, I also estimate the link between beta and leverage using the first difference estimator to check for the robustness of the results. Therefore, in this section, the regression estimates are derived using four panel data regression models, including a pooled ordinary least squares (OLS), two extended versions that allow for bank fixed-effects (FE) and random effects (RE) and the first-difference model (FD). The differences among these models are described as follows. The OLS model does not consider heterogeneity across banks but assumes all banks have the same relationship between beta and leverage.

[11] The likelihood of obtaining spurious regression results is reduced here given that the small-bank beta estimate is the only variable that does not follow a stationary process. Moreover, it is worth noting that the panel estimator averages across individuals and the information in the independent cross-section data in the panel leads to a stronger overall signal than the pure time-series case (Baltagi, 2008).

The FE model takes into account the heterogeneity across banks using bank dummy variables. The RE model also considers the heterogeneity between banks but assumes that the individual effect is a random variable. The FD model removes time-invariant individual components by first-differencing the data so that it can be consistently estimated by pooled OLS.

Tables 4.4 and 4.5 present regression results of equity beta on book leverage and market leverage, respectively. Regressions on market leverage are found to be vastly more useful than regressions on book leverage, given that none of the slope coefficients in table 4.4 is significant at the 5% significance level. The results are consistent with the M-M framework functioning based on market values, not book values. In table 4.5, the slope coefficients obtained from all regressions except the FD estimator are significantly positive at the 5% level, which supports the hypothesis that the M-M offset effect works to some extent. The F tests for individual effects and the Hausman tests suggest that the RE estimator is consistent and that RE is the preferred model for both large banks (panel A) and small banks (panel B). Therefore, the coefficients from the RE regressions reported in table 4.5 are used for the subsequent analysis.

The slope coefficients between equity beta and market leverage are 0.027 for large banks and 0.017 for small banks (table 4.5). However, the estimated beta-leverage slope coefficients are not statistically different between the two subsamples (based on unreported significance testing). Thus, the M-M effect might hold to a similar extent for both large banks and small banks.

On the other hand, it is worth noting that if the M-M theorem holds precisely, the constant term in the beta-leverage regression should be close to zero. As reported in table 4.5, the constant coefficient in panel A column 3 is 0.794, which is almost double that of 0.405 in panel B column 3. These results suggest that the average constant term in the beta-leverage regression is lower for the small-bank subsample. Hence, in this respect, the M-M offset effect on beta risk might be relatively stronger for small banks.

Table 4.6 reports results of individual regressions of equity beta on leverage for each individual bank. Results of beta regressions on book leverage and market leverage are presented in panels a and b respectively. Regressions on market leverage once again appear to be more useful than those on book leverage, with no significantly negative slope coefficient observed with respect to market leverage. There are four insignificant beta estimates in the regressions on book leverage while there are only two insignificant beta estimates in the regressions on market leverage. Being predominantly an investment bank, Macquarie Bank MQG's equity beta appears to be strongly driven by market leverage.

Table 4.4: Beta and Book Leverage

	Dependent Variable: Beta							
	Panel A: Big Banks				Panel B: Small Banks			
Lag_Book_Lev	0.002	0.002	0.002	0.025*	0.014	0.003	0.006	0.004
	(0.014)	(0.012)	(0.012)	(0.013)	(0.009)	(0.006)	(0.006)	(0.008)
Constant	1.022***	1.027***	1.023***		0.377	0.547**	0.496**	
	(0.217)	(0.247)	(0.187)		(0.251)	(0.27)	(0.22)	
Regression Model	OLS	FE	RE	FD	OLS	FE	RE	FD
Year Effects	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Bank Effects	No	Yes	No	No	No	Yes	No	No
Observations	224	224	224	219	215	205	205	198
Adjusted R^2	0.317	0.363	0.371	0.026	0.177	0.429	0.407	0.001
F Statistic	4.423***	5.815***	5.695***	5.897**	1.902***	7.410***	6.207***	−0.023
Note:								*p<0.1; **p<0.05; ***p<0.01

	ANZ	CBA	MQG	NAB	WBC	ABA	ADB	BEN	BOQ	BWA	MYS	SGB
FE	0.95	0.77	1.11	0.90	0.91	-0.24	0.34	0.32	0.28	0.38	-0.46	0.40
p.value	***	***	***	***	***		*	*	*	**	**	**

– This table reports statistical results of beta regressions on book leverage under four different estimators using large-bank data series (in panel A) and small-bank data series (in panel B). The four estimators are pooled OLS, fixed effects (FE), random effects (RE) and first-difference (FD). – The 12 bank specific effects are the individual intercepts of the FE models, where the first four coefficients belong to panel A and the others belong to panel B. – FD estimator removes time-invariant components such as intercepts and individual error components. The FD model is run without a constant. – Breusch-Godfrey/Wooldridge tests for serial correlation are conducted for all models at the 1%, 5% and 10% significance level. Serial correlation is evident in all models under both panel A and panel B. Since the error terms are serially correlated, FD estimator is biased and inconsistent. – F tests for individual effects and Hausman tests suggest that RE is appropriate, and RE estimator is consistent. Thus, RE is the preferred model under both panels A and B. – Breusch-Pagan tests suggest the presence of heteroskedasticity in all models in panels A and B. – In all regressions, standard errors are robust to clustering effects at the bank level. Adjusted standard errors are in parenthesis. When the heteroskedasticity-consistent covariance estimator "arellano" is employed to address heteroskedasticity and serial correlation issues, it provides similar results to the cluster-robust standard errors. – The reported constant term in each model includes the average of both bank fixed-effects (where applicable) and year fixed-effects. Similarly, the standard errors on the constant represent the average standard error across all banks and time periods.

