Impact of additional equity capital on bank funding costs: Australian evidence

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Abstract

This study examines the long-run cost implications for banks of funding more of their assets with equity capital, in an economy with a strong dependence on bank-intermediated financing and a highly concentrated banking industry. Despite domestic conditions that are likely to heighten expectations of government support for banks, we find robust evidence that equity investors are willing to accept a lower risk premium for investing in less leveraged banks. The relationship between the equity risk premium and leverage is not significantly affected by bank size. However, we find that equity pricing became more responsive to bank leverage after the 2007-2009 financial crisis. The impact of additional equity capital on the overall cost of bank funding is small (in the order of 0-3 basis points annually for each 1-percentage-point increase in the ratio of equity capital to risk-adjusted assets).

JEL classification: G21, G28

Keywords: Commercial banks, Bank capital structure, Bank funding costs

1. Introduction

Equity capital is the cushion that banks have against a sudden drop in the value of their assets or an unexpected withdrawal of liabilities (Cecchetti and Schoenholtz, 2021: 301). Banks with larger capital cushions are more likely to survive and expand their market shares during periods of financial market disruption (Berger and Bouwman, 2013; Demirgüç-Kunt, Detragiache and Merrouche, 2013). Since the outbreak of the COVID-19 pandemic, banking regulators have implemented plans to limit banks' discretionary capital distributions (Svoronos and Vrbaski, 2020). These plans have been designed to ensure that banks maintain capacity to lend and conserve capital in a stressed operating environment. Banks have acted by suspending or reducing dividend payments, share buybacks and discretionary bonuses (Turner, 2020). The responses of regulators and banks to the crisis demonstrate the value of bank capital for supporting the ongoing supply of credit to the economy. As the economy recovers from the COVID-19 crisis, banks can be expected to come under renewed scrutiny from regulators, investors and ratings agencies to review their capital management plans and assess whether additional equity capital is required to increase the banks' capacity to withstand stressed economic conditions.[1] To inform the debate about the net benefits of additional equity capital, this study examines the impact of additional equity capital on the long-run cost of funding banks' lending activities.

This study examines an economy with a strong dependence on bank lending for financing economic activity and with a highly concentrated banking industry. Banks dominate the Australian financial system and locally incorporated banks hold assets worth more than 200 per cent of annual gross domestic product. Bank financing is a more dominant source of investment funds than in other countries including the United States, Japan and the United Kingdom.[2] Furthermore, Australia's banking industry is much more concentrated than those of other countries, with the four largest banks accounting for more than three-quarters of total banking assets. The concentrated nature of the Australian banking industry is likely to contribute to perceptions among equity investors that authorities will protect the industry in

[1] As part of its new capital framework, which came into effect from January 2023, the Australian Prudential Regulation Authority (APRA) introduced a 1.0 per cent default setting for the countercyclical capital buffer (see APRA, 2021). The countercyclical capital buffer is an additional amount of common equity capital above the minimum regulatory requirement that can be imposed by APRA to protect the banking sector from systemic risk.

[2] The reliance on bank financing in Australia relative to other countries is indicated by statistics on bank credit to the private non-financial sector as a percentage of gross domestic product. See the Bank for International Settlements publication, *Credit to the Non-Financial Sector*, December 2023, table F2.4.

disaster states (Gandhi and Lustig, 2015; Kelly, Lustig and Van Nieuwerburgh, 2016). Strong public finances provide the government with a greater capacity to support the country's largest financial institutions than in many European and other OECD countries (Demirgüç-Kunt and Huizinga, 2013).[3] These circumstances might make equity investors indifferent to the greater safety brought about by additional equity capital and eliminate an important channel through which the impact on a bank's overall cost of funds could be reduced.

This study differs from studies that use realised returns to examine the impact of additional equity capital on a bank's cost of equity. Miles, Yang and Marcheggiano (2013) and Junge and Kugler (2013) examine the relationship between a bank's financial leverage and its level of systematic risk. Baker and Wurgler (2015) examine the relationships both between a bank's financial leverage and its systematic risk and between the bank's systematic risk and its risk-adjusted returns. A significant limitation of the studies by Miles, Yang and Marcheggiano (2013), Junge and Kugler (2013) and Baker and Wurgler (2015) is that they rely on realised returns for estimating the level of systematic risk and expected stock returns. Although realised returns may provide unbiased estimates of expected returns, they are extremely noisy (Fama and French, 1997; Elton, 1999). To avoid the problems of using realised returns, for this study we use dividend discount models (DDMs) to infer a bank's cost of equity.[4] The estimates we use represent the discount rate that equates the bank's stock price to the present value of all expected future cash flows to equity-holders. An advantage of the DDM-based approaches is that they bypass the cumulative uncertainty of standard asset pricing techniques; that is, the uncertainty of identifying risk factors, measuring the sensitivity of expected returns to those factors and estimating the reward for bearing the sensitivity (Pástor, Sinha and Swaminathan, 2008; Lee, Ng and Swaminathan, 2009). The DDM-based approaches allow us to directly examine the impact of additional equity capital on a bank's cost of equity.

Despite domestic conditions that are likely to heighten expectations of government support for banks, we find robust evidence that equity investors are willing to accept a lower risk premium for investing in less leveraged banks. There is no evidence we can find for

[3] The Australian Government ran fiscal deficits from 2008-2017, reflecting weaker economic performance and stimulatory policy settings after the financial crisis (see International Monetary Fund, 2019). However, federal government debt remained below 20 per cent of annual gross domestic product throughout the sample period for our study.

[4] We thank David Norman for suggesting we use DDM-based approaches to estimate a bank's cost of equity.

Australian banks that the relationship between the equity risk premium and leverage is affected by bank size. However, we find evidence that equity investors became significantly more wary of bank leverage after the financial crisis of 2007-2009. Equity pricing is more responsive to banks' leverage levels in the ten-year period beginning with the financial crisis than in the ten-year period leading up to the crisis.

Allowing for the reduced reliance on interest tax shields and on funding potentially obtained from guaranteed sources, the impact of additional equity capital on the overall cost of bank funding is small (in the order of 0-3 basis points annually for each 1-percentage-point increase in the ratio of equity capital to risk-adjusted assets). The estimates we derive of the impact of additional equity capital on bank funding costs are close to those of Miles, Yang and Marcheggiano (2013) for United Kingdom banks. The impact on bank funding costs will be more burdensome than our estimated range for banks with riskier-than-average assets, as measured under the Basel III regulatory framework. The impact can be expected to approach the upper end of our estimated range if changes in government bailout policy reduce the incentive of equity investors to monitor bank leverage or if changes in taxation policy reduce the value that equity investors realise from the imputation credits distributed with bank dividends.

