Capital Requirements and Banks Performance Under Basel-III: A Comparative Analysis of Australian and British Banks

Abstract: This study examines whether the capital requirements under Basel III are effective in enhancing the profitability and efficiency of the banking sector. Drawing on a sample of the largest commercial banks from the UK and Australia over the period from 2000 to 2019, we employ the FMOLS (Fully Modified OLS) and DOLS (Dynamics OLS) estimation approaches. The results indicate that stricter capital ratio increases operating earnings, whist it fails to improve bank profitability and bank efficiency. Our findings cast doubts on the effectiveness of tax policy in the observed banks. Further empirical testing shows an optimal capital structure in which the banks can achieve the best performance. Interestingly, these optimal ratios are broadly in line with the minimum common equity ratio required under Basel-III. The macroeconomic outlook also contributes to the performance of British and Australian banks. British banks are found to perform well under inflationary pressure and higher policy rates, contrary to the Australian banks whose performance deteriorates. Our results hold across different samples, efficiency, and profitability measures and various estimation models.

Keywords: Capital ratio; bank performance; Basel III; Monetary Policy; Financial Stability.

JEL Classification: G21; G30

1. Introduction

The Global Financial Crisis 2008-09 led to sudden changes in assets quality and value that further resulted in banks having inadequate capital and financial instability as a result of excessive risks exposures. It also manifested fundamental issues associated with bank equity capital from the angle of bank survival. Consequently, there are calls for more bank capital buffer as a cushion to prevent future crisis (Kashyap, Rajan, and Stein, (2002); Acharya, Mehran, and Thakor, (2010). The underlying logic is that the higher level of capital, the safer the banks are, especially during the financial crisis. In this context, the Basel Committee on Banking Supervision (BASEL) launched a set of internationally agreed measures (BASEL III) which requires banks to have the enhancement of regulation, supervision and risk management with the gradual implementation starting from 1st January 2014 until the end of 2018. BASEL's Supervisory Committee has extended requirements relating to quantitative and qualitative capital. Specifically, the BASEL III entails financial institutions to achieve a minimum level of basic own funds of 4.5% risk-weighted assets (higher than at least 2% under BASEL II requirements), and the total of Tier 1 and Tier 2 own funds are 8% of risk-weighted assets.

The nexus between capital adequacy and bank profitability is an important one that concerns banks. Particularly, how bank capital affects bank performance after the financial crisis is of supreme importance for banking policymakers anticipating micro-and macro-wise banking regulations. It raises the concern whether higher capital improves or mitigates banks' performance and therefore, how this effect is important for regulators who are weighting levels and other explicit requirements of capitals under Basel III to apprehend banking stability. However, the requirements of the Basel III and the impact of new capital regulations on banks' performance is controversial. On the one hand, it is argued that a higher level of capital can compete more efficiently for deposits and loans (Calomiris and Powell, 2001; Calomiris and Mason, 2003; Kim et al., 2004) and hence suggesting a positive relationship between capital and market share (Mehran and Thakor, 2011). Additionally, banks are more stable and profitable (Naceur and Kandil, 2009) under Basel III since the excess of minimum capital requirements diminishes the moral hazard problem and improves monitoring and controls risk by shareholders (Agoraki et al., 2009; Tan and Floros, 2013). On the other hand, it is also argued that holding more capital expose to less lending and lower level of performance since higher capital requirements by raising banks' marginal cost of funding, result in higher lending rates. The implication is that the higher level of capital or equity means a higher level of equity and lower level of return on equity (Fekka, 2014) in which the returns of banks are reduced due to the lack of funds for lending and hence no dividends distributed to shareholders. More capital also reduces the credit risk of banks' portfolios and therefore will diminish their profits (Giordana and Schumacher, 2017). In other words, Basel III with the implementation of the leverage ratio of 3% leads to a negative impact on ROE (Jayadev, 2013) or increased capitals as well as increased financing costs are causes of banks' margins because higher holding capital means lower available capitals to investment and lower profits for banks (KPMG, 2011). Additionally, bank performance and capital buffers are a negative association (Berger and Bonaccorsi, 2003; Argimon and Espana, 2004) and hence strong bank performance substitutes for capital as a cushion in an unexpected loss. For example, higher capital requirements increase banks' marginal cost of loans if the marginal cost of capital is greater than the marginal cost of deposits. As a result, higher cost of equity financing relative to debt financing would lead banks to increase the price of lending and thus hinder loan growth and restrain the economic salvage (Angelini et al., 2011). Furthermore, the increase o capital ratio might cause the information asymmetries, which deteriorate the value of financial institutions (Huynh et al., 2020).

To this day, there isn't a strong agreement regarding the association between capital requirements and bank performance in the literature. Some studies have argued that higher capital ratios may lead to reduced lending due to descending modifications of risk-weighted assets to encounter capital requirements. Furthermore, it may deteriorate the lenders' monitoring. Therefore, holding more capital than essential is costly and it would reduce bank performance (Alfon et al., 2004; Berger and Bonaccorsi, 2006; Mamatzakis and Vu, 2018; Bagntasarian and Mamatzakis, 2019). Another strand of literature advocates the positive relationship capital cushion and bank performance because highly capitalized banks have lower bankruptcy costs and lower funding costs, higher shareholders' monitoring of risk, which ultimately drives bank to greater ability to enhance credit growth (Berger, 1995; Flannery and Rangan, 2008; Tsionas and Mamatzakis, 2017).

There can be different perspectives on the impact that capital can have bank performance, and how there might be differences across banks in different countries. Particularly, this paper aims to empirically examine the effects of capital requirements under BASEL III on bank performance in the United Kingdom and Australia, the two developed countries have a historical relationship in many aspects. For examples, while the UK has been one of Australia's most prominent trading partner, Australia has been a destination of the UK's accumulated inbound investment, making

Australia a very prosperous country.[1] Moreover, the Bank of England and the Reserve Bank of Australia conduct monetary policy using the approach of a medium-term target for inflation, endorsed by the government, with operational independence of the central banks, and a flexible exchange rate. Overall, the UK and Australia share a perspective on how an economy should be organised and governed, how markets in setting prices and allocating resources, and ultimately how commitment to a world economy of free trade and capital flows, and therefore, it can be generally considered that capital requirements in both countries may have similar effects on banks' performance. Concurrently, in this study, we drew on the data from top banks in the UK and Australia for the period from 2000 to 2019 and employed a rich set of empirical approaches including Dynamic Ordinary Least Squares (DOLS) and Fully Modified OLS (FMOLS). Our key empirical findings indicate that the operating income increases with a stricter capital ratio, while profitability and efficiency reduce. The testing of the quadratic model at threshold provides an optimal capital structure which is roughly equal to the minimum common equity required under Basel III. At the optimal level, the banks are expected to achieve the best performance. The economic factors affect differently the UK banks and Australian banks. That means, an increase in inflation and interest rates do not harm the UK banks' performance but it can deteriorate Australian banks performance.

The paper proceeds as follows: Section 2 briefly acknowledges the existing evidence capital and banks' performance/profitability. Section 3 presents the empirical framework and details on the dataset. Section 4 presents and discusses the empirical findings. Section 5 presents the conclusion and discussion of policy implications.

2. Literature Review

This study focuses on the impact of the Basel III capital requirements on banks' performance on the sake of agency theory, before, and after the financial crisis 2007-2008. Most of the studies tend to emphasis on which extent capital adequacy impacts bank stability and risk-taking, all of which are working under two theories, the moral hazard theory and the agency problem theory. Specifically, the moral hazard of deposit insurance hypothesizes that the lessening of banks' capital would enhance risk, while agency theories suggest that bank charters are valuable assets, and hence

[1] *Australians: Historical Statistics*, Fairfax, Sync & Weldon Associates, Sydney.

managerial risk-taking behaviour of management and shareholders may not be unjustifiable since they prefer to keep their bank charter away from failure (Marcus, 1984; Furlong and Keeley, 1989).