Table 4.5: Beta and Market Leverage

	Dependent Variable: Beta							
	Panel A: Big Banks				Panel B: Small Banks			
Lag_Lev	0.031^{***}	0.027^{***}	0.027^{***}	0.005	0.040^{***}	0.012^{**}	0.017^{***}	0.007
	(0.010)	(0.009)	(0.009)	(0.008)	(0.015)	(0.006)	(0.006)	(0.009)
Constant	0.746^{***}	0.815^{***}	0.794^{***}		0.155	0.465^{*}	0.405^{**}	
	(0.128)	(0.272)	(0.099)		(0.264)	(0.257)	(0.192)	
Regression Model	OLS	FE	RE	FD	OLS	FE	RE	FD
Year Effects	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Bank Effects	No	Yes	No	No	No	Yes	No	No
Observations	224	224	224	219	215	205	205	198
Adjusted R^2	0.380	0.411	0.420	0.002	0.247	0.437	0.409	0.004
F Statistic	5.962^{***}	7.265^{***}	7.134^{***}	0.291	2.941^{***}	7.680^{***}	6.276^{***}	0.504

Note: $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

	ANZ	CBA	MQG	NAB	WBC	ABA	ADB	BEN	BOQ	BWA	MYS	SGB
FE	0.45	0.32	0.64	0.42	0.44	-0.26	0.28	0.27	0.24	0.36	-0.46	0.37
p.value	***	**	***	***	***					**	***	**

– This table reports statistical results of beta regressions on market leverage under four different estimators using large-bank data series (in panel A) and small-bank data series (in panel B). The four estimators are pooled OLS, fixed effects (FE), random effects (RE) and first-difference (FD). – The 12 bank specific effects are the individual intercepts of the FE models, where the first four coefficients belong to panel A and the others belong to panel B. – FD estimator removes time-invariant components such as intercepts and individual error components. The FD model is run without a constant. – Breusch-Godfrey/Wooldridge tests for serial correlation are conducted for all models. There is evidence of serial correlation in the errors of OLS and FD models but not in that of FE and RE models under panel A. Whereas the serial correlation problem is present in all models under panel B. Since the error terms are serially correlated, FD estimator is biased and inconsistent. – F tests for individual effects and

Hausman tests suggest that RE is appropriate, and RE estimator is consistent. Thus, RE is the preferred model under both panels A and B. – Breusch-Pagan tests suggest the presence of heteroskedasticity in all models in panels A and B. – In all regressions, standard errors are robust to clustering effects at the bank level. Adjusted standard errors are in parenthesis. When the heteroskedasticity-consistent covariance estimator "arellano" is employed to address heteroskedasticity and serial correlation issues, it provides similar results to the cluster-robust standard errors. – The reported constant term in each model includes the average of both bank fixed-effects (where applicable) and year fixed-effects. Similarly, the standard errors on the constant represent the average standard error across all banks and time periods.

Table 4.6: Beta Regressions on Leverage by Bank

(a) Beta Regressions on Book Leverage

	Const		t-stat	Slope		t-stat	Adj R-sqd
ANZ	0.16		0.72	0.06	***	4.31	0.28
CBA	0.82	***	4.58	0.00		0.41	-0.02
MQG	1.42	***	5.14	-0.01		-0.72	-0.01
NAB	-0.06		-0.25	0.07	***	4.77	0.32
WBC	1.30	***	5.75	-0.02		-1.17	0.01
ABA	0.15		1.41	0.00		0.50	-0.02
ADB	0.70	***	2.84	0.00		-0.24	-0.04
BEN	2.29	***	6.47	-0.10	***	-4.41	0.30
BOQ	0.48	*	1.73	0.01		0.84	-0.01
BWA	0.50		1.37	0.01		0.40	-0.07
MYS	-0.10		-0.23	0.02		0.69	-0.05
SGB	0.24		1.20	0.03	**	2.54	0.15

(b) Beta Regressions on Market Leverage

	Const		t-stat	Slope		t-stat	Adj R-sqd
ANZ	0.86	***	10.44	0.02	***	2.85	0.13
CBA	1.04	***	9.98	-0.02		-1.48	0.03
MQG	0.87	***	6.46	0.04	***	2.94	0.17
NAB	0.70	***	4.87	0.03	**	2.31	0.09
WBC	1.03	***	11.69	0.00		0.11	-0.02
ABA	0.30	***	2.81	-0.01		-1.05	0.00
ADB	0.50	**	2.38	0.01		0.72	-0.02
BEN	0.57	**	2.26	0.01		0.67	-0.01
BOQ	0.01		0.06	0.06	***	5.65	0.40
BWA	0.57		1.68	0.01		0.20	-0.08
MYS	-0.33		-1.09	0.05		1.78	0.16
SGB	0.79	***	5.56	-0.01		-0.47	-0.03

Note: *p<0.1; **p<0.05; ***p<0.01

This table shows the effects of book leverage and market leverage, respectively, on equity beta for each individual bank. The sample period varies across 12 banks between 1992 and 2015 (refer to table 4.1). The regression equation for each bank is as follows:

$$\beta_t = a + b \times Leverage_{t-1} + \epsilon_t$$

where, at time t = 1,...,t, β_t is the equity beta estimated at the end of the period, $Leverage_{t-1}$ is the book or market value of leverage reported at the beginning of the period, a is the constant and b is the slope coefficient, which shows the relationship between equity beta and lagged leverage. For each regression, coefficient t statistics (t-stat), p values indicating the levels of statistical significance as well as the model's adjusted R^2 (Adj R-sqd) are reported.