2. Impact of additional equity capital on bank funding costs

In the frictionless and tax-free world considered by Modigliani and Miller (1958), the proportion of equity capital included in a firm's capital structure has no effect on the overall cost of funding the firm. The Modigliani-Miller (MM) theorem states that, absent additional considerations such as those involving interest tax shields and financial distress costs, an increase in the proportion of equity financing simply changes how risk is allocated among the various investors in the company (that is, the holders of debt, equity and any hybrid instruments issued by the company). The total risk to which all investors are exposed does not change and is determined by the risk that is inherent in the company's asset returns. In a market in which risk is priced correctly, an increase in the proportion of equity financing lowers the returns demanded by both equity-holders and debt-holders in a way that leaves the total funding costs of the company the same.

In practice, there are reasons why the MM predictions may not hold exactly for banks. First, an increase in equity financing may mean that banks forgo some of the tax advantage associated with debt financing (Schepens, 2016). Banks can deduct interest payments as an expense to set against their corporate tax payments.[5] Second, an increase in equity financing may limit the extent to which banks can take advantage of subsidised funding sources. Deposit guarantees, unless they are charged at an actuarially fair rate, may provide banks with an incentive to substitute equity finance with deposit finance (Demirgüç-Kunt and Huizinga, 2004). To the extent that investor expectations of government support are embedded in the credit spreads on banks' wholesale debt, the cost of that type of debt will also fall relative to equity (Ueda and Weder di Mauro, 2013). If equity investors anticipate that government support for the banking industry reduces the probability of them being wiped out in disaster states, they may be less perturbed about any tail risk taken on by banks (Gandhi and Lustig, 2015). These distortions can be expected to weaken the pricing response in both debt and equity markets to changes in equity financing by banks.

However, the distortions created by tax considerations and bank funding subsidies do not completely nullify the mechanism underlying the MM result: Increasing the required proportion of equity financing, relative to debt financing, should reduce the returns demanded by equity-holders because the reduced leverage reduces the volatility and thus the systematic risk of the equity returns (Miller, 1995; Brealey, 2006). Based on regression analysis of the relationship between equity betas and leverage for United Kingdom banks, Miles, Yang and Marcheggiano (2013) find that less leveraged banks have lower systematic risk. For Swiss banks, Junge and Kugler (2013) report similar findings. For United States banks, Baker and Wurgler (2015) also find that less leveraged banks have lower systematic risk. However, Baker and Wurgler conclude that less leveraged banks do not necessarily have a lower cost of equity, because they find evidence of a low-risk anomaly whereby banks with lower systematic risk have higher risk-adjusted returns. In this study, we use DDM-implied estimates of a bank's cost of equity to test the degree to which the MM result with respect to the relationship between a bank's cost of equity and its leverage holds for Australian banks. We further investigate whether the strength of the relationship between a bank's cost of equity and its leverage is affected by bank size or by equity market conditions that prevail after the 2007-2009 financial crisis.

[5] This effect can be reduced if returns to equity investors in the form of dividends and capital gains are taxed less heavily than interest receipts at the personal level.

The recent literature suggests that the long-run costs of additional equity capital for banks are low, even if there are substantial departures from the MM predictions and extra tax paid by banks is lost to the economy. In the United Kingdom, the findings of Miles, Yang and Marcheggiano (2013) suggest that the impact on bank funding costs will be in the range of 1-3 basis points annually for each 1-percentage-point increase in the ratio of common equity to risk-adjusted assets measured according to the Basel III rules.[6] In this study, we estimate the long-run impact of additional equity capital on the overall cost of funding for Australian banks. We describe the sensitivity of our estimates to changes in assumptions we make about the risk-free interest rate, the strength of MM theorem effects, the effective corporate tax rate and taxation arrangements with respect to dividend income.

3. Empirical implementation

3.1 Data and sample

This study focusses on 13 listed Australian banks in the period from January 1998 to December 2017. Monthly data for each bank are obtained from Thomson Reuters Institutional Brokers Estimate System (IBES) that include the consensus analyst forecasts of earnings per share and dividends per share for the next three financial years. Annual data are obtained from Worldscope on the current book value per share. Daily data are obtained from Thomson Reuters Datastream on the closing stock prices and cash dividends for the sample banking companies. Data on 90-day bank bill interest rates are obtained from the Reserve Bank of Australia.

Semi-annual financial reporting data are obtained from Worldscope on the cash and amounts due from banks, total loans, total assets, total liabilities, preferred stock, common equity, total shareholders' equity and earnings for the sample banking companies. Data on the non-performing loans for each bank are extracted from the companies' annual reports stored in the Morningstar DatAnalysis database. The dates that the banking companies release their financial results are obtained from the Morningstar DatAnalysis database. Data on consumer price inflation rates are obtained from the Australian Bureau of Statistics.

[6] The lower end of the range suggested by Miles, Yang and Marcheggiano's (2013) analysis corresponds to no tax effect and an MM effect that is 75 per cent as large as it would be if the MM theorem held exactly. The upper end of the range corresponds to a tax effect and an MM effect that is 45 per cent as large as it would be if the MM theorem held exactly.

The analysis is restricted to listed domestic companies, for which the provision of banking services represents the main part of their business activities. The Bank of Western Australia, which was a subsidiary of the Bank of Scotland and HBOS from December 1995 to October 2008, is excluded from the sample. AMP and Elders, which have been engaged predominantly in the provision of wealth management and agricultural services respectively, are excluded from the sample. Three of the sample banks merged with other banks during the sample period. Observations for the acquired banks from the dates that the merger transactions were announced to the market are removed from the sample.

3.2 Equity risk premium

To estimate a bank's equity risk premium – the excess return over the safe rate required by investors as reward for bearing the uncertainty associated with the equity return – we use two dividend discount model of stock prices-based approaches. The DDMs are estimated on a semi-annual basis; to take account that Australian listed companies report their financial results and distribute dividends to their investors semi-annually.

First, we use an equity risk premium implied by the constant-growth DDM (Gordon and Shapiro, 1956):

$$\begin{aligned} P_{i,t} &= \frac{E(DPS_{i,t+1})}{E(r_{i,t})^C - g} \\ ERP_{i,t}^C &= E(r_{i,t})^C - r_{f,t} \end{aligned} \tag{1}$$

where $P_{i,t}$ is the stock price,[7] $E(DPS_{i,t+n})$ is the consensus analyst forecast of dividends per share for the n^{th} semi-annual period ahead, $E(r_{i,t})^C$ is the expected return on the stock implied by the constant-growth DDM, g is the constant growth rate and $r_{f,t}$ is the risk-free rate at the IBES statistical period date in the month after the bank releases its semi-annual financial results. The constant growth rate is estimated as:

$$g = [1 - E(\delta_{i,t+1})] \times E(ROE_{i,t+3}) = [1 - \frac{E(DPS_{i,t+1})}{E(EPS_{i,t+1})}] \times \frac{E(EPS_{i,t+3})}{E(BVS_{i,t+2})} \tag{2}$$

[7] The stock price is adjusted for cum-dividend trading by deducting the value of cash dividends declared for previous semi-annual periods.

where $1 - E(\delta_{i,t+n})$ is the expected plowback ratio (the fraction of earnings expected to be reinvested in the firm), $E(ROE_{i,t+n})$ is the market's expectation of the return on equity, $E(EPS_{i,t+n})$ is the consensus analyst forecast of earnings per share and $E(BVS_{i,t+n})$ is the expected book value per share for the n^{th} semi-annual period ahead. For the risk-free rate, we use the 90-day bank bill interest rate. Equation (1) is solved analytically for $ERP_{i,t}^{C}$.