The moral hazard theorists argue that higher capital ratios mean lower moral hazard incentives due to excessive portfolio and leverage risks which shareholders try to maximize their value at the expense of the deposit insurance (Furlong and Keeley, 1989). Therefore, a higher level of capital will work as a mechanism to force bank shareholders to absorb larger losses, thereby reducing the value of the deposit insurance put option.[2] However, more capital and less risk-taking would result in a decrease in the likelihood of the bank's default. The ability of capital requirements to encumber banks probability/performance has been challenged in the mean-variance models. The results from the study of Koehn and Santomero (1980); Kim and Santomero (1988) show that the reduction in leverage due to the luxurious capital is a cause of lower expected returns in banks. Therefore, the bank's shareholders may swap a higher return and a higher risk, which leads to a higher default probability.

While the lack of convincing evidence on the moral hazard behaviour of insured banking firms could be an outcome of effective regulatory oversight and market discipline that limits risk-taking banks, most of the studies focus on the agency problems between bank management and shareholders. This agency theory suggests that the choice of different capital structures would help banks to reduce agency costs. The implication is that if banks choose to have a higher level of leverage to exchange to a lower level of equity/asset ratio, such capital structure will encourage managers to act more in the interests of shareholders, and hence reduces the agency costs of outside equity and increases firm value. In the banking system, the problems associated with corporate governance, agency costs, and capital structure issues provoke researchers. However, in many countries, capital structures banks are set by regulators who often set minimum for equity capital to discourage excessive risk-taking and as a result, that regulatory capital may impact agency costs. The choice of a higher ratio of leverage should lead to lower agency costs of minority shareholders and enhance firm performance. However, when the leverage becomes higher, banks would put debtors at a very high level of risk due to the significant agency costs which include both costs of bankruptcy and financial distress caused by the conflicts between bondholders and shareholders.

[2] Deposit insurance is treated as a put option on the value of banks' assets at strike price equal to the maturity value of its debt (Merton, 1977).

In sum, the prestige of the Basel III regulations and the effect of new capital regulations on profitability is highly debated and is often discussed under the theory of agency cost.

The reappearance of banking crises has augmented concerns associated with the stability of the financial system. Under this context, several authors have argued that a plentiful safety net may provide encouragements for bank risk-taking and therefore, on the need for stricter prudential regulations. Among the various methods used by regulators for prudential purposes, capital adequacy requirements may play an increasingly important role. However, theoretical literature suggests opposing results as to the optimal structure of capital adequacy regulation and the effects of capital requirements on bank banking firms' level of profitability. In the period before the crisis 2002-2007, we have experienced a great number of studies relating to the impact of capital in terms of ownership structures on profitability. It is argued that conflicts of interest between shareholders and managers may be sometimes caused by the divergence of profitability and other variables. Specifically, banks' owners often pursue to take full advantages of profit while managers are willing to sacrifice profit to mitigate risk by undertaking more insecure activities or to maximize. Clearly, in the banking industry, the parting of ownership from control is common to mutual, public and privately owned banks, which indicates that in the context of the lack of capital market discipline, public banks experience a lower level of competition and as a result may operate less efficiently than privately owned banks (Nicols, 1967; O'Hara, 1981). There are few empirical studies as to extent which differences in the banks' performance come from different ownership structures (Altunbas and Molyneux, 2001; Carbo et al. 2002). To be specific, Altunbas and Molyneux, (2001) focus on whether the different structures of ownership influence banks' efficiency. The study is carried out in the Germany banks' market with diversified ownership forms-private, public, and mutual. However, the finding suggests that there is little evidence that privately owned banks are more efficient than their mutual and public sector counterparts. On the other hand, Carbo et al. (2002) use savings banks as a measure of capital because saving banks are an important part of the European banking system which is accounted for approximately 20% of banking assets. Moreover, saving banks represent over 30% and 40% market share ("European Savings Banks Group," 1997). The study uses a large sample of savings banks in Europe in the period from 1989 to 1996 to measure bank size but the result shows that there is no relationship between size and efficiency. However, the finding suggests that European savings banks can attain cost reductions through reducing managerial and other inefficiencies and by increasing the scale of production.

The global financial crisis (GFC) in 2007-2008 had an enormous influence on the stability of the banking system. This crisis, also, discovered several critical limitations in the prevailing banking supervisory framework Basel II at the international level. Therefore, the Basel Committee relating Banking Supervision propositions many leverage and liquidity standards, and new capital to strengthen regulation, supervision, and risk management in the banking sector. Overall, Basel III is set to create a safe financial system by generating new regulations in a higher challenging environment of higher liquidity and stricter capital requirements for banks to operate. As per the necessities of the Basel III, every bank should maintain a desirable level of Capital Adequacy Ratio (CAR) and it is stated as a percentage of a bank's risk-weighted credit exposures. Also, it is recognized as a capital-to-risk weighted assets ratio (CRAR), and it works as a safe shelter for depositors and enhances the stability of international financial systems. Overall, the ratio measures a banks' capital to its risk which means that how much extent a bank can cover its losses in the future.

It is no surprise that there is an increasing concern for the association between bank capital and risk (profitability), especially what extent to the level of capital should give rise to both advantageous and disadvantageous effects of bank performance. Nevertheless, the connection between capital adequacy, bank stability and risk-taking has always been uncertain. On the one hand, it is argued that the modification in capital encourages a variation in risk because banks often invest in the disproportionate portfolio and take leverage risks to capitalize on shareholder values at the expense of the depositors because the banks assume that the depositors are always protected by deposit insurance if bankruptcy is probable (Benston et al.,1986; Furlong and Keeley, 1989), and therefore this tendency creates more motivation for managers to take more risk. As a result, the further requirements of capital under Basel III is a promise to prevent this pattern of moral hazard and to support financial stability. These requirements refer to a positive relationship between capital and risk which is adapt to the Basel III that higher capital is to take with more risk taken (Altunbas et al. 2007); to force the bank to absorb losses and reduce moral hazard (Rime, 2001). Subsequently, quality of assets and off-balance sheet risk exposure will be merged into bank capital requirement and firm up the stability of the banking system (Barrios and Blanco, 2003; Vazquez and Federico, 2015). While capital requirements are ways to control excessive risk-taking and ensure bank stability, there have been worries over its side effects. As argued by Barth et al. (2006) the impact of regulatory restrictions on a bank's activities could hinder its income diversification and might reduce its incentive for efficiency. Furthermore, the restrictions of capital usage can provide choice to the regulators, and therefore their bargaining supremacy regarding rent-seeking (Djankov et al., 2002). Such arguments support the negative activity restrictiveness or higher capital requirements under Basel III and bank efficiency. Undeniably, the aforementioned literature highlights both positive and negative effects of capital regulation on bank efficiency/profitability.

The premise is that the higher capital stringency helps banks curtail their riskier projects and rebalance their portfolios toward more prudent ones, which increases loss absorption capacity, improve monitoring and control risk by shareholders, which improve banks performance (Keeley and Furlong, 1990; Kaufman, 1992; Barth et al., 2006). More specifically, in a stochastic frontier model using a panel of banks from 16 Latin American countries, Carvallo and Kasman (2005) summarize that more capital buffers measured by retained earnings are found inefficient banks. Specifically, too small and too big banks are associated with poor profit performance. Such finding is somewhat similar to that of Ariff and Can (2008) although the latter uses a sample of Chinese banks with a non- parametric approach for the period of 1995-2004. Higher capital holdings lessen agency issues between managers and shareholders. Shareholders have a greater motivation to ensure that the bank's efficiency through manager monitoring. Based on this argument, Chortareas et al. (2015) report that there is a positive relationship between capital and efficiency for bank operations in 22 European countries. Similarly, there are ample studies associated with the association between capital and profitability. They indicate that higher capital ratios are related to higher bank performance because highly capitalized banks might have lower bankruptcy costs and lower funding costs (Berger, 1995); have better management monitoring (Iannotta et al., 2007), have higher credit ratings relating to less borrowing and careful lending (Tan, 2016), all of which in turn increasing in higher ROE/ROA and higher stock return of large banks (Demirguc-Kunt et al., 2013). Moreover, using a sample of Chinese banks, both Tan and Floros (2013) and Tan (2016) also indicate a weak positive relationship between capital and profitability.