Chapter 5

Impact of higher capital requirements on overall funding costs

In this chapter, the impacts of heightened capital requirements on banks' funding costs are estimated taking into account the M-M offset effect on equity beta evident in chapter 4. A bank's average cost of funding, also known as the weighted average cost of capital, WACC in corporate finance theory, can be expressed as the weighted sum of its cost of equity and its cost of debt. According to equation (4.3), if the M-M theorem holds exactly and if the debt is roughly risk-less ($\beta_{debt} = 0$), when a bank doubles its capital ratio, i.e., halves its leverage, while holding the riskiness of the bank's assets (β_{asset}) unchanged, the equity risk (β_{equity}) should fall by half. I aim to estimate the extent to which this prediction applies to Australian banks and investigate how a doubling in equity would affect the bank's WACC. Subsequently, I extend the calibration to calculating the impact on overall funding costs of a 10 per cent increase in CET1/RWA capital requirements.

Although stricter capital requirements can mean that banks are less able to exploit any favourable tax treatment of debt, the extra corporate tax payments are not necessarily lost to the economy (Miles et al., 2013). The additional tax receipts could potentially be used by the government to neutralise the impact of any increase in banks' funding costs on economic activity. Thus, it is uncertain whether the private cost to banks of paying higher taxes should be included when estimating the economic cost of having banks use more equity and less debt. Based on available Australian evidence, it is expected that banks pass on the savings from tax shields to their customers[12] and the government can potentially compensate bank customers for any higher borrowing costs arising from higher capital requirements using the additional taxation revenue. In assessing how the cost of bank funds varies with leverage, I set the base case for Australian banks as a scenario that considers corporate tax shields and partial dividend imputation effects. However, for robustness, I examine other scenarios that allow for changes in assumptions about the corporate tax regime, the value that investors attribute to dividend imputation credits, the M-M effect, the risk-free rate and market risk premium. In all scenarios, the current leverage level is set to 10, which is close to the average market value based leverage for Australian banks over the sample period, as reported in table 4.2.

[12] A few studies, including Tellez (2015) and Wilkins et al. (2016), suggest that banks' funding and lending rates have moved together closely in recent years, with declines in funding costs contributing to declines in lending rates. On the other hand, Valadkhani and Anwar (2012) find that banks have tended to pass on rate cuts more slowly than rate rises.

5.1 Funding cost impacts of doubling the equity ratio - The base case

Following equation (4.3), debt is assumed to have a zero beta[13], so that the cost of debt is similar to the risk-free rate (r_f). Taking corporate tax shields into account, the cost of debt is adjusted to reflect interest deductibility at the company level by a factor equal to $(1 - T)$, whereas the cost of equity (r_{equity}) under an imputation tax system should be adjusted by a factor equal to $\frac{(1-T)}{1-T(1-\gamma)}$ (Officer, 1994). Therefore, a companys WACC under imputation, can be formulated as follows:

$$\text{WACC} = \frac{E}{E+D} \times \frac{(1-T)}{1-T(1-\gamma)} \times r_{equity} + (1 - \frac{E}{E+D}) \times (1-T) \times r_f \tag{5.1}$$

where T is the effective corporate tax rate, gamma (γ) is the proportion of tax collected from the firm that will be rebated against personal income in the hands of shareholders, D is the market value of debt and E is the market value of equity.

Given the Australian corporate tax rate of 30 per cent, the corresponding adjustment factor for the cost of debt is then 0.7; thus, the effective cost of debt is $0.7r_f$. Cummings and Wright (2016) suggest that given the existence of the imputation tax system and the influence of domestic investors, the cost of equity for Australian banks should be adjusted by a factor equal to 0.87; hence, the effective cost of equity is

[13]This assumption removes one of the routes through which the M-M effect might work as it assumes away any beneficial impact on the cost of debt from the debt being made safer as leverage falls. Using this conservative assumption, I avoid understating the increase in funding costs that lower leverage might bring.

assumed to be $0.87 r_{equity}$[14].

Equity beta and expected return on equity are estimated as shown below.

$$\hat{\beta}_{equity} = \hat{a} + \hat{b} \times Leverage \tag{5.2}$$

$$E(r_{equity}) = r_f + \hat{\beta}_{equity} \times (E(r_{market}) - r_f) \tag{5.3}$$

where, in equation (5.2), $\hat{a}$ is the reported constant incorporating the average of the year fixed-effects; in equation (5.3), $E(r_{market})$ is the expected return on the market portfolio.

Accordingly, substituting the RE estimates reported in table 4.5 into equation (5.2) suggests that the equity risk for large banks and small banks can be estimated as follows.

$$\text{Large banks:} \qquad \hat{\beta}^{L}_{equity} = 0.794 + 0.027 \times Leverage \tag{5.4}$$

$$\text{Small banks:} \qquad \hat{\beta}^{S}_{equity} = 0.405 + 0.017 \times Leverage \tag{5.5}$$

According to equation (5.4), initially when leverage equals 10, the expected equity beta for the large banks should be 1.064. When leverage is halved from 10 to 5, i.e., when the capital ratio is doubled from 10% to 20%, the new equity beta should then be 0.929. In theory, if the M-M offset effect held precisely, if leverage is halved, equity beta