The constant-growth DDM is estimated on a semi-annual basis using IBES consensus analyst forecasts of earnings and dividends per share for the next two financial years. For this purpose, $E(DPS_{i,t+1})$ is calculated as the forecast first-financial-year dividend divided by $2 + g$ if the recently released results are final results; and as the forecast first-financial-year dividend minus the actual interim dividend if the recently released results are interim financial results. $E(\delta_{i,t+1})$ is calculated as the dividend-per-share forecast divided by the earnings-per-share forecast for the first financial year. $E(ROE_{i,t+3})$ is calculated as the earnings-per-share forecast for the second financial year divided by the current book value per share plus earnings per share expected to be reinvested in the firm in the first financial year; with the result converted to a semi-annual rate of return.

Second, we use an equity risk premium implied by a multistage-growth DDM:

$$P_{i,t} = \frac{E(DPS_{i,t+1})}{1+E(r_{i,t})^{MS}} + \frac{E(DPS_{i,t+2})}{[1+E(r_{i,t})^{MS}]^2} + \frac{E(DPS_{i,t+3})}{[1+E(r_{i,t})^{MS}]^3} + \frac{E(DPS_{i,t+3})(1+g^T)}{[E(r_{i,t})^{MS} - g^T][1+E(r_{i,t})^{MS}]^3} \quad (3)$$

$$ERP_{i,t}^{MS} = E(r_{i,t})^{MS} - r_{f,t}$$

where $E(r_{i,t})^{MS}$ is the expected return on the stock implied by the multistage-growth DDM and g^T is the terminal growth rate. The terminal growth rate is estimated as:

$$g^T = [1 - E(\delta_{i,t+3})] \times E(ROE_{i,t+5}) = [1 - \frac{E(DPS_{i,t+3})}{E(EPS_{i,t+3})}] \times \frac{E(EPS_{i,t+5})}{E(BVS_{i,t+4})}. \quad (4)$$

Equation (3) is solved numerically for $ERP_{i,t}^{MS}$.

The multistage-growth DDM is estimated on a semi-annual basis using IBES consensus analyst forecasts for the next three financial years. Accordingly, $E(DPS_{i,t+1})$ is calculated as the forecast first-financial-year dividend divided by 2 if the recently released results are final financial results; and as the forecast first-financial-year dividend minus the actual interim dividend if the recently released results are interim results. $E(DPS_{i,t+2})$ is calculated as the forecast first-financial-year dividend divided by 2 if the recently released results are final financial results; and as the forecast second-financial-year dividend divided by 2 if the recently released results are interim results. $E(DPS_{i,t+3})$ is calculated as the forecast second-financial-year dividend divided by 2 + g^T if the recently released results are final financial results; and as the forecast second-financial-year dividend divided by 2 if the recently released results are interim results. $E(\delta_{i,t+3})$ is calculated as the dividends-per-share forecast divided by the earnings-per-share forecast for the second financial year. $E(ROE_{i,t+5})$ is calculated as the earnings-per-share forecast for the third financial year divided by the current book value per share plus earnings per share expected to be reinvested in the firm in the first and second financial years; and converted to a semi-annual rate of return.

The measures we use of a bank's equity risk premium represent the market consensus of the required rate of return above the safe rate embedded in the bank's stock price. These measures have the advantage of avoiding problems associated with estimating the firm-level cost of equity capital using realised returns (Fama and French, 1997; Elton, 1999; Pástor, Sinha and Swaminathan, 2008; Lee, Ng and Swaminathan, 2009). In particular, the DDM-based approaches bypass the cumulative uncertainty of identifying risk factors, measuring the sensitivity of expected returns to those factors and estimating the reward for bearing the sensitivity. The DDM-based approaches have their own limitations, because the estimation of future cashflows used to estimate the equity risk premium is model specific. To ameliorate this concern, we supplement the constant-growth DDM with the multistage-growth DDM. The multistage-growth DDM can be expected to provide a more reliable measure of a bank's equity risk premium than the constant-growth DDM when the bank's dividend growth prospects are different in the medium-to-long term than in the short term. In this regard, the IBES forecast data suggest a cyclical pattern in the difference between the medium-term and short-term dividend growth prospects for the sample banks; this difference increased during the financial crisis of 2007-2009 and tapered away in subsequent years.

3.3 Financial leverage

Following Junge and Kugler (2013), a bank's financial leverage is measured as:

$$LEVERAGE_{i,t} = \frac{(E_{i,t} + D_{i,t})}{E_{i,t}} \tag{5}$$

where $E_{i,t}$ is shareholders' equity, $D_{i,t}$ is debt and $E_{i,t} + D_{i,t}$ represents the total assets of the bank. We wish to examine the relationship between the equity risk premium and a measure of leverage that is affected by regulatory rules on bank capital. The ultimate form of loss-absorbing capital under the Basel III framework is common equity tier 1 (CET1) capital, which is common equity with regulatory adjustments. The shareholders' equity we use in the leverage calculation includes common equity and some preferred stock which has more limited loss-absorbing capacity. However, preferred stock represents only a small proportion of total shareholders' equity for the sample banks (4.6 per cent on average over the sample period). Consequently, shareholders' equity and the purer measure of loss-absorbing capital defined under Basel III as CET1 track closely together and the results we obtain on the relationship between the equity risk premium and leverage defined using shareholders' equity are likely to be informative about how the equity risk premium responds to changes in the amount of truly loss-absorbing capital.[8]

[8] We repeat all the regression analysis for our study using the ratio of total assets to common equity as the leverage measure and the results are similar.

4. Results

4.1 Descriptive statistics

Table 1 presents descriptive statistics for each bank in our sample. Figure 1 illustrates the constant-growth DDM-implied equity risk premium and leverage for Australian banks from January 1998 through December 2017. The average total assets for all sample banks is $286.1 billion in constant 2017-dollar terms (table 1).

The average constant-growth DDM-implied equity risk premium for all sample banks is 5.9 per cent per annum. This estimate is slightly lower than the long-run historical average realised excess return for the Australian equity market of 6.5 per cent per annum documented by Brailsford, Handley and Maheswaran (2012). The average equity risk premium for all banks implied by the multistage-growth DDM is similar in annual percentage terms to that implied by the constant-growth DDM. The constant-growth DDM-implied equity risk premium increased following the onset of the financial crisis in mid-2007 and generally remained at a higher level in the post-crisis period than in the pre-crisis period (see figure 1).