On the other hand, bankers would argue that a higher proportion of capital would hurt shareholders and lower economic growth. The higher capital ratios would reduce the expected return on equity that the investors require. The highly regulatory requirements of capital, also, reduce the advantage of tax shield of interest payment and subordinate the after-tax earnings. As a result, there should be a negative link between capital strictness and bank performance. For instance, Bitar et al. (2017) use a sample of 39 OECD countries during the 1999–2013 period to examine whether higher capital ratios are effective in reducing risk and enhances the efficiency and profitability of banking institutions. The study shows that the ineffectiveness of risk-based capital ratios is likely to be impaired under the new Basel III capital regulations. The Basel III requires banks to hold higher liquidity ratios along with higher capital ratios, which suggests a negative effect on the efficiency and profitability of highly liquid banks. The findings are subject to different subsamples, alternative risk, efficiency, and profitability measures and a battery of estimation techniques. Moreover, Sutorova and Petr (2014) analyze what extent the Basel III context impacts on European banks in the period of 2005-2011. Consistent with the result of Bitar et al. (2017), this study emphasizes that the capital regulatory requirements under Basel III impact negatively the market value of the experimental banks.

Additionally, the banking literature also acknowledges different determinants of bank profitability and different aspects of capital regulation. These include the size of the bank (Triki et al., 2017); operating performance and market structure measured by the degree of market concentration with an industry (Claessens and Laeven, 2004); the level of external competition the bank encounters (Rhoades, 1997; Goddard et al., 2001); the level of risk (Lee and Hsieh, 2013).

3. Model specification and methodology

3.1. Model specifications

In this study, we used the data of top banks in the UK and Australia from 2000 to 2019. The reason for this choice is that these banks constitute over 85% of the market share. The top five banks in the United Kingdom are HSBC Holdings, Barclay's PLC, Royal Bank of Scotland, Lloyds Banking Group, Standard Chartered PLC, while Commonwealth Bank, Australia and New Zealand Banking Group, National Australian Bank, Westpac Bank, and Suncorp Bank are representatives for top five banks in Australia. The definition of each variable in our dataset and a brief explanation and sources have been identified in Appendix A.1. Our first generalized model is written as this form for a specific bank (i), quarterly period (t) and the other economic control variables:

$$\text{Bank performance}_{i,t} = \beta_0 + \beta_j \text{Bank ratio}_{i,t} + \vec{\beta}_k \overrightarrow{\text{Economic control}}_{i,t} + \varepsilon_{i,t} \quad \text{(Model 1)}$$

In which, bank performance represents four indicators as the dependent variables including the natural logarithm of net income, earnings before interest and tax per total revenues, Return on total asset, and Return on total common equity. Bank ratio denotes the ratio of equity over the asset, which is considered as the main independent variable. To control the external and internal effects, our model also has the other macroeconomic and microscopic determinants namely inflation, real interest rate, unemployment rate, gross domestic product, and the bank size, captured by the natural logarithm of total assets (or total equity). Moreover, β_0 and β_j are the constant term and coefficient of bank ratio for our model, respectively. $\vec{\beta}_k$ is the set of coefficients for macroscopic economic factors; thereby, $\varepsilon_{i,t}$ is the error term.

We also want to examine the threshold impact of Bank ratio on bank performance. Therefore, we adjusted Model (1) by adding the quadratic term, specifically Bank $\mathrm{ratio}^2{}_{i,t}$, into our main model. Our second generalized model is written as this form for the specific bank (i), and quarterly period (t):

$$\mathrm{Bank\ performance}_{i,t} = \beta_0 + \beta_j \mathrm{Bank\ ratio}_{i,t} + \beta_p \mathrm{Bank\ ratio}^2{}_{i,t} + \vec{\beta}_k \overrightarrow{\mathrm{Economic\ factor}}_{i,t} + \varepsilon_{i,t} \quad \text{(Model 2)}$$

β_p is the coefficient of the quadratic term of bank ratio variable while the other denotations were aforementioned. In the case that the quadratic term in Model (2) is statistically significant, we can observe that the quadratic specification can be substituted for the linear Model (1). Then, we can see the threshold value of the U-shaped relationship (if β_p is positive) and inverted U-shaped relationship (if β_p is negative). By doing it, we can see the effect of whether the bank ratio would statistically influence bank performance or not. Then, the threshold value will be calculated with $-\frac{2\beta_p}{\beta_j}$.

3.2. Methodology

We employed the Dynamic Ordinary Least Squares (DOLS) and Fully Modified OLS for estimation. It is worth acknowledging that the Ullah et al. (2018) has argued that the generalized method of moments (GMM) is an appropriate approach to deal with endogeneity as dynamic panel estimation techniques use lags of the dependent variables as explanatory variables. Lagged values of the dependent variables are used as instruments to control the endogenous relationship. However, FMOLS (Fully Modified OLS) and DOLS (Dynamics OLS) also addresses the endogeneity issue by adding leads and lags (DOLS). Furthermore, white heteroskedastic consistent standard errors are used. FMOLS does the same using a nonparametric approach. To be more precise, we would test whether our dataset has cross-sectional dependence or not by using the approach of Pesaran (2004, 2007). Afterwards, the stationarity test for each variable would be employed for unbalanced panel data. To test for the existence of a long-term relationship among under analysis variables, we would perform the co-integration test. In so doing, we chose three types of co-integration test including the Pedroni (1999, 2004), Kao (1999) and Westerlund (2005). Finally, we would employ DOLS and FMOLS for our main estimates. These approaches are useful in addressing the autocorrelation issue, especially in panel data with a long-time horizon (the large T). The main difference between FMOLS and DOLS is how to correct the error in autocorrelation. FMOLS involves Newey-West to correct the autocorrelation in the error term ε_{it}, whereas DOLS is the estimation, which employs the lagged variables and leads variables to address the autocorrelation in the error term ε_{it}. This method is widely used for the studies in economics such as Nasir et al (2019) and Nguyen et al (2020). In the following sub-sections, we would summarize our empirical approaches.

3.2.1. Cross-section dependence

The cross-sectional dependence of Pesaran (2004, 2007) is written in the following specification:

$$\Delta \mathrm{Y}_{\mathrm{it}} = \pi_{\mathrm{i}} \mathrm{Y}_{\mathrm{i,t-1}} + \gamma_{\mathrm{i}} \xi_{\mathrm{it}} + \sum_{\mathrm{j=1}}^{\mathrm{p-1}} \theta_{\mathrm{ij}} \mathrm{Y}_{\mathrm{i,t-j}} + \varepsilon_{\mathrm{it}} \text{ (Eq. 1)}$$

In which, ξ_{it} is a deterministic factor and $\sum_{j=1}^{p-1} \theta_{ij} Y_{i,t-j}$ is Augmented Dickey-Fuller test. Thereby, ε_{it} is considered cross-sectional for object i when they have the common factors.

$$\varepsilon_{\mathrm{it}} = \theta_{\mathrm{i}} \mathrm{f}_{\mathrm{t}} + \mathrm{u}_{\mathrm{it}} \quad \text{(Eq. 2)}$$

Specifically, θ_i shows the different impact of individuals while u_{it} denotes that there is no cross-sectional. More importantly, we would like to examine the non-autocorrelation by embedding the Equation (2) into Equation (1), we have:

$$\Delta \mathrm{Y}_{\mathrm{it}} = \pi_{\mathrm{i}} \mathrm{Y}_{\mathrm{i,t-1}} + \gamma_{\mathrm{i}} \xi_{\mathrm{it}} + \sum_{\mathrm{j=1}}^{\mathrm{p-1}} \theta_{\mathrm{ij}} \mathrm{Y}_{\mathrm{i,t-j}} + \theta_{\mathrm{i}} \mathrm{f}_{\mathrm{t}} + \mathrm{u}_{\mathrm{it}} \text{ (Eq. 3)}$$

The null hypothesis of Pesaran (2004, 2007) test is H0: $\theta_i \neq 0$ and HA: $\theta_i = 0$, which is used to test cross-section dependence among variables within panel data (for i object and time t).