[14]The firm-specific gamma can be estimated as follows: $\gamma = F \times \theta$ where F is the rate at which franking credits are distributed to shareholders and θ is the value of franking credits in the hands of the average shareholder.
– Distribution rate (F): For the period 2004-2012, Hathaway (2014) found that \$337 billion in franking credits were distributed to shareholders from Australian net company tax collections of \$486 billion, representing a distribution rate of 69 per cent.
– Value of franking credits (θ): Based on estimates from previous studies, including Beggs and Skeels (2006) and Cummings and Frino (2008), franking credits are assumed to be worth 50 per cent of their face value.
– Gamma (γ): Based on an estimated distribution rate of 70 per cent and a value to shareholders of 50 per cent of face value, a conservative estimate of the imputation gamma for Australian banks is $0.70 \times 0.50 = 0.35$, or 35 per cent.
– Substituting the Australian corporate tax rate of 30 per cent and the gamma of 35 per cent in equation $\frac{(1-T)}{1-T(1-\gamma)}$ (Officer, 1994), the estimated adjustment factor for the cost of equity equals 0.87.

should be halved, thus reduced to 0.532. On the other hand, if the M-M theorem did not hold at all, heightened capital requirements would leave the equity beta unchanged at 1.064. Hence, for the large banks, the M-M offset effect on equity betas appears to be around 25% (i.e., $\frac{1.064-0.929}{1.064-0.532}$) of the extent that it would be if the M-M theorem held exactly.

Similarly, using equation (5.5), when leverage is 10, the expected equity beta for small banks is 0.575. When leverage is halved from 10 to 5, the new expected equity beta is 0.49. If the M-M offset effect held precisely, if leverage is halved, equity beta should be halved, thus reduced to 0.288. On the other hand, if the M-M theorem did not hold at all, heightened capital requirements would leave the equity beta unchanged at 0.575. Therefore, for the small banks, the M-M offset effect on equity betas is approximately 30% (i.e., $\frac{0.575-0.49}{0.575-0.288}$) of the extent that it would be if the M-M theorem held precisely.

To continue, I calibrate the effect of doubling equity capital from 10% to 20% of total assets on banks' weighted cost of capital[15]. The average market return over the sample period on the S&P/ASX 200 Accumulation Index of 15% is used as the expected return on the market portfolio for the base case. In addition, 5% is employed as the level of the nominal safe rate given that it is roughly the average 90-day Bank Accepted Bill rate over the sample period 1992-2015. Substituting all of the obtained estimates and assumed values in equation (5.3), the expected cost of equity for the large and small bank sub-samples can be calculated as follows.

$$\text{Large banks:} \qquad E(r^L_{equity}) = 5\% + (0.794 + 0.027 \times Leverage) \times 10\% \tag{5.6}$$

$$\text{Small banks:} \qquad E(r^S_{equity}) = 5\% + (0.405 + 0.017 \times Leverage) \times 10\% \tag{5.7}$$

[15]Specifically, I assume that new equity is raised at existing market prices and is used to retire debt, such that the total market value of the bank's assets is unchanged.

Using equation (5.6), for large banks, when the market value of leverage falls by half from 10 to 5, the required rate of return on equity falls from 15.64% (i.e., $5\% + 1.064 \times 10\%$) to 14.29% (i.e., $5\% + 0.929 \times 10\%$). Before the change in capital structure, at leverage of 10, E/(D+E) is 1/10 and D/(D+E) is 9/10. Substituting these values into equation (5.1), the weighted cost of capital is then (1/10) x 0.87 x 15.64% + (9/10) x 0.7 x 5% = 4.51%. After the change, at leverage of 5, E/(D+E) is 1/5 and D/(D+E) is 4/5, and the weighted cost of capital equals (1/5) x 0.87 x 14.29% +(4/5) x 0.7 x 5% = 5.29%. Thus, a doubling in the market value of equity from 10% to 20% of total assets raises the overall cost of bank funds by 5.29% - 4.51% = 0.78%, or 78 basis points.

Following the same steps using equation (5.7) for small banks, doubling the market value of equity from 10% to 20% of total assets is found to increase the overall cost of funds for small banks by only 0.44%, or 44 basis points. For small banks, when the market value of leverage falls by half from 10 to 5, the required rate of return on equity falls from 10.75% (i.e., $5\% + 0.575 \times 10\%$) to 9.9% (i.e., $5\% + 0.49 \times 10\%$). Before the change in capital structure, at leverage of 10, E/(D+E) is 1/10 and D/(D+E) is 9/10. Substituting these values into equation (5.1), the weighted cost of capital then is (1/10) x 0.87 x 10.75% + (9/10) x 0.7 x 5% = 4.08%. After the change, at leverage of 5, E/(D+E) is 1/5 and D/(D+E) is 4/5, and the weighted cost of capital equals (1/5) x 0.87 x 9.9% +(4/5) x 0.7 x 5% = 4.52%. Therefore, the increase in WACC is 4.52% - 4.08% = 0.44%.

The size of the M-M offset on the beta risk is similar for large banks and small banks, realised around 25% and 30% of the extent it would be if the M-M theorem held exactly. Doubling the equity ratio, however, appears to have a more substantial impact on the funding costs of large banks compared with small banks (78 basis points vs. 44 basis points). The milder impact on overall funding costs for small banks can be explained by the fact that they start with much lower beta risk than large banks, before taking into account the effect of leverage on bank equity betas ($\hat{\beta}^{S}_{equity} = 0.575$ vs. $\hat{\beta}^{L}_{equity} = 1.064$). As evident in table 4.2, betas are approximately 1 for large banks and 0.6 for small banks over the sample period. Further, small banks have on average much lower estimated equity betas independent of leverage than large banks, captured by the constant terms (0.794 in panel A vs. 0.405 in panel B, as reported in table 4.5). Therefore, the estimated slope coefficient of 0.017 in panel B represents a larger percentage change in equity risk than the coefficient of 0.027 in panel A. The results for both large banks and small banks imply that as banks increase equity capital, their beta risk decreases, thus, the marginal cost of newly issued equity is likely to be lower.