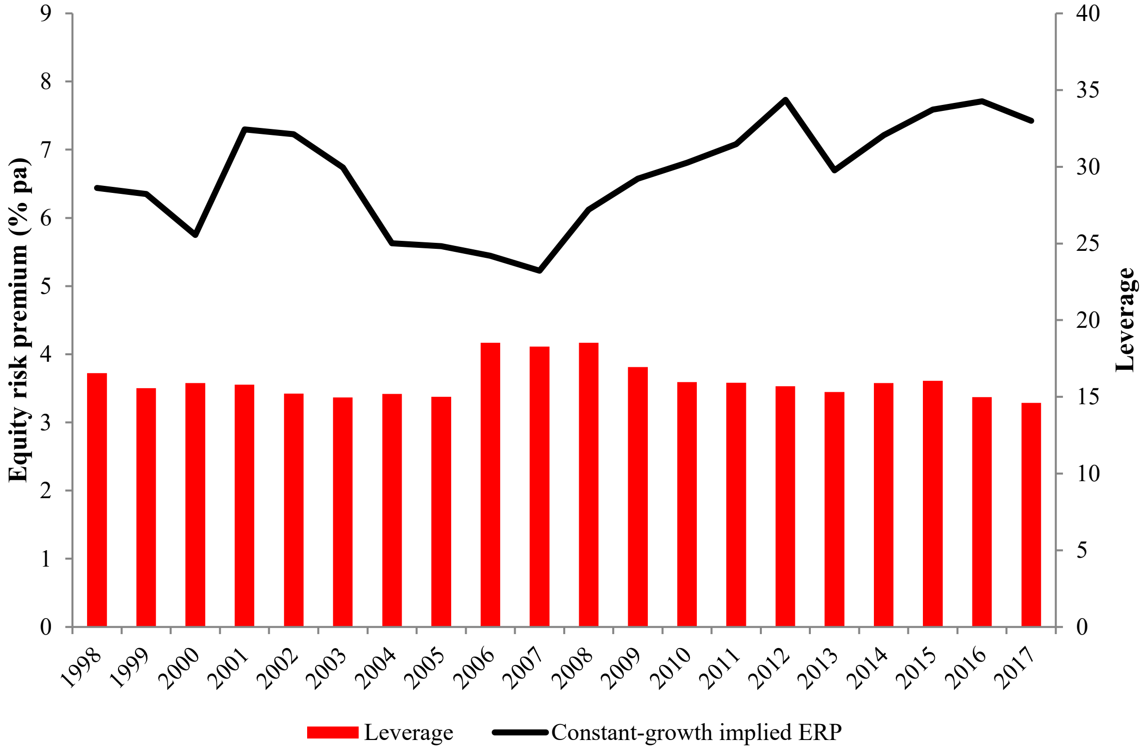
For all sample banks, the average leverage is 16 (table 1). The measure we use for leverage increased markedly in 2006, when banks adopted Australian equivalents to International Financial Reporting Standards (figure 1). With the implementation of International Financial Reporting Standards, securitisation vehicles were recognised to a greater extent as both assets and liabilities on the balance sheet and some financial instruments issued by banks were reclassified from equity to debt. Leverage decreased from 2009, when banks moved to strengthen their capital positions in response to the 2007-2009 financial crisis.

Table 1
Descriptive statistics for each sample bank

This table reports summary statistics for each bank in the sample. The sample period is January 1998 to December 2017. *N* is the number of semi-annual observations. *Total assets* is the book value of assets in constant 2017 Australian dollars. *Constant-growth implied ERP* is the difference between the bank's constant-growth dividend discount model-implied cost of equity and the risk-free rate. The constant growth rate is estimated as the earnings retention rate multiplied by the market's expectation of the return on equity for the third semi-annual period ahead. *Multistage-growth implied ERP* is the difference between the bank's multistage-growth dividend discount model-implied cost of equity and the risk-free rate. The multistage-growth dividend discount model allows for consensus analyst forecasts of dividends per share for the next three semi-annual periods before the bank settles down to a sustainable growth trajectory. The terminal growth rate is estimated as the earnings retention rate multiplied by the market's expectation of the return on equity for the fifth semi-annual period ahead. The risk-free rate is proxied by the 90-day bank bill interest rate. *Leverage* is the book value of assets divided by the book value of equity. *NPL* is the ratio of non-performing loans to total loans. *Cash holdings* is the ratio of cash and amounts due from banks to total assets. *Return on assets* is pre-tax profit divided by average assets.

Bank name	N	Period	Total assets $bil	Constant-growth implied ERP % pa	Multistage-growth implied ERP % pa	Leverage	NPL %	Cash holdings %	Return on assets %
National Australia Bank	40	1998-2017	691.4	6.9	7.2	17.7	1.11	5.5	1.17
Commonwealth Bank of Australia	40	1998-2017	589.7	6.0	6.1	16.6	0.88	3.0	1.47
Australia and New Zealand Banking Group	40	1998-2017	529.4	7.5	7.5	16.2	1.16	5.1	1.37
Westpac Banking Corporation	40	1998-2017	528.7	7.0	7.1	17.0	0.84	3.6	1.43
Macquarie Bank	40	1998-2017	126.8	7.4	7.6	15.8	1.57	6.6	1.48
St.George Bank	20	1998-2007	94.8	3.5	4.1	15.8	0.50	1.4	1.35
Suncorp-Metway	40	1998-2017	79.5	5.0	5.5	9.1	2.01	1.7	1.53
Colonial	4	1998-1999	70.6	4.0	4.6	13.8	2.84	2.4	2.26
Bendigo and Adelaide Bank	40	1998-2017	38.6	4.2	4.3	15.4	1.31	1.8	0.85
Bank of Queensland	40	1998-2017	28.5	4.5	5.0	17.2	1.02	3.6	0.85
Adelaide Bank	19	1998-2007	14.4	5.0	5.2	23.2	0.46	1.1	0.92
MyState Bank	6	2015-2017	4.5	6.9	7.3	14.6	0.28	2.4	1.07
Auswide Bank	5	2015-2017	3.1	6.2	6.7	14.1	0.47	1.7	0.66
All banks	374	1998-2017	286.1	5.9	6.1	16.0	1.15	3.5	1.26

Figure 1
Implied ERP and leverage for Australian banks, 1998-2017



This figure plots the implied equity risk premium and leverage for Australian banks from January 1998 through December 2017. *Constant-growth implied ERP* is the difference between the bank's constant-growth dividend discount model-implied cost of equity and the risk-free rate, in the month after the bank releases its semi-annual financial results. The constant growth rate is estimated as the earnings retention rate multiplied by the market's expectation of the return on equity for the third semi-annual period ahead. The risk-free rate is proxied by the 90-day bank bill interest rate. *Leverage* is the book value of assets divided by the book value of equity at the end of the previous semi-annual period. Numbers presented in this figure are weighted based on the value of the bank's equity.

4.2 Empirical analysis of the MM offset effect

In this subsection, we examine the impact on a bank's cost of equity of changes in its financial leverage. The constant-growth DDM-implied and multistage-growth DDM-implied estimates of a bank's equity risk premium are regressed on the bank's financial leverage, using a panel framework that allows for differences in asset risk between banks and differences in financial market conditions over time.