3.2.2. Stationarity and co-integration tests

Since our data is unbalanced panel data, we would like to perform the Im-Pesaran-Shin (2003) for our stationary test. This formula will summarize how the stationarity testing in our sample.

$$\Delta \mathrm{Y}_{\mathrm{it}} = \pi_{\mathrm{i}} \mathrm{Y}_{\mathrm{i,t-1}} + \gamma_{\mathrm{i}} \mathrm{Z}_{\mathrm{it}} + \mathrm{u}_{\mathrm{it}} \text{ (Eq. 4)}$$

In which, u_{it} is white noise then $\mathrm{u}_{\mathrm{it}} \sim N(0; \sigma^2)$. The null hypothesis is H_0: $\pi_i \neq 0$ and H_A: $\pi_i < 0$. This test is similar to Levin-Lin-Chu (2002); however, Im-Pesaran-Shin (2003)'s test improves the procedures by using Augmented Dickey-Fuller regression with unit root on the pooled panel data by Ordinary Least Squares.

To test for the existence of a long-term relationship among under analysis variables, we performed the co-integration test. In so doing, we chose three types of co-integration test including the Pedroni (1999, 2004), Kao (1999) and Westerlund (2005). The test of Pedroni (1999, 2004) is applied by the unit root test of estimated residuals by Augmented Dickey-Fuller regression while Kao (1999) works on asymptotic distribution then the white noise must be converged. While Westerlund (2005) chooses cross-sectional dependency as the primary option and endogenously structural breaks. Therefore, this test calculates for different individual slope coefficients in the co-integration matrix. By employing the different tests of co-integration, we can see how our dataset are robust to have co-integration in the long-term.

3.2.3. Fully Modified Ordinary Least Squares and Dynamic Ordinary Least Squares

There are two main approaches to estimate the coefficients for panel data with co-integration such as the Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS). The main distinguishing feature between FMOLS (Fully Modified OLS) and DOLS (Dynamics OLS) is how to correct the error in autocorrelation. FMOLS uses Newey-West to eliminate the autocorrelation in the error term Uit, whereas DOLS is the estimation, which employs the lagged variables and leads variables to address the autocorrelation in the error term U_{it}. This formula will extract how the FMOLS model works.

$$\hat{\beta}_{FMOLS} = \left(\sum_{i=1}^{N} \hat{L}_{22i}^{-1} \sum_{t=1}^{T} (x_{it} - \bar{x}_i)^2\right)^{-1} \sum_{i=1}^{N} \hat{L}_{11i}^{-1} \hat{L}_{22i}^{-1} \left(\sum_{t=1}^{T} (x_{it} - \bar{x}_i) y_{it}^{*} - T\hat{\delta_\imath}\right) \text{ (Eq. 5)}$$

Equation (5) summarizes how the coefficient of this model is estimated. The estimation with the dependent variable and independent variables are specified as follows:

$$y_{it}^{*} = (y_{it} - \bar{y}_i) - \left(\frac{\hat{L}_{21i}}{\hat{L}_{22i}}\right) \Delta x_{it} + \left(\frac{\hat{L}_{21i} - \hat{L}_{22i}}{\hat{L}_{22i}}\right) \beta (x_{it} - \bar{x}_i) \quad \text{(Eq. 6)}$$

Therefore, we denote $\hat{\delta_\imath}$ herein

$$\hat{\delta_\imath} \equiv \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \left(\frac{\hat{L}_{21i}}{\hat{L}_{22i}}\right) \left(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0}\right) \text{ (Eq. 7)}$$

In which, Ω refers to asymptotic covariance matrix for long-run variance while Γ is dynamic covariance. Then, L is a lower triangular matrix with partition calculation. This is the approach to taken to conduct FMOLS estimation. However, DOLS estimator is performed by the following specification:

$$y_{it} = \beta_i' x_{it} + \sum_{j=-q}^{q} \zeta_{ij} \Delta x_{i,t+j} + \gamma_{li}' D_{li} + \varepsilon_{it} \quad (\text{Eq. } 8)$$

Then, q means the numbers of leads/lags chosen for the models.

4. Findings and results

4.1. Descriptive statistics

Table 2 represents the descriptive statistics of our variables. Two main points are raising from our preliminary analysis. We can observe that our variables exhibit non-normal distribution. Therefore, the econometric model with non-normal distribution correction would be helpful to adjust the biased estimates. Our main independent variable (the ratio of equity and asset) has the mean value at 6.34 (Std.Dev = 2.5). It implies that the banks' equity values are from six to eight folds to their assets. Further, the mean of the UK banks is at 5.4 (Std.Dev = 1.5) while the mean for Australian banks is around 7.28 (Std.Dev =3). The description results present a higher ratio of the Australian banks' equity than those of the UK banks.

Table 2. Descriptive statistics

Variable	Mean	Std.Dev.	Skewness	Kurtosis	JB
CR	6.344	2.516	1.635	7.094	913.1***
EBITS	587.017	1684.691	2.834	17.369	7934***
ROA	0.348	0.244	-1.501	10.418	2130***
ROE	5.692	5.2404	-4.749	56.058	9700***
Inflation	1.106	1.0828	0.869	2.806	101.7***
RIR	2.067	2.6870	-0.282	2.011	43.11***
Unemployment	5.661	1.0830	0.992	3.482	138.9***
GDP	1.268	1.4459	-1.494	9.751	1813***
Log(Asset)	13.022	1.6279	-5.202	41.525	5300***
Log(Equity)	10.242	1.3433	-4.452	34.490	3600***

Log(Income)	6.243	3.905	-2.870	10.110	2777***

Notes: JB denotes Jarque-Bera test for normality distribution. * < 0.1, ** < 0.05, and *** < 0.01.

Table 2.1. Descriptive statistics for UK banks

Variable	Mean	Std.Dev.	Skewness	Kurtosis	JB
CR	5.405	1.551	-0.638	3.213	723.1***
EBITS	1136.618	2253.356	1.641	8.913	6833***
ROA	0.2313	0.263	-1.555	10.306	1723***
ROE	4.421	6.705	-4.036	38.572	7850***
Inflation	1.997	0.857	0.483	3.337	87.7***
RIR	2.067	2.6870	-0.282	2.011	33.11***
Unemployment	5.834	1.366	0.696	2.147	123.8***
GDP	1.842	1.828	-2.373	9.982	1555***
Log(Asset)	13.430	1.573	-6.250	53.633	5250***
Log(Equity)	10.510	1.364	-4.575	35.841	4522***
Log(Income)	5.273	5.160	-1.882	4.893	1752***

Notes: JB denotes Jarque-Bera test for normality distribution. * < 0.1, ** < 0.05, and *** < 0.01.

Table 2.2. Descriptive statistics for Australian banks

Variable	Mean	Std.Dev.	Skewness	Kurtosis	JB
CR	7.283	2.916	1.507	4.735	517.1***
EBITS	37.416	15.721	0.303	8.568	6982***
ROA	0.466	0.151	0.259	6.364	857***
ROE	6.963	2.606	-0.397	2.837	1250***
Inflation	0.216	0.156	2.557	16.067	189.7***
RIR	3.782	1.715	-0.134	1.867	11.23***
Unemployment	5.489	0.649	0.011	2.732	151.9***
GDP	0.694	0.429	-0.011	3.449	1325***
Log(Asset)	12.613	1.579	-5.223	41.255	6700***
Log(Equity)	9.974	1.267	-5.007	39.065	1856***
Log(Income)	7.212	1.420	-4.207	29.805	3752***

Notes: JB denotes Jarque-Bera test for normality distribution. * < 0.1, ** < 0.05, and *** < 0.01.