5.2 Funding cost impacts of doubling the equity ratio - Alternative scenarios

The base case of the model uses the assumptions that are deemed most average. In this section, I assess the sensitivity of the baseline estimates to changes in assumptions related to the corporate tax regime, the value that investors attribute to dividend imputation credits, the contribution of the M-M effect, the risk-free rate and the market risk premium.

First, the cost of debt in the base case is adjusted by a factor equal to 0.7, i.e., (1-T), where T is the Australian corporate tax rate of 30 per cent. However, as discussed at the beginning of this chapter, it is uncertain whether the private cost to banks of paying higher taxes should be included when estimating the economic cost of requiring banks to use more equity. Therefore, an alternative scenario that assumes away the tax benefits of debt is examined.

Second, the cost of equity is adjusted by a factor equal to 0.87 in the base case. In a situation where corporate tax shields are taken into account but the tax advantage of debt financing is fully offset by dividend imputation, the imputation adjustment factor can theoretically equal 0.7. On the other hand, if the marginal cost of equity for Australian banks is determined by international investors who cannot utilise the dividend imputation credits accompanying bank dividends, as suggested by Siau et al. (2015), the cost of equity should not be adjusted for imputation credits. Taking these factors into consideration, two alternative assumptions regarding the size of the imputation adjustment factor are considered.

Third, regarding the risk-free rate assumption, using the Bank Accepted Bills 3-month interest rate as a proxy, it appears that the average risk-free interest rate for Australia in 2015 was around 2.5 per cent, half of the base case rate. Furthermore, the implied market risk premium of 10 per cent in the base case is larger than suggested in the study by Brailsford et al. (2012b). Based on historical equity risk premium data in Australia from 1883 to 2010, they find that the observed equity premium averaged only 6.5 per cent per annum over this period. A summary of these model assumptions and their related justifications is provided in table 5.1.

Table 5.2 reports the estimated changes in bank funding costs corresponding to a doubling of bank market capital under 14 different scenarios. Scenarios 1 to 8 consider alternative adjustment factors for the cost of debt and cost of equity, whereas, scenarios 9 to 14 take alternative funding benchmarks for the risk-free rate and market risk premium into account. If market equity were doubled from 10 to 20 per cent of total assets, in the presence of partial M-M offsets, the increase in the overall cost of funding would be relatively mild, ranging from 18 to 55 basis points for small banks and from 36 to 94 basis points for large banks. The increase in WACC is lowest when the tax advantage of debt financing is fully offset by dividend imputation, as reported in scenario 14. However, a larger change in WACC is observed in scenario 5, in which investors do not benefit from the dividend imputation credits. Furthermore, it is evident in scenarios 2, 4, 6 and 8 that the change in WACC would be significantly higher, up to 121 basis points for large banks and 73 basis points for small banks, in the absence of the M-M offset effect.

In all scenarios, regardless of the assumptions pertaining to the debt tax shield, dividend imputation, risk-free rate and market risk premium, the size of the M-M offset on beta risk remains the same for both large and small banks (25 per cent and 30 per cent, respectively, of the reductions in the cost of equity that would be achieved if the M-M theorem held exactly). Comparing scenarios 9 to 14 with scenarios 1 to 8, the impact of doubling the equity ratio on bank funding costs is found to be smaller when either the assumed risk-free rate or market risk premium is lower.

It should be noted that the above scenarios examine the impact of a doubling in the market value of equity, whereas capital requirements are based on book values. For any bank with a market-to-book ratio greater than 1, a doubling in the book value of equity implies a smaller percentage increase in the market value of equity, thus, a smaller impact on banks' funding costs than suggested by the analysis presented in this section. This applies to all of the sample banks as they currently trade at market-to-book ratios in the range of 1.08 to 2.44 (refer to table 4.3).

Table 5.1: Justification for considering alternative model assumptions

Debt tax shields (TAF)	**Dividend imputation (IAF)**	**Risk-free rate ($\mathbf{r_f}$)**	**Risk premium (ERP)**
TAF is the adjustment factor for the cost of debt due to corporate tax shields.	IAF is the adjustment factor for the cost of equity due to the imputation tax system.	Debt is assumed to have a zero beta, thus the cost of debt is similar to the risk-free rate, r_f.	ERP is the equity risk premium, the difference between the expected return on the market portfolio and the risk-free rate.
TAF = 1 The cost of debt is not adjusted for interest deductibility at the company level. When banks are less able to exploit the tax treatment of debt, extra tax revenues to the government are assumed to be used to offset extra costs to banks (Miles et al., 2013).	**IAF = 1** Assumes that the marginal investors in bank equity are mainly foreign investors who do not benefit from the dividend imputation credits (Siau et al., 2015); hence, the cost of equity is not adjusted for dividend imputation credits.	**$\mathbf{r_f}$ = 5%** 5 per cent is employed as the level of the nominal safe rate given that it is roughly the average 90-day Bank Accepted Bill rate over the sample period (1992-2015).	**ERP = 10%** The average market return over the sample period on the S&P/ASX 200 Accumulation Index of 15 per cent is used as the expected return on the market portfolio for the base case. Given a risk-free rate of 5 per cent, ERP is 10 per cent.
TAF = 0.7 The cost of debt is adjusted for interest deductibility at the company level. Based on available Australian evidence, e.g., Tellez (2015), Wilkins et al. (2016) and Valadkhani and Anwar (2012), it is expected that banks pass on the savings from tax shields to their customers.	**IAF = 0.87** Given the existence of the imputation tax system and the influence of domestic investors, the cost of equity should be adjusted by a factor equal to 0.87 (Cummings and Wright, 2016).	**$\mathbf{r_f}$ = 2.5%** Using the Bank Acccepted Bills 3-month interest rate as a proxy, the average risk-free interest rate for Australia in 2015 was around 2.5 per cent.	**ERP = 6.5%** Using historical equity risk premium data in Australia from 1883 to 2010, Brailsford et al. (2012b) find that the observed equity premium averaged 6.5 per cent p.a. over this period.
	IAF = 0.7 Assumes that the tax advantage of debt financing is fully offset by the dividend imputation credits; thus, the adjustment factor for the cost of equity equals 0.7.		