The MM theorem implies that the risk premium on a bank's assets can be decomposed into a risk premium demanded by equity investors and a risk premium demanded by debt investors as follows:

$$E(r_A) - r_f = \frac{E}{E+D}[E(r_E) - r_f] + \frac{D}{E+D}[E(r_D) - r_f] \tag{6}$$

where $E(r_A)$ is the expected return on the bank's assets, $E(r_E)$ is the expected return on its levered equity and $E(r_D)$ is the expected return on its debt. If we assume that the risk premium on the bank's debt is zero, such that $E(r_D)$ is the risk-free rate,[9] equation (6) implies that:

$$ERP = E(r_E) - r_f = \frac{E+D}{E}[E(r_A) - r_f] = LEVERAGE \times [E(r_A) - r_f] \tag{7}$$

Equation (7) states that, if the risk premium on the bank's debt is zero, the risk premium on its equity should decrease linearly with leverage. If the leverage of a bank is halved – holding the riskiness of the bank's assets unchanged – the same risks are supported on an equity cushion that is twice as large. Each unit of equity bears half as much risk as before and, consequently, the MM theorem predicts that the risk premium demanded by equity investors will be reduced by half. We test the extent to which this prediction holds for Australian banks.

[9] The retail deposit liabilities of banks are close to riskless on account of explicit guarantees. A bank's wholesale debt is less likely to be riskless than its retail deposits. However, empirical studies provide evidence that the risk premium demanded by investors who invest in the wholesale debt of large banks is reduced by implicit guarantees (Ueda and Weder di Mauro, 2013; Beyhaghi, D'Souza and Roberts, 2014; Cummings and Guo, 2020).

The panel regression we estimate is:

$$ERP_{i,t} = \alpha_i + \gamma LEVERAGE_{i,t-1} + \text{Year FE} + \varepsilon_{i,t} \quad (8)$$

where, for bank i at time t after the bank releases its financial results, $ERP_{i,t}$ is the equity risk premium estimated using the constant-growth DDM or the multistage-growth DDM and $LEVERAGE_{i,t-1}$ is leverage at the end of the previous semi-annual period.[10] Equation (7) shows that the coefficient on leverage is an estimate of the average risk premium on banks' assets. The regression specification includes bank effects, represented by a bank-specific intercept term, to control for differences in asset risk between banks. It also includes year effects, to control for the influence of any other effects on the equity risk premium that are common to all banks, for example, effects related to changes in the level of risk aversion among investors, changes in macroeconomic conditions or variations in accounting and regulatory standards.[11] The bank effects and year effects are scaled, by subtracting the observation-weighted mean of the bank effects and the observation-weighted mean of the year effects respectively. As a result, the regression constant includes the mean of the bank effects and the mean of the year effects.

We run the regression analysis based on the full sample and based on two partitions of the sample of bank-observations. To investigate whether the relationship between the equity risk premium and leverage may be affected by bank size, we run regressions for the four major banks (National Australia Bank, Commonwealth Bank, Westpac and the Australia and New Zealand Banking Group) and for the other domestic banks. To investigate whether the relationship may be affected by market conditions, we run regressions for the ten-year period leading up to the financial crisis (1998 to 2007) and for the ten-year period following the onset of the crisis (2008 to 2017).

Table 2, panel A reports the results of regressing a bank's constant-growth DDM-implied equity risk premium on its leverage. For the full sample of bank-observations (column 1), the coefficient on leverage is positive and significant at the 10 per cent level. This result suggests that equity investors allow for the financial risk inherent in a bank's leverage when they price the bank's stock. The size of the coefficient suggests that the average risk premium on banks'

[10] We carry forward leverage from the end of the previous period to avoid simultaneity problems.

[11] The results of several asset pricing studies suggest that expected equity risk premiums vary with macroeconomic conditions (see, for example, Fama and French, 1988; 1989; Ferson and Harvey, 1991).

assets is low – around 13 basis points per annum. The coefficient on leverage is positive in all the regressions for the partitioned data (columns 2 to 5) and it is significant in the regressions for the major banks (column 2), for the other banks (column 3) and for the 2008-2017 period (column 5). In unreported tests, we find that the difference in the coefficients on leverage between the major banks and the other banks is statistically insignificant. Thus, there is no evidence that the relationship between the constant-growth DDM-implied equity risk premium and leverage is affected by bank size. However, we find that the difference in the coefficients on leverage between the 1998-2007 period and the 2008-2017 period is significant at the 5 per cent level. These results suggest that equity investors are more concerned about banks' leverage levels in the period beginning with the financial crisis than in the period leading up to the crisis and that they demand a significantly higher risk premium for investing in more leveraged banks in the post-crisis period.

The results provide an indication of the extent to which the MM theorem holds for the full sample and for the period following the financial crisis. For the full sample of bank-observations, the results do not conform to equation (7) because the regression constant is positive and significant. The positive constant term suggests that the predictions of the MM theorem do not hold exactly. We can get a sense of the extent to which the theorem holds, by comparing changes in the constant-growth DDM-implied equity risk premium in response to changes in leverage based on our regression results to those based on the assumption that the MM theorem holds exactly. At the average level of leverage of the sample banks of 16, the coefficient estimates in column 1 suggest that investors require an equity risk premium of: $3.77 + 0.13 \times 16 = 5.85\%$, for bearing the uncertainty associated with the equity return. If leverage were to fall by half to 8, the coefficient estimates suggest that the required equity risk premium would decrease to: $3.77 + 0.13 \times 8 = 4.81\%$. If the MM theorem held exactly, the constant-growth DDM-implied equity risk premium could be expected to decrease to $\frac{1}{2} \times 5.85 = 2.93\%$ and, if the MM theorem did not hold at all, it could be expected to stay at 5.85%. Therefore, the MM effect on the DDM-implied equity risk premium is about $(5.85 - 4.81) / (5.85 - 2.93) = 36\%$ as large as it would be if the MM theorem held exactly. For the 1998-2007 sub-sample period, the estimated regression coefficients in column 5 suggest that the impact on the equity risk premium of changing leverage is roughly the same as if the MM theorem held exactly (assuming riskless debt).

Table 2
Bank implied equity risk premium and leverage

This table examines the effect of leverage on a bank's equity risk premium, where the equity risk premium is inferred using a constant-growth dividend discount model (panel A) and using a multistage-growth dividend discount model (panel B). The sample period is January 1998 to December 2017. *Constant-growth implied ERP* is the difference between the bank's constant-growth dividend discount model-implied cost of equity and the risk-free rate, in the month after the bank releases its semi-annual financial results. The constant growth rate is estimated as the earnings retention rate multiplied by the market's expectation of the return on equity for the third semi-annual period ahead. *Multistage-growth implied ERP* is the difference between the bank's multistage-growth dividend discount model-implied cost of equity and the risk-free rate, in the month after the bank releases its semi-annual financial results. The multistage-growth dividend discount model allows for consensus analyst forecasts of dividends per share for the next three semi-annual periods before the bank settles down to a sustainable growth trajectory. The terminal growth rate is estimated as the earnings retention rate multiplied by the market's expectation of the return on equity for the fifth semi-annual period ahead. The risk-free rate is proxied by the 90-day bank bill interest rate. *Constant* includes the observation-weighted mean of bank effects and the observation-weighted mean of year effects. *Leverage* is the book value of assets divided by the book value of equity at the end of the previous semi-annual period. Robust *t*-statistics in parentheses are based on standard errors clustered at the bank level. *, ** and *** indicate significance at the 10%, 5% and 1% levels.