Figure 1 summarizes the correlation matrix among our main variables. Particularly, the variables with similar characteristics have a high correlation; for example, return on asset (ROA) and return on equity (ROE) or natural logarithm of equity and the natural logarithm of the asset. It suggests that we need to avoid putting these variables in the same estimates to suffer the multicollinearity.

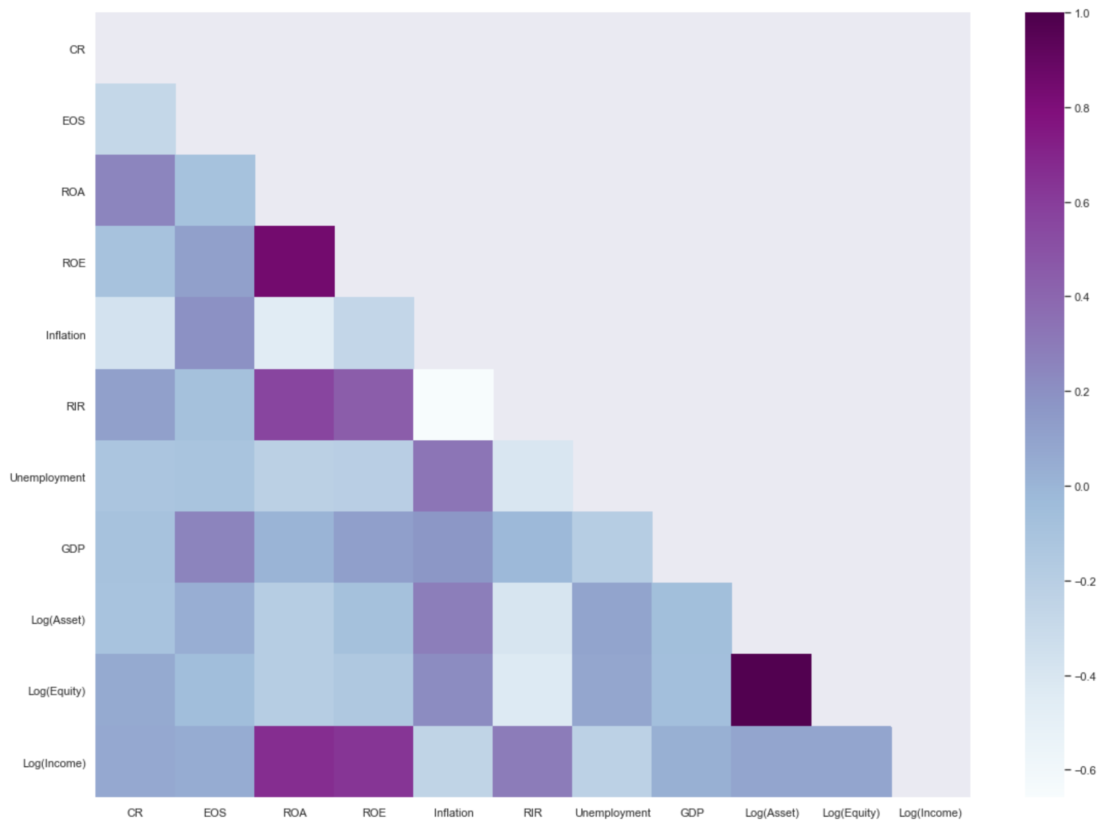

Figure 1. Correlation matrix

Notes: The abbreviations of our variables are presented in Appendix A.1. The correlation estimates are mainly based on Pearson approach.

4.2. Cross-sectional dependence and stationary test

At first glance, we can observe that the cross-sectional dependence test provides evidence that our dataset experiences cross-sectional dependence. Therefore, the stationary with the Im-Pesaran-Shin (2003) would be appropriate. To be more precise, in Table 3, the three tests of cross-sectional Frees' test, Pesaran, and Friedman (0.791, 3.526, and 11.3664, respectively) rejected the null hypotheses at 1% significance level.

Table 3. Cross-section dependence tests

Test	Parameter	Results
Frees' test	0.791***	Reject at significance level 1%
Pesaran	3526***	Reject at significance level 1%
Friedman	113664***	Reject at significance level 1%

Notes: The null hypothesis is that H_0: there is no cross-sectional dependence. Levels of significance: * < 0.1, ** < 0.05, and *** < 0.01.

Table 4 summarizes the stationary results of our variables with two options (no trend and with trend). We observed that all variables are stationary with I(0) or I(1) at 1% significance level. We do find no evidence that any variable exhibits non-stationary, which might lead to unbiased estimates. Hence, we can proceed further with the current forms of our variables.

Table 4. Stationary test

Variable	Intercept	Intercept and Trend
CR	-6.436***	-7.131***
EBITS	-6.915***	-8.923***
ROA	-5.498***	-8.635***
ROE	-3.885***	-7.626***
Inflation	-9.484***	-10.104***
RIR	0.218	-3.473***
D.Unemployment	-10.882***	-11.146***
GDP	-10.393***	-10.504***
Log(Asset)	-12.589***	-16794***
Log(Equity)	-15.004***	-13.277***
Log(Income)	-10.793***	-10.543***

Notes: * < 0.1, ** < 0.05, and *** < 0.01. This test refers to Im-Pesaran-Shin (2003). Since unemployment is un-stationary at the original level, we performed the first-differencing to examine if this variable is stationary or not.

4.3. Co-integration and Estimations

4.3.1 Co-integration estimates

By employing the different types of co-integration tests, we do find that there exists co-integration among our variables. Table 5 shows that Kao (1999) and Pedroni (1994, 2004) reject the null hypotheses that our variables have no co-integration.

Table 5. Panel co-integration tests by Kao (1999) and Pedroni (1999,2004)

Panel A: Test-Statistics by Kao (1999)	**T-statistics**
Modified Dickey-Fuller t	-5.2251***
Dickey-Fuller t	-4.8365***
Augmented Dickey-Fuller t	-4.1833***
Unadjusted modified Dickey-Fuller t	-21.8251***
Unadjusted Dickey-Fuller t	-9.3716***
Panel B: Test-Statistics by Pedroni (1999, 2004)	**T-statistics**
Modified Phillips-Perron t	-4.8681***
Phillips-Perron t	-5.7240***
Augmented Dickey-Fuller t	-7.0138***

Notes: The symbol *, **, *** denote the significance at the 10%, 5%, and1% levels, respectively. H_0: No co-integration and H_A: All panels are co-integrated.

4.3.2 Analysis with linear estimation

As mentioned above, two estimators of error correction -Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) - are used to estimate a long-run relationship between economic growth and financial development. Specifically, Table 6 and present the results from FOMLS and DOLS regarding the cointegrating relationship. Clearly, the estimated coefficients of EBIT are positive and statistically significant at 1% for both models. It means that a 1% increase in EBIT results in 65% and 105 % in equity to assets, respectively. In contrast, 0.32 % and 2.18% reduction in equity per assets are caused by a 1% increase in ROE, consistent with the results of Bitar et al. (2017). As a measure of bank performance, while capital (equity to assets) increases EBIT, it weakens ROE. The results support the argument that highly capitalized banks cannot take the full advantages of tax shield of debts and therefore lower the after-tax earnings. Other measures of performance, such as ROA and Income do not show a robust result.

The economic determinants have a different impact on bank performance. In terms of inflation, higher inflation is the higher cost of capital, which results in a lower probability of fully committed payments of customers. Therefore, higher inflation is likely to be associated with lower bank performance. In fact, both model FMOLS and DOLS provide different results. In model 1 (FMOLS), 1% increase in EBIT, ROE, and Income is caused by an increase in 43%, 0.11%, 0.20%, and a decrease of 0.01% in inflation. On the other hand, model 2 (DOLS) shows that while 1% increase in EBIT and Log (Income) leads to 137% and 0.66% increase in inflation, respectively, ROA and ROE cause a reduction in inflation of 0.07% and 0.25%, respectively, at 1% significant level. The inflation has both positive and negative effects on bank performance, which aligns with Azariadis and Smith (1996); and Boyd and Smith (1998), who argue that when the inflation increases it might have a positive association with bank performance until the inflation surpasses a critical rate "threshold", it would beat the threshold, and therefore resulting in a decline in bank performance. The real interest rate (RIR) provides the similar effect on bank performance since there is a connection of real interest rate with inflation.