Table 5.2: Funding cost impacts of doubling the equity ratio - the base case and alternative scenarios

	Assumptions					**Impacts of doubling the equity ratio**				
						Large banks		Small banks		
	Tax shield adj. factor	Imputation adj. factor	M-M effect	Risk-free rate	Equity risk premium	M-M %	ΔWACC	M-M %	ΔWACC	
		Alternative adjustment factors								
1	TAF = 0.7	IAF = 0.87	Yes	$r_f = 5\%$	ERP = 10%	25%	78 bps	30%	44 bps	Base case
2	TAF = 0.7	IAF = 0.87	No	$r_f = 5\%$	ERP = 10%	0%	101 bps	0%	59 bps	
3	TAF = 1	IAF = 1	Yes	$r_f = 5\%$	ERP = 10%	25%	79 bps	30%	41 bps	
4	TAF = 1	IAF = 1	No	$r_f = 5\%$	ERP = 10%	0%	106 bps	0%	58 bps	
5	TAF = 0.7	IAF = 1	Yes	$r_f = 5\%$	ERP = 10%	25%	94 bps	30%	55 bps	Highest Δ
6	TAF = 0.7	IAF = 1	No	$r_f = 5\%$	ERP = 10%	0%	121 bps	0%	73 bps	
7	TAF = 0.7	IAF = 0.7	Yes	$r_f = 5\%$	ERP = 10%	25%	56 bps	30%	28 bps	
8	TAF = 0.7	IAF = 0.7	No	$r_f = 5\%$	ERP = 10%	0%	74 bps	0%	40 bps	
		Alternative funding benchmarks								
9	TAF = 0.7	IAF = 0.87	Yes	$r_f = 2.5\%$	ERP = 10%	25%	73 bps	30%	39 bps	
10	TAF = 0.7	IAF = 0.87	Yes	$r_f = 5\%$	ERP = 6.5%	25%	53 bps	30%	31 bps	
11	TAF = 0.7	IAF = 1	Yes	$r_f = 2.5\%$	ERP = 10%	25%	87 bps	30%	48 bps	
12	TAF = 0.7	IAF = 1	Yes	$r_f = 5\%$	ERP = 6.5%	25%	67 bps	30%	41 bps	
13	TAF = 0.7	IAF = 0.7	Yes	$r_f = 2.5\%$	ERP = 10%	25%	56 bps	30%	28 bps	
14	TAF = 0.7	IAF = 0.7	Yes	$r_f = 5\%$	ERP = 6.5%	25%	36 bps	30%	18 bps	Lowest Δ

M-M % is calculated as the impact of the M-M offset on equity beta relative to the situation where the M-M theorem held exactly. ΔWACC is the change in WACC as a consequence of doubling the equity ratio, measured in basis points (bps). Reported figures under scenario 1 represent the base case's estimates. Scenarios 2, 4, 6 and 8, which assume no M-M offset effect while other conditions are the same as in scenarios 1, 3, 5 and 7, are reported for comparison purposes. In the presence of the M-M offset effect, the funding cost impacts of doubling the equity ratio are largest under scenario 5 and smallest under scenario 14.

5.3 Funding cost impacts of a 10% increase in risk-based capital requirements

This section demonstrates the likely funding cost implications resulting from a 10 per cent increase in Basel risk-based capital requirements. The regression results reported in chapter 4 show how banks' estimated equity risk changes with the market value of leverage. However, regulatory capital requirements and risk-weightings are applied based on book values of bank asset portfolios. To determine the funding cost implications of a 10 per cent increase in regulatory capital requirements, i.e., based on the common equity tier 1 (CET1) capital to risk-weighted assets (RWA) ratio, requires translating such an increase to an equivalent increase in the equity ratio, i.e., the ratio of common equity to total assets based on market values. Subsequently, the impact of the increased regulatory capital ratio on a bank's WACC is estimated following the same steps outlined in section 5.1.

As reported in table 4.3, all of the sample banks trade at average market-to-book ratios greater than 1. In particular, large banks have a higher average market-to-book ratio, at around 1.63, than that of small banks at 1.17. In addition, risk-weighted assets represent on average about 44 per cent of the book value of assets for both large banks and small banks. Taking these statistics into account, the translation of a 10 per cent increase in regulatory capital ratios to an increase in the market equity ratio is derived and detailed in table 5.3.