Panel A: Constant-growth model

	Dependent variable: Constant-growth implied ERP (% pa)				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent variables	**Full sample**	**Major banks**	**Other banks**	**1998-2007**	**2008-2017**
Constant	3.7693***	1.9681	3.1465***	3.1299**	0.2553
	(3.54)	(1.08)	(3.39)	(2.65)	(0.21)
Leverage	0.1306*	0.2884*	0.1291*	0.1237	0.4300***
	(1.96)	(2.66)	(2.13)	(1.78)	(5.17)
Bank effects	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.57	0.51	0.56	0.72	0.47
Banks	13	4	9	11	10
Observations	374	160	214	203	171

Panel B: Multistage-growth model

	Dependent variable: Multistage-growth implied ERP (% pa)				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent variables	**Full sample**	**Major banks**	**Other banks**	**1998-2007**	**2008-2017**
Constant	4.3001***	2.8227	3.2699***	3.2405***	1.6178
	(4.66)	(1.94)	(4.19)	(3.29)	(1.33)
Leverage	0.1145*	0.2466*	0.1451**	0.1331**	0.3562***
	(1.98)	(2.85)	(2.84)	(2.30)	(4.32)
Bank effects	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.62	0.55	0.61	0.77	0.44
Banks	13	4	9	11	10
Observations	373	160	213	202	171

Table 2, panel B reports the results of regressing a bank's multistage-growth DDM-implied equity risk premium on its leverage. The coefficient on leverage is positive and statistically significant in all the regressions. These results suggest that equity investors take account of a bank's leverage when pricing the bank's stock. In unreported tests, we find that the difference in the coefficients on leverage between the major banks and the other banks is statistically insignificant. However, we find that the difference in the coefficients on leverage between the 1993-2007 period and the 2008-2017 period is significant at the 10 per cent level. Thus, the results suggesting that equity investors are more anxious about the levels of leverage recorded on banks' balance sheets in the period after the financial crisis than in the period leading up to the crisis are robust to estimating the equity risk premium using the multistage-growth DDM.

A potential concern with our analysis is that other bank-specific characteristics correlated with leverage are omitted from the regression specification and may result in a spurious relationship between the bank's equity risk premium and leverage. To address this concern, we augment the bank effects in equation (8) with variables that capture other bank-specific characteristics and redo all the analysis. To capture the asset risk, liquidity resources and profitability of the bank, we use the ratio of non-performing loans to total loans, the ratio of cash and amounts due from banks to total assets and pre-tax profit divided by average assets respectively. None of our results change significantly. This robustness analysis suggests that the more parsimonious specification incorporating bank effects is adequate to control for differences in the characteristics of the sample banks. The results support our findings that equity investors take account of a bank's leverage when pricing the bank's stock and that equity investors are more concerned about a bank's leverage in the period after the financial crisis than in the period leading up to the crisis.

4.3 Impact on bank funding costs of additional equity capital

In this subsection, we provide an estimate of the impact on a bank's overall cost of funding of it increasing its CET1 risk-adjusted capital ratio by 1 percentage point. In assessing the impact of the additional equity capital on a bank's cost of funding, we take account of the reduction in the extent to which the bank can take advantage of interest tax shields and the reduction in the extent to which it can potentially source funding from guaranteed deposits, together with the MM offset documented in the previous subsection.

Table 3 shows the estimated impact on a bank's overall cost of funding of it maintaining an additional 1% in CET1 risk-weighted capital. In this scenario, the bank can increase its CET1 capital ratio by issuing common equity to investors at prevailing market prices and using the proceeds to retire debt of the same value. In the table, RWA intensity is defined as risk-weighted assets divided by total assets. The analysis considers a bank that has the average RWA intensity for domestic banks in December 2020 of 45% (column 1).[12] For comparison, the analysis considers a bank that has a high RWA intensity of 100% (column 2). For the bank with the average RWA intensity (column 1), a 1% increase in common equity relative to risk-weighted assets translates to a 1% × 45% = 0.45% increase in common equity relative to the total assets. Before issuing capital, we assume that the bank has the average level of leverage for banks in December 2020 of 14.5. The 0.45% increase in common equity relative to total assets translates to a decrease in leverage of 0.9 (from 14.5 before the capital issuance to 14.5 / (1 + 0.45% × 14.5) = 13.6 after the capital issuance). For a bank with a higher than average RWA intensity (column 2), the 1% increase in common equity relative to risk-weighted assets translates to a larger increase in leverage than for the bank with the average RWA intensity.

[12] Data on the total risk-weighted assets, total assets and total shareholders' equity of Australian domestic banks, comprising the four major banks and other domestic banks, are sourced from the APRA publication, *Quarterly Authorised Deposit-taking Institution Performance Statistics*, December 2020 (released 16 March 2021).

Table 3

Impact on bank funding costs of maintaining an additional 1% in common equity tier 1 risk-weighted capital

This table reports estimates of the increase in funding costs for a bank of maintaining an additional 1% in common equity tier 1 risk-weighted capital. The bank is assumed to issue common equity to investors and use the proceeds to retire debt of the same value. *RWA intensity* is risk-weighted assets divided by total assets. The analysis considers a bank that has the average RWA intensity for domestic banks in December 2020 of 45% (column 1). For comparison, the analysis considers a bank that has a high RWA intensity of 100% (column 2). Before the capital issuance, the bank has the average level of leverage for domestic banks in December 2020 of 14.5. The equity risk premium is calculated, allowing for a 36% Modigliani-Miller offset, using the estimated coefficients in table 2 panel A, column 1. The cost of equity is the risk-free rate of 5% pa plus the equity risk premium. The risk premium on the bank's debt is assumed to be zero, such that the cost of debt is the risk-free rate of 5% pa. The weighted average cost of capital is calculated using Officer's (1994) formula, with an effective corporate tax rate of 30% pa and an imputation gamma of 35%. The increase in funding costs for the bank is the long-run increase in the weighted average cost of capital resulting from the capital issuance transaction.