Interestingly, unemployment reduces during the periods of economic growth which is also associated with higher bank performance. Specifically, as shown by FMOLS, at 1% significant level, unemployment reduces 82%, 0.01%, and 0.37% while GDP increases 14%, 0.03%, and 0.54% due to 1% increase in EBIT, ROA, and ROE, respectively. Further, the dynamic model DOLS suggests the consistent results between the association between unemployment, GDP, and bank performance. That is, if performance measured by ROA, ROE, and Income increase by 1%, GDP also increases 0.04%, 1.02%, and 0.34% respectively while unemployment reduces 68.56%, 0.45% and 0.35% due to 1% increase in EBIT, ROE, and Income. Undoubtedly, an increase in bank performance/profitability is accompanying with the economic growth measured by real GDP development (Demirgiic and Huizinga, 1999; Ranjan and Dhal, 2003), which results in an enhancement of employment. In other words, lower unemployment, in return, causes a surge in aggregate demand and further lowers rates of borrowers, which ultimately boosts bank performance (Mendes and Abreu, 2003; Heffernan et al., 2008). Our findings are, also, consistent with that of Abreu and Mendes (2001) which shows that there is a negative relationship between unemployment and return on average assets (ROAA) and return on average equity (ROAE), all of which are used to measure bank performance.

The size of a bank is measured by the total assets and according to the economies of scale theory (Goddard et al., 2004), larger banks are expected to be more profitable since they spread costs throughout their systems and results in a lower cost of operations. Moreover, the larger credits would lessen banks' spreads, reduce lending rates and as a result enhance competitive ability with other financial institutions in providing credit products (Trad et al.,2017). Therefore, larger banks are associated with higher bank performance (Sanwari and Zakaria, 2013). However, table 6 shows different results regarding bank size and bank performance. At 1% significant level, while a 1% increase in ROE reduces 0.06% of assets, 1% increase in Income will create an increase in 0.03% in Assets. The model DOLS provides more statistically significant results. To be specific, the total assets of the observe banks drop by 128%, 3.37%, and 1.02% if EBIT, ROE, and Income grow by 1%, respectively. The inefficiency of bank performance in the big banks of the model is likely to involve in the belief "too big to fail" (Acharya and Yorulmazer, 2007). Such expectation inclines with an increase in efficient costs because banks believe that if they are larger and risker they will benefit from the "too big to fail" government bailout. Moreover, the probability of being larger might is associated with the holdings of default risk, lower-quality assets, or non-performing loans, or uninsured deposits, all of which require a high interest expense to cover risk premium or increased interest costs of the banks (Hannan and Hanweck, 1988), which ultimately results in lower bank profitability/performance.

The models DOLS and FMOLS provide almost similar results. On the whole, we conclude that the effect of capital ratio on bank performance is statistically significant robust. Our findings, therefore, are consistent with the previous studies, as of Chortareas et al. (2015); Berger (1995); Iannotta et al. (2007); Tan (2016); Demirguc-Kunt et al. (2013); Tan and Floros (2013) and Tan (2016), but inconsistent with that of Bitar et al. (2017); and Sutorova and Petr (2014). Also, both models indicate a negative relationship between equity measured by Equity and bank performance (ROA) at 1% significant level. In particular, a drop of Equity by 0.1% and 0.25% in FMOLS and DOLS, respectively due to 1% increase in ROA, indicating that we should conduct more estimations to find out what the optimal capital structure is. To determine the optimal structural capital, we construct a quadratic term of CR (i.e. CR^2). The findings are presented in the 7 Table below.

Table 6. Regression model of capital ratio and bank performance

Panel A: Fully Modified OLS (FMOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	64.95***	0.02**	-0.32***	-0.10
	[4.04]	[2.45]	[-32.43]	[-0.16]
Inflation	42.49**	-0.01***	0.11***	0.20***
	[2.44]	[-5.02]	[15.74]	[7.03]
RIR	120.93***	0.01***	0.35***	0.19
	[2.69]	[6.04]	[8.24]	[1.32]
Unemployment	-82.01***	-0.01***	-0.37***	-0.23
	[-13.37]	[-3.97]	[6.09]	[-0.29]
GDP	14.08***	0.03***	0.54***	0.17
	[11.97]	[7.82]	[9.69]	[11.08]
Log(Asset)	22.02		-0.06***	0.30***
	[0.93]		[-24.12]	[20.82]
Log(Equity)		-0.10***		
		[-13.17]		
Mean VIF	1.51	1.56	1.53	1.53
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.15	0.35	0.24	0.15
Panel B: Dynamic Modified OLS (DOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	104.88***	-0.02***	-2.18***	-0.53***
	[3.41]	[-7.16]	[-29.32]	[-7.38]
Inflation	136.87***	-0.07***	-0.25***	0.66***
	[5.80]	[-7.09]	[-6.63]	[4.59]
RIR	143.06**	-0.02***	-0.38***	-0.00***
	[2.57]	[-7.97]	[-8.93]	[-4.71]
Unemployment	-68.56***	-0.01	-0.45***	-0.35***
	[-6.67]	[-1.19]	[-8.19]	[-6.46]
GDP	-29.83***	0.04***	1.02***	0.34***
	[-12.68]	[8.21]	[13.67]	[6.36]
Log(Asset)	-128.48***		-3.37***	-1.02***

	[-3.47]		[-19.78]	[-10.38]
Log(Equity)		-0.25***		
		[-24.50]		
Mean VIF	1.53	1.56	1.53	1.53
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.15	0.35	0.25	0.15

4.3.2 Analysis with quadratic terms

The greater the capital ratios, the lower the profitability of banks, and therefore the positive relationship between CR and all bank performance ratios statistically reverse into a negative relationship between CR^2 and measures of bank performance. Stated differently, 1% decrease in EBIT, ROA, ROE, and Log(Income) comes from increases in quadratic CR by 163%, 0.06%, 1.34%, and 1.20%, respectively, at a highly significant level of 1%. The negatively significant estimate (β_2) of CR^2 indicates that the bank performance is maximized at thresholds, in which the capital ratios reach the optimal points. The intuition is associated with the inventory theory of costs and benefits to sustain liquidity buffers (Baltensperger, 1980). In fact, the relationship between bank performance and the square of CR is in a downward concave parabola form. That is, the more we hold shares, the higher profits we achieve, and the marginal profits keep increasing to a certain optimal point (at threshold in Table 7). However, when the banks hold further shares beyond the optimal point would weaken banks' profitability while all other things are constant. The implication is that financial markets will reward banks at lower interest rates of holding adequate liquid assets which provide banks buffers against unexpected shocks, absorb the loss, fulfil their obligations (Bordeleau and Graham, 2010).

Consistent with the inventory theory, the optimal capital equity ratios are ranging from 4.43% to 5.03% in the model FMOLS and from 3.57% to 5.55% in the model DOLS. Interestingly, the optimal ratios are significantly corresponding to the regulatory capital requirements under Basel III (4.5% required as minimum common equity ratios). Although, there are some variances between FMOLS and DOLS in terms of signs of coefficients for the economic factors. The implication is about the existence of CR^2, which might cause endogenous errors.