New CET1 capital is assumed to be issued at prevailing market prices and used to retire debt of the same value; thus, the increase in CET1 capital arising from higher capital requirements reflects the increase in market value of equity. As shown in table 5.3, a 10 per cent increase in CET1 capital/RWA translates to a relatively modest increase in the market-based equity ratio: 2.6 per cent for large banks and 3.7 per cent for small banks. Using the regression estimates obtained in chapter 4, I estimate the impact on bank overall funding costs of increasing the equity ratio by 2.6 per cent and 3.7 per cent following the steps outlined in section 5.1. Employing the base case assumptions described in section 5.1, I find that a 10 per cent increase in the regulatory capital adequacy ratio would have only a modest impact on bank funding costs, around 11 basis points for small banks and 20 basis points for large banks. The estimated impact on overall funding costs of a 10 per cent increase in regulatory capital requirements is approximately one-quarter the cost of raising bank market capital by 10 per cent of total assets, as reported in section 5.1.

These results are, however, subject to assumptions about the RWA-to-asset and book-to-market ratios. Therefore, alternative scenarios are considered to perform robustness testing on these two factors. Table 5.4 reports the estimated impact on funding costs of a 10 per cent increase in regulatory capital requirements under 6 scenarios. The results show that the impact on banks' funding costs of heightened capital requirements becomes more onerous on banks as the RWA-to-asset ratio and book-to-asset ratio increase. Indeed, both of these ratios can be expected to increase in an economic downturn. Given the trend of banks being required to strengthen their capital ratios, banks with market-to-book ratios greater than 1 may wish to take advantage of their high market values to increase their regulatory capital ratios so as to stay ahead of forthcoming international policy developments.

Table 5.3: Translation of a 10% increase in regulatory capital requirements to an increase in the market equity ratio

	Large banks	Small banks
Assumptions		
RWA-to-asset ratio $\frac{\text{RWA}}{\text{BV of assets}}$	0.44	0.44
Book-to-market ratio $\frac{\text{BV of assets}}{\text{MV of assets}}$	$\frac{1}{1.63} = 0.61$	$\frac{1}{1.17} = 0.85$
Translation steps		
1. Increase in $\frac{\text{CET1}}{\text{RWA}}$	10%	10%
2. Increase in $\frac{\text{CET1}}{\text{BV of assets}}$	$10\% \times 0.44 = 4.4\%$	$10\% \times 0.44 = 4.4\%$
3. Increase in $\frac{\text{CET1}}{\text{MV of assets}}$	$4.4\% \times 0.61 = 2.6\%$	$4.4\% \times 0.85 = 3.7\%$
4. Increase in $\frac{\text{MV of equity}}{\text{MV of assets}}$	2.6%	3.7%

BV stands for the book value and MV stands for the market value.

CET1 is common equity tier 1 capital.

RWA is total risk-weighted assets as defined under Basel III rules.

$\frac{\text{CET1}}{\text{RWA}}$ is the regulatory capital ratio.

$\frac{\text{MV of equity}}{\text{MV of assets}}$ is the equity ratio.

New CET1 capital is assumed to be issued at prevailing market prices, thus $\frac{\text{CET1}}{\text{MV of assets}} = \frac{\text{MV of equity}}{\text{MV of assets}}$.

Table 5.4: Funding cost impacts resulting from a 10% increase in risk-based capital requirements

	Assumptions			**Impacts of a 10% increase in CET1/RWA**		
	RWA-to-asset ratio	Book-to-market ratio	Translated change in the market equity ratio	Large banks ΔWACC	Small banks ΔWACC	
1	0.44	0.61	2.6%	20 bps	11 bps	
2	0.44	0.85	3.7%	29 bps	16 bps	
3	0.44	1.00	4.4%	34 bps	19 bps	
4	0.75	1.00	7.5%	58 bps	33 bps	
5	1.00	1.00	10%	78 bps	44 bps	Base case
6	1.00	1.25	12.5%	97 bps	55 bps	

ΔWACC is the change in WACC as a consequence of an 10% increase in risk-based regulatory capital requirements, i.e., CET1-to-RWA ratio, measured in basis points (bps). The base case corresponds to estimates presented in section 5.1 (which assume RWA-to-asset ratio = 1 and book-to-market ratio = 1). In all scenarios, the cost of debt is adjusted by a factor equal to 0.7, the cost of equity is adjusted by a factor equal to 0.87, the risk-free rate is 5%, the equity risk premium is 10% and the M-M % is 25% for large banks and 30% for small banks. The M-M % is calculated as the impact of the M-M offset on equity beta relative to the situation where the M-M theorem held exactly. The M-M % values obtained are consistent with the estimates reported in sections 5.1 and 5.2.

5.4 Short-run costs of capital raisings

In the previous section, the steady-state costs of regulatory capital changes on bank overall funding costs are found to be relatively modest. There, however, will likely be additional short-term costs associated with transitioning to a regime with higher capital requirements. This may lead to temporary increases in the borrowing costs faced by bank customers, which are not accounted for in the steady-state analysis undertaken for this study. In this section, I discuss the short-run consequences of raising new equity. The literature offers potential solutions to the issues raised.

Asymmetric information combined with transactions costs of new issues are viewed as two distortions that make capital structure relevant, in contrast to the M-M theorem. In a world of asymmetric information, equity issuance can be costly if investors fear that managers only issue equity when it is overpriced (Myers and Majluf, 1984). This situation tends to arise as bank managers generally have more information about their own earnings prospects and financial condition than the capital markets. Because of this opacity, the market will draw inferences from the actions of the bank, as such if investors are aware of an adverse selection problem when new equity is issued, they will place a lower value on the new equity issuance. Furthermore, transactions costs, which a bank incurs when raising funds from external sources, particularly the costs of issuing equity, can be quite substantial. These costs include preparation of the registration statement and prospectus, registration fees, printing and mailing costs and underwriting fees (Berger et al., 1995). Thus, taken together, these frictions might make banks disinclined to raise new equity from external sources.