	(1) **Average** **RWA intensity**	**(2)** **High** **RWA intensity**
RWA intensity		
RWA / total assets %	45	100
Relative size of the capital issuance		
Increase in common equity / RWA %	1.00	1.00
Increase in common equity / total assets %	0.45	1.00
Leverage		
Before the capital issuance	14.5	14.5
After the capital issuance	13.6	12.7
Change	-0.9	-1.8
Equity risk premium		
Before the capital issuance % pa	5.66	5.66
After the capital issuance % pa	5.55	5.42
Change bps pa	-12	-24
Weighted average cost of capital		
Before the capital issuance % pa	3.90	3.90
After the capital issuance % pa	3.92	3.94
Cost increase bps pa	1.8	4.1

The equity risk premium is calculated, allowing for a 36% Modigliani-Miller offset, using the estimated coefficients in table 2, panel A, column 1. For the bank with the average RWA intensity (table 3, column 1), the equity risk premium decreases by 12 basis points per annum in response to the capital issuance (from 3.77 + 0.13 × 14.5 = 5.66% per annum to 3.77 + 0.13 × 13.6 = 5.55% per annum). For a bank with a higher than average RWA intensity (column 2), the decrease in the equity risk premium is larger than for the bank with the average RWA intensity, owing to a larger decrease in leverage associated with the capital issuance transaction.

The weighted average cost of capital under the imputation tax system is calculated using Officer's (1994) formula:

$$WACC = E(r_E) \times \left[\frac{1-T}{1-T(1-\gamma)} \right] \times \frac{E}{E+D} + E(R_D) \times (1-T) \times \frac{D}{E+D} \quad (9)$$

where $WACC$ is the company cost of capital after corporate tax, $E(r_E)$ is the expected return on equity before tax, $E(r_D)$ is the expected return on debt before tax, T is the effective corporate tax rate and gamma (γ) is the proportion of tax collected from the company that will be rebated against personal income in the hands of shareholders. We use 5% as the nominal risk-free rate. Five per cent is roughly the average 90-day bank-bill interest rate over the twenty-year period 1998-2017. The expected return on equity before tax is the risk-free rate of 5% plus the constant-growth DDM-implied equity risk premium. The risk premium on the bank's debt is assumed to be zero, such that the expected return on debt before tax is the risk-free rate of 5%.[13] For the effective corporate tax rate, we use the Australian statutory tax rate of 30%. For the imputation gamma, we use the estimate for Australian banks of 35% suggested by Cummings and Wright (2016).[14]

[13] This is a conservative assumption in assessing how the cost of bank funding varies with the amount of equity capital, in the sense that it is designed not to understate the increase in funding costs that additional equity capital may bring. By assuming away any beneficial impact on the cost of debt of it being made safer as equity capital increases, we are nullifying one of the channels through which MM effects may work.

[14] A firm-specific gamma can be estimated as $\gamma = F \times \theta$ 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. As a guide to the distribution rate, Australian banks have typically paid out between 70% and 80% of their after-tax profits as dividends in recent years. As a guide to the value of franking credits, results from empirical studies by Beggs and Skeels (2006) and Cummings and Frino (2008) suggest that investors value them at close to 50% of their face value. Using an estimated distribution rate of 70% and a value to shareholders of 50% of face value, a conservative estimate of the imputation gamma for Australian banks is 70% × 50% = 35%.

Using equation (9) for the bank with the average RWA intensity (table 3, column 1), the weighted average cost of capital before the capital issuance is (5% + 5.66%) × (1 − 0.3) / (1 − 0.3(1 − 0.35)) × (1 / 14.5) + 5% × (1 − 0.3) × ((14.5 − 1) / 14.5) = 3.90% per annum. After the capital issuance, it increases to (5% + 5.55%) × (1 − 0.3) / (1 − 0.3(1 − 0.35)) × (1 / 13.6) + 5% × (1 − 0.3) × ((13.6 – 1) / 13.6) = 3.92% per annum. Therefore, we estimate that the bank's overall funding cost increases by 3.92% − 3.90% = 0.02%, or 2 basis points per annum, in response to the capital issuance transaction. For a bank with a higher than average RWA intensity (column 2), the cost increase is larger than for the bank with the average RWA intensity. In deriving these estimates, we have assumed there is no change in the expected return on debt as leverage changes. This is a conservative assumption and potentially understates MM effects. For wholesale debt that is not covered by explicit government guarantees, an increase in the amount of equity capital is likely to reduce the expected return on the debt – even if only marginally.

4.4 Impact on bank funding costs of additional equity capital—Alternative scenarios

This subsection examines the sensitivity of the estimated impact of maintaining an additional 1 percentage point in CET1 risk-adjusted capital on a bank's overall funding cost to changes in various corporate finance benchmarks. The analysis considers alternative scenarios for the risk-free interest rate, degree of MM offset effect, effective corporate tax rate and imputation gamma.

Table 4 presents ten scenarios, which provide an indication of the sensitivity of the overall funding cost results to changes in the parameters underpinning our analysis. In all the scenarios, the bank is assumed to increase its CET1 capital ratio by issuing common equity to investors at prevailing market prices and using the proceeds to retire debt of the same value. Before the issuance, the bank has the average level of leverage in December 2020 of 14.5. In all the scenarios, the bank is assumed to have the average RWA intensity in December 2020 of 45%. Scenario 1, the base case, is identical to the funding cost analysis for the bank with the average RWA intensity in table 3, column 1.

Table 4
Impact on bank funding costs of maintaining an additional 1% in common equity tier 1 risk-weighted capital—alternative scenarios

This table reports the sensitivity of the estimated impact on bank funding costs to changes in various corporate finance benchmarks. The analysis considers alternative scenarios for the risk-free interest rate, degree of Modigliani-Miller (MM) offset effect, effective corporate tax rate and imputation gamma. The bank is assumed to issue common equity to investors and use the proceeds to retire debt of the same value. Before the capital issuance, the bank has the average level of leverage for domestic banks in December 2020 of 14.5. In all scenarios, the bank is assumed to have a risk-weighted assets intensity of 45%. *Impact on WACC* is the long-run increase in the weighted average cost of capital resulting from the capital issuance transaction.

	Risk-free rate	**MM effect**	**Corporate tax rate**	**Imputation gamma**	**Impact on WACC**
Scenario	**% pa**	**%**	**% pa**	**%**	**bps pa**
Base case					
1	5	36	30	35	1.8
Variation in the risk-free rate					
2	2	36	30	35	1.6
3	8	36	30	35	2.1
Variation in the MM effect					
4	5	0	30	35	2.6
5	5	100	30	35	0.4
Variation in the corporate tax rate					
6	5	36	0	35	1.7
7	5	36	26	35	1.8
Variation in the imputation gamma					
8	5	36	30	0	2.4
9	5	36	30	100	1.2
Adverse combination of factors					
10	8	0	30	0	3.6

Scenarios 2 and 3 allow for changes in the risk-free interest rate. We repeat the cost impact analysis, leaving all the parameter inputs unchanged, except by using a nominal risk-free rate of either 2% (scenario 2) or 8% (scenario 3). Two per cent is roughly the 90-day bank bill rate at the end of the sample period in December 2017. Eight per cent is roughly the level at which the bank bill rate peaked near the middle of the sample period in March 2008. The results show that the cost increases flowing from the capital issuance are greater when interest rates are higher. However, changes in the risk-free rate have only a marginal influence on the funding cost implications of the additional equity capital.