Table 7. Regression model of capital ratio and bank performance with a quadratic term

Panel A: Fully Modified OLS (FMOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	1444.36***	0.63***	13.33***	12.07***
	[11.69]	[21.55]	[19.07]	[15.84]
CR^2	-162.98***	-0.06***	-1.34***	-1.20***
	[-10.65]	[-21.00]	[-21.44]	[-16.28]
Inflation	53.91***	-0.04***	-0.16***	0.46***
	[5.31]	[-4.85]	[-3.75]	[4.31]
RIR	125.49***	-0.02***	0.28***	0.29***
	[7.88]	[-10.88]	[4.20]	[9.28]
Unemployment	-196.51***	-0.04***	-1.01***	-0.84***
	[-14.63]	[-10.76]	[-16.10]	[-14.71]
GDP	-4.05***	0.01	0.10***	-0.02***
	[-4.95]	[0.28]	[2.26]	[-0.00]
Log(Asset)	290.20***		0.39***	1.28***
	[9.69]		[18.03]	[24.09]
Log(Equity)		-0.20***		
		[-22.30]		
Mean VIF	7.61	8.11	7.61	7.61
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.22	0.41	0.25	0.16
Threshold value	4.43%	5.25%	4.97%	5.03%

Panel B: Dynamic Modified OLS (DOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	-588.75***	1.00***	12.76***	8.40***
	[-6.99]	[24.76]	[13.45]	[16.68]
CR^2	82.28***	-0.09***	-1.15***	-0.88***
	[7.53]	[-25.52]	[-17.95]	[-17.50]
Inflation	153.36***	-0.04***	0.04***	1.06***
	[6.31]	[-17.41]	[13.98]	[12.04]
RIR	149.06***	-0.02***	-0.02***	0.20***
	[2.55]	[-10.93]	[-8.68]	[6.06]
Unemployment	-0.91***	-0.03***	-0.70***	-0.75***

	[-8.88]	[-7.98]	[-11.74]	[-5.39]
GDP	-22.50***	0.02***	0.70***	0.18***
	[-8.99]	[3.58]	[5.25]	[8.23]
Log(Asset)	-238.55**		-1.13***	0.65***
	[-2.82]		[-21.11]	[31.39]
Log(Equity)		-0.17***		
		[-26.72]		
Mean VIF	7.61	8.11	7.61	7.61
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.22	0.41	0.25	0.15
Threshold value	3.57%	5.55%	5.54%	4.77%

4.4. Country-level Analysis

There is a concern if there are similarities or differences regarding the effect of capital ratios on the UK banks and the Australian banks, and whether the results are still consistent if we analyze data separately for the UK and Australia. The separate estimation, also, might advise if Basel III's 'one-size fits all' treat equally for all banks because although both the UK and Australia are common law countries, they have are two different economies with different regulatory applications. For example, Australian banks are dependent on intermediation than securitization, and hence applying a strict capital is unlikely to be appropriate in this country. Moreover, Australian banks are less vulnerable than UK banks in the global financial crisis of 2007-2009 (Lui, 2013) although both countries have a slight difference in capital ratios, approximately 8%[3].

The statistically significant coefficients of all variables in Table 8 seem to be consistent with the above findings. Evidently, the higher capital ratios in the UK banks will increase their performance (EBIT, ROA, and ROE). In particular, the model FMOLS reports that at a 1% significant level, the increase in CR by 132%, 0.02%, and 0.24% is created by 1% increase in EBIT, ROA, and ROE. The model DOLS, however, provide an insignificant correlation between CR and ROA, between CR and Income while the relationship between CR and EBIT is strongly significant in both models.

The results for Australian banks in Table 10 are in an opposite direction as compared to the UK banks. To be specific, both models show the significant negative association between capital ratios

[3] Published annual reports; Factiva and Financial Times

(CR) with bank profitability (ROA, ROE, and Income). At the significant level of 1%, ROE drops 1% due to CR rise by 0.87% in FMOLS. However, in the model DOLS, the negative correlation happens between CR and the other 3 variables, which are ROA, ROE, and Income at the level of 1% significance. The separate testing in two countries provides an interesting implication. The profitability (ROA) and the efficiency (ROE) in Australian banks are weaker than those of the UK banks when capital ratios are higher and stricter under Basel III. These findings are ultimately inconsistent with Beltratti and Stulz (2009), who indicate that Australian banks are more efficient than the UK banks.

In terms of the economic factors, there are also interesting stories inside each country. The higher inflation, higher real interest rate, a growth of GDP, and a lower proportion of unemployment indicate strong growth in the UK economy, and as a result a positive correlation with the UK banks' performance (Table 8). The profitability/efficiency of Australian banks, on the other hand, is consistent with lower inflation associated with the lower real interest rate, and therefore, boosts higher the economy at a higher level of GDP and lower unemployment (Table 10). It cannot deny that low and stable inflation has been maintained through a long decade and is a feature of the Australian economy. Such stabilizing of inflation contributes to a decrease in macroeconomic fluctuations (Hartigan and Morley, 2019), and a boost for highly banking performance

Again, the quadratic model (Table 9 and Table 11) signposts the optimal capital structure in the range from 3.52% to 5.77% for the UK banks, and a slightly higher level for the Australian banks which is at 5.46% and 6.05%. At these levels of capital, banks are highly performed measured by profitability, efficiency, and Income, whereas EBIT seems not strongly significant in the relationship with Australian banks' capital structures.

Table 8. Regression model of capital ratio and bank performance in UK

Panel A: Fully Modified OLS (FMOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	130.02***	0.02***	0.24***	-0.16**
	[6.91]	[3.27]	[28.59]	[2.96]
Inflation	93.00***	0.22***	0.00***	0.38***
	[9.18]	[6.97]	[21.80]	[9.11]
RIR	242.62***	0.04***	0.95***	0.53***
	[11.60]	[12.70]	[22.42]	[12.48]
Unemployment	-157.66**	0.01***	-0.22***	-0.33**
	[-2.86]	[6.24]	[14.36]	[2.21]
GDP	26.84	0.01***	0.46***	0.15***
	[14.02]	[7.87]	[10.17]	[12.41]
Log(Asset)	52.93		1.90***	0.02**
	[0.86]		[21.87]	[3.00]
Log(Equity)		-0.11***		
		[-13.36]		
Mean VIF	1.52	1.63	1.52	1.52
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.2	0.3	0.2	0.2
Panel B: Dynamic Modified OLS (DOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	207.47***	-0.01	-2.16***	-0.67
	[4.03]	[-1.05]	[-16.80]	[-0.64]
Inflation	279.86***	0.04***	0.78***	1.14***
	[9.10]	[14.57]	[12.27]	[3.4]
RIR	285.14***	-0.01	-0.12	0.23**
	[4.45]	[-0.84]	[-0.77]	[3.06]
Unemployment	-134.08***	0.00	-0.59***	-0.65***
	[-3.37]	[0.60]	[-8.33]	[-9.03]
GDP	-62.45***	0.03***	1.01***	0.25
	[-12.51]	[6.57]	[13.49]	[1.02]

Log(Asset)	-266.84**** [-12.13]		-4.26*** [-18.55]	-2.43 [-1.21]
Log(Equity)		-0.33*** [-25.58]		
Mean VIF	1.52	1.63	1.52	1.52
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.3	0.4	0.2	0.1

Table 9. Regression model of capital ratio and bank performance with quadratic term in UK

Panel A: Fully Modified OLS (FMOLS)

Variable	EBIT	ROA	ROE	Log(Income)
CR	2921.12*** [21.28]	1.01*** [17.63]	22.66*** [23.39]	21.57*** [15.58]
CR^2	-328.78*** [-19.43]	-0.09*** [-17.37]	-2.13*** [-24.64]	-2.15*** [-15.75]
Inflation	114.46*** [11.73]	0.05*** [10.41]	0.97*** [8.69]	1.17*** [8.04]
RIR	251.15*** [15.26]	0.03*** [8.14]	1.56*** [16.28]	0.86*** [10.01]
Unemployment	-388.55*** [-11.74]	-0.02** [-2.15]	-1.12*** [-11.22]	-1.44*** [-10.25]
GDP	-10.03*** [-3.21]	-0.01*** [-4.01]	-0.27*** [-7.79]	-0.17*** [-4.04]
Log(Asset)	575.73*** [7.74]		4.19*** [3.92]	2.54*** [8.11]
Log(Equity)		-0.16*** [-8.63]		
Mean VIF	12.29	11.64	12.29	12.29
(Multicollinearity)	(Yes)	(Yes)	(Yes)	(Yes)
R^2	0.28	0.38	0.24	0.14
Threshold value	4.44%	5.61%	5.31%	5.01%