The short-run costs of capital raisings, however, can be avoided if banks increase equity by their internally generated cash flow, i.e., using retaining earnings. In fact, retained earnings are expected to be the most popular source of funding for corporations, over debt and equity issues. This is known as the "pecking order" hypothesis in corporate finance, which postulates that the cost of financing increases with asymmetric information (see Myers and Majluf, 1984; Mayer, 1988). In this context, it is suggested that the quickest way to strengthen banks without entailing any harmful side effects on the economy is to require banks to retain their earnings until they have significantly more equity (Admati and Hellwig, 2014).

In challenging economic conditions, banks may not have the capacity to generate the required equity internally to build up substantially larger capital cushions. Therefore, requiring banks to reach a particular ratio of equity to assets may have harmful side effects if banks respond to this requirement by making fewer loans, rather than by issuing new shares. This negative impact of increased capital requirements on lending, however, can be lessened by regulators specifying an amount of equity that must be reached, instead of a target ratio (Admati and Hellwig, 2014).

Chapter 6

Conclusion

Reforms that strengthen financial institutions are necessary to improve the efficiency and stability of the financial system (Munchenberg, 2011). In response to the experience of the 2007-2009 global financial crisis, capital requirements have been raised for banks across many jurisdictions. It is likely that the trend of banks being required to strengthen their capital ratios will continue for the foreseeable future. Although the main concern of regulators is to ensure that banks have enough capital to absorb losses, which will help to avoid a systemic crisis, they are also concerned that increased equity requirements might have an adverse impact on economic activity. Many banks are resisting calls to further strengthen their capital buffers. They may be discouraged from maintaining higher capital ratios by the nature of competition in the financial services industry, which effectively compels them to keep funding costs at a minimum (Fonseca and González, 2010; Hanson et al., 2011). While supporters of stricter regulations point to the risks associated with high bank leverage and the exorbitant costs of the global financial crisis, opponents of increased capital requirements argue that they might significantly increase the cost of bank credit and impede economic growth. This study provides empirical evidence that is relevant to the current debate on banking regulation by estimating the long-run costs of regulatory capital changes for banks in Australia, a small open economy with a concentrated banking system.

In this study, I find evidence that a reduction in the risk premium on bank equity helps cushion the impact on bank funding costs of heightened equity capital requirements. Thus, increasing capital requirements is likely to have a relatively minor impact on bank funding costs. I demonstrate that the funding cost implications of capital requirements are subject to several caveats in relation to the corporate tax regime and dividend imputation system. First, I provide empirical evidence that the equity betas of banks decline as banks use more equity in their capital structure, consistent with the M-M theorem and with empirical evidence from major economies (Miles et al., 2013 in the UK and Kashyap et al., 2010 in the US). In particular, the M-M offset effect on equity risk is realised to around 25 to 30 per cent of the extent that it would be if the M-M theorem held exactly. Importantly, the regression results are consistent with the M-M framework functioning based on market values, not book values. Second, I find that under reasonable assumptions, a doubling in bank market capital from 10 to 20 per cent of total assets would have a relatively mild effect on bank funding costs, ranging from 18 to 55 basis points for small banks and from 36 to 94 basis points for large banks. Despite the similar size of the M-M offset on the beta risk for both groups, the greater impact on overall funding costs for large banks eventuates because they start with greater beta risk in the first place, which makes their equity more expensive to service than small banks. This results in a greater impact on funding costs when equity is increased.

Furthermore, because Australian banks have average market-to-book ratios greater than 1, a doubling in the book value of equity implies a smaller percentage increase in the market value of equity, and thus, a smaller impact on bank funding costs than suggested by the base case estimates provided in this thesis. The cost to banks of maintaining higher risk-based regulatory capital ratios is further reduced when the risk weightings on bank assets are less than one and the bank equity trades at market-to-book ratios greater than one. Based on current statistics, I find that the estimated impact on overall funding costs of a 10 per cent increase in regulatory capital requirements is approximately one-quarter the cost of raising bank market capital by 10 per cent of total assets, as reported in the base case.

Given that the 5 large Australian banks hold more than 80 per cent of total banking resident assets and thus closely represent the market in dollar-weighted terms, the results for large banks are compared against the UK and US results from studies conducted by Miles et al. (2013) and Kashyap et al. (2010). The estimated M-M offset for large Australian banks (around 25 per cent as large as it would be if the M-M theorem held exactly) is lower than that found by Miles et al. (2013) in the UK (between 45 and 90 per cent). The smaller M-M offset may be a consequence of the concentrated nature of the banking industry in Australia. As conjectured, increased capital requirements appear to have slightly greater implications for bank funding costs in Australia than suggested by studies from larger economies. However, the impact on funding costs is likely to be mitigated by the presence of the dividend imputation system, which narrows the differential tax treatments of debt and equity. In particular, the impact on the average cost of bank funding of a 10-percentage-point increase in the equity capital ratio is estimated to be about 36-94 basis points for large Australian banks, similar to estimates derived by Miles et al. (2013) and Kashyap et al. (2010) for large UK and US banks, respectively.

This study has several implications for regulators and banks. First, if there were tax treaties across all jurisdictions to eliminate double taxation of corporate dividends within and across countries, this would significantly bring down the cost of requiring banks to be funded with more equity. Second, banks with market-to-book ratios greater than 1 may wish to take advantage of their strong market values to increase their equity capital ratio at a lower cost, so as to stay ahead of forthcoming international policy developments. Furthermore, as banks increase equity capital, their beta risk decreases; thus, the marginal cost of newly issued equity is likely to be lower.

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