Scenarios 4 and 5 allow for variation in the MM effect. Our empirical analysis suggests that the magnitude of the MM effect may be influenced by market conditions: the DDM-implied equity risk premium exhibits greater sensitivity to leverage in the ten-year period beginning with the financial crisis than in the ten-year period leading up to the crisis (see table 2). If we reduce the MM effect from 36% to 0% (scenario 4), the cost increase associated with the capital issuance rises from 2 basis points to 3 basis points. However, if we set the MM effect to 100% (scenario 5), the cost increase falls to less than 1 basis point. This pattern demonstrates that the impact on a bank's cost of funds of it increasing its CET1 capital ratio depends crucially on the extent to which equity investors are willing to accept a lower risk premium for investing in a less leveraged bank.

Scenarios 6 and 7 allow for different assumptions with respect to the value that a bank extracts from debt tax shields. If banks pay more tax as leverage falls, the loss to banks is balanced by higher tax revenue to the government. The government could, in principle, use the additional tax receipts to counteract the impact on the wider economy of increases in banks' funding costs (Admati, DeMarzo, Hellwig and Pfleiderer, 2013). This line of reasoning suggests that corporate tax payments should be excluded from the analysis. If we set the effective corporate tax rate to 0% (scenario 6), the cost increase resulting from the capital issuance is marginally less than when we set it to the statutory tax rate of 30%. Even if we treat tax costs as actual economic costs, the effective corporate tax rate for a bank can be lower than the statutory tax rate. Based on Australian Taxation Office statistical data, the ratio of net company tax expense to taxable income for depository institutions averaged 26% over the 2011-2018 period.[15] If we set the effective corporate tax rate to this level (scenario

[15] Data on the net tax expense and taxable income of depository financial intermediaries are sourced from the Australian Taxation Office publication, *Taxation Statistics*, Company - Table 4, 2010-11 to 2017-18 editions.

7), the cost increase resulting from the capital issuance is roughly the same as when we set it to the statutory tax rate. These scenarios demonstrate that changes in the effective corporate tax rate have negligible impact on the funding cost implications of the additional equity capital.

Scenarios 8 and 9 allow for changes in the imputation gamma. Most of the dividends paid by Australian banks in recent years have been fully franked at the corporate tax rate of 30%. However, the market value of franking credits is commonly disputed.[16] For example, the empirical findings of Lajbcygier and Wheatley (2012) and Siau, Sault and Warren (2015) suggest that the distribution of franking credits by firms has no effect in lowering the returns that investors require on equity. We repeat the cost impact analysis, except by using an imputation gamma of either 0% (scenario 8) or 100% (scenario 9). The results show that the cost increases flowing from the capital issuance are greater when the imputation gamma is lower. Changes in the imputation gamma have a more pronounced impact on the results than changes in the corporate tax rate.

Finally, scenario 10 allows for an adverse combination of factors. This represents an improbable scenario, in which the risk-free rate is 8%, equity investors are indifferent to reductions in a bank's leverage, the effective corporate tax rate is 30% and imputation credits are worthless. In this case, the cost increase resulting from the capital issuance is roughly double that in the base case.

[16] Only shareholders who are resident taxpayers in Australia are entitled to use franking credits to offset their tax liability, which means that for many foreign investors there is no benefit from imputation.

5. Conclusion

Equity capital is the cushion that banks have against a sudden drop in the value of their assets or an unexpected withdrawal of liabilities (Cecchetti and Schoenholtz, 2021: 301). The larger a bank's capital cushion, the less likely it will be made insolvent by an adverse surprise. As of end-2020, equity capital in the Australian banking system amounted to $308 billion. That capital was combined with $4.2 trillion worth of liabilities to own $4.5 trillion in assets. Thus, the ratio of assets to equity in the Australian banking system is around 15 to 1. Why do banks not build up a larger capital cushion against their credit and other risks? Capital is costly for banks, because the holders of the capital instruments need to be remunerated. As a result of interest tax shields, deposit guarantees and other forms of government support, capital may be more costly for banks than funding sourced through retail deposits or wholesale debt. Banks may also take more risk by increasing leverage; increasing both the expected reward and the risk per unit of costly capital. To inform the debate about the net benefits of additional equity capital, this study examines the impact of additional equity capital on the long-run cost of funding banks' lending activities.

The results of our study suggest that the mechanism underlying the MM theorem is not nullified by perceptions among equity investors that the government will protect them in disaster states. For Australian banks, expectations of government support are likely to be exacerbated by the heavy reliance on bank lending for financing economic activity and the high level of concentration in the banking industry. Despite these conditions, we find robust evidence that equity investors are willing to accept a lower risk premium for investing in less leveraged banks. This evidence is consistent with evidence, provided by Baker and Wurgler (2015) for United States banks, Miles, Yang and Marcheggiano (2013) for United Kingdom banks and Junge and Kugler (2013) for Swiss banks, that less leveraged banks have lower systematic equity risk. There is no evidence we can find for Australian banks that the relationship between the equity risk premium and leverage is affected by bank size. However, we find evidence that equity investors became significantly more wary of bank leverage after the onset of the financial crisis of 2007-2009. Equity pricing is more responsive to banks' leverage levels in the ten-year period beginning with the financial crisis than in the ten-year period leading up to the crisis.

Taking account of the reduced reliance on interest tax shields and on funding potentially sourced from guaranteed deposits, together with the MM offset on the cost of equity, the impact of additional equity capital on the overall cost of bank funding is small (in the order of 0-3 basis points annually for each 1-percentage-point increase in a bank's CET1 risk-adjusted capital ratio). The estimates we derive of the impact of additional equity capital on bank funding costs are close to those of Miles, Yang and Marcheggiano (2013) for United Kingdom banks. The impact on bank funding costs will be more burdensome than our estimated range for banks with higher-than-average asset risk-weightings. The impact can be expected to approach the upper end of our estimated range if changes in government bailout policy reduce the incentive of equity investors to monitor bank leverage or if changes in taxation policy reduce the value that equity investors realise from the imputation credits distributed with bank dividends.

The cost implications of additional equity capital are clearly less substantial than those assessed by the Basel Committee's Long-term Economic Impact working group after the 2007-2009 financial crisis. In its analysis of the economic costs and benefits of stronger capital regulation across thirteen countries (Bank for International Settlements, 2010), the working group estimated that each 1-percentage-point increase in the CET1 risk-adjusted capital ratio would raise banks' funding costs by 7 basis points on average. Their estimate was based on a very conservative set of assumptions, including that the cost of equity and the cost of debt do not change with changes in capital levels, and that there is no relief for equity investors from the taxation of dividend income. Our estimates indicate that each 1-percentage-point increase in the CET1 risk-adjusted capital ratio raises funding costs by less than one-half of the amount predicted by the Basel Committee. Relative to their assessment, the impact of additional equity capital on banks' funding costs in Australia is softened by the pricing response in the equity market and by the imputation tax regime. If additional equity capital is effectual at reducing the failure rates of individual banks and the frequency and depth of systemic banking crises, these benefits can be procured at far lower cost than anticipated by Basel Committee member countries after the financial crisis.

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