Panel B: Dynamic Modified OLS (DOLS)

Variable	EBIT	ROA	ROE	Log(Income)

CR	-1129.04***	0.79***	8.66***	13.95***
	[-9.45]	[19.18]	[10.01]	[7.43]
CR^2	160.21***	-0.07***	-0.75***	-1.50***
	[9.71]	[-19.47]	[-12.30]	[-7.67]
Inflation	308.97***	0.06***	1.48***	1.46***
	[9.13]	[23.52]	[16.66]	[5.36]
RIR	298.07	0.01	0.59***	0.67***
	[0.04]	[0.11]	[4.40]	[3.12]
Unemployment	1.83***	-0.03***	-0.87***	-1.40***
	[3.63]	[-3.60]	[-6.77]	[-4.23]
	-48.44***	0.01***	0.86*	-0.06*
GDP	[-6.71]	[4.10]	[1.73]	[-1.44]
Log(Asset)	-480.21**		0.63***	0.97
	[-2.86]		[11.66]	[1.22]
Log(Equity)		-0.16***		
		[-21.46]		
Mean VIF (Multicollinearity)	12.29 (Yes)	12.29 (Yes)	12.29 (Yes)	12.29 (Yes)
R^2	0.29	0.38	0.29	0.14
Threshold value	3.52%	5.64%	5.77%	4.65%

Table 10. Regression model of capital ratio and bank performance in Australia

Panel A: Fully Modified OLS (FMOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	-0.11	0.01	-0.87***	-0.05
	[-1.20]	[0.21]	[-17.28]	[-2.74]
Inflation	-8.02***	-0.04	0.22	0.02
	[-5.73]	[0.31]	[0.46]	[0.84]
RIR	-0.75***	-0.02***	-0.26***	-0.14***
	[-7.79]	[-4.15]	[-10.76]	[-10.61]
Unemployment	-6.37***	-0.02	-0.51***	-0.13**
	[-16.05]	[-0.64]	[-5.75]	[-2.62]
GDP	1.32**	0.05***	0.59***	0.20***
	[2.92]	[3.20]	[3.54]	[3.26]
Log(Asset)	-8.90**		-2.02***	0.58***
	[-2.16]		[-12.25]	[26.45]
Log(Equity)		-0.08***		
		[-5.27]		
Mean VIF	1.10	1.11	1.10	1.62
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.4	0.05	0.4	0.1
Panel B: Dynamic Modified OLS (DOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	2.29	-0.04***	-2.20***	-0.40***
	[0.79]	[-9.07]	[-24.66]	[-11.07]
Inflation	-6.14	-0.18***	-1.27**	0.19**
	[-0.90]	[-4.55]	[-2.89]	[3.09]
RIR	0.98	-0.04***	-0.65***	-0.23***
	[0.81]	[-10.44]	[-11.86]	[-9.73]
Unemployment	-3.03***	-0.02**	-0.31***	-0.06
	[-6.06]	[-2.29]	[-3.26]	[-0.12]
GDP	2.78***	0.05***	1.02***	0.42***
	[5.43]	[5.04]	[5.84]	[7.98]
Log(Asset)	9.88***		-2.47***	0.39***
	[7.22]		[-9.42]	[15.89]
Log(Equity)		-0.17***		

		[-9.07]		
Mean VIF	1.1	1.1	1.1	1.1
(Multicollinearity)	(No)	(No)	(No)	(No)
R^2	0.4	0.05	0.4	0.7

Table 11. Regression model of capital ratio and bank performance with quadratic term in Australia

Panel A: Fully Modified OLS (FMOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	-32.40***	0.24***	4.00***	2.58***
	[-4.76]	[12.85]	[3.58]	[6.82]
CR^2	2.83***	-0.02***	-0.56***	-0.25***
	[4.36]	[-12.32]	[-5.69]	[-7.27]
Inflation	-6.64***	-0.12***	-1.29***	-0.26**
	[-4.22]	[-3.55]	[-3.39]	[-1.94]
RIR	-0.18***	-0.07***	-1.01***	-0.29***
	[-4.12]	[-23.53]	[-22.22]	[-23.13]
Unemployment	-4.46***	-0.07***	-0.90***	-0.25***
	[-8.94]	[-13.07]	[-11.55]	[-10.56]
GDP	1.94***	0.03***	0.47***	0.14***
	[3.80]	[4.43]	[4.59]	[4.04]
Log(Asset)	4.67***		-3.40***	0.02***
	[5.97]		[-21.59]	[25.96]
Log(Equity)		-0.25***		
		[-22.90]		
Mean VIF	17.44	16.81	17.44	17.44
(Multicollinearity)	(Yes)	(Yes)	(Yes)	(Yes)
R^2	0.5	0.3	0.44	0.67
Threshold value	5.72%	6.00%	3.57%	5.16%
Panel B: Dynamic Modified OLS (DOLS)				
Variable	**EBIT**	**ROA**	**ROE**	**Log(Income)**
CR	-48.46	1.21***	16.86***	2.84***
	[-0.44]	[15.84]	[9.01]	[16.15]
CR^2	4.35	-0.10***	-1.55***	-0.26***
	[0.95]	[-16.62]	[-13.08]	[-17.08]

Inflation	-2.26	-0.14	-1.40***	0.66***
	[-0.21]	[-1.11]	[-3.12]	[11.67]
RIR	0.05***	-0.04***	-0.63***	-0.27***
	[3.56]	[-15.34]	[-16.68]	[-11.69]
Unemployment	-3.65***	-0.04***	-0.52***	-0.10***
	[-8.93]	[-7.96]	[-9.83]	[-3.39]
GDP	3.43***	0.03***	0.54***	0.42***
	[6.00]	[9.16]	[9.15]	[13.08]
Log(Asset)	3.12		-2.88***	0.34***
	[1.14]		[-18.21]	[43.17]
Log(Equity)		-0.19***		
		[-16.34]		
Mean VIF	17.44	16.81	17.44	17.44
(Multicollinearity)	(Yes)	(Yes)	(Yes)	(Ye)]
R^2	0.5	0.3	0.4	0.7
Threshold value	5.57%	6.05%	5.43%	5.46%

5. Conclusion & Policy Implications

Drawing on the data from the largest commercial banks in the UK and Australia over the 2000-2019 periods, this paper examines the relationship between capital ratios under Basel III and banks' performance and banks' efficiency measured by earnings before interest and tax (EBIT), return on assets (ROA), return on equity (ROE), the net income. In addition, the effects of bank size, inflation, real interest rates, unemployment, and GDP are considered in the analyses. Across all four performance measures, the results show that capital is positively correlated with bank performance as measured by EBIT, but negatively correlated with bank efficiency as measures of ROE, and bank profitability ROA. Evidently, these results do not validate the Basel III consensus, in which governments encouraged banks to enhance the minimum common equity ratio to absorb losses, curb the excessive risk craving of banks, and to endorse banking sector stability. Therefore, banks should be careful about increasing their capital requirements. We also performed a quadratic estimation to find the optimal capital structures where banks can achieve the best performance. The effect of capital is more pronounced for banks holding the capital ratio at around 4% to 5.55%. Therefore, it can be concluded that if the capital ratios are higher than the optimal points, the bank performance will weaken. Moreover, we test the effects of capital ratio on bank performance for the UK and Australia separately. The results for the UK banks remain the same while the capital ratio in Australian banks weakens their bank performance for all measures. However, the results of the quadratic model show similar ratios for both the UK and Australia.

The economic factors have a different impact on bank performance in the UK and Australia. A higher rate of inflation and real policy rates in the UK boost bank performance, while lower inflation and lower interest rates in Australia enhance banks performance. Moreover, the growth of a country can be seen at a lower level of unemployment and a higher level of GDP, those of which have an obvious impact on the banking sector in the UK and Australia.

Our findings have significantly important implications for banks, policymakers and regulators, especially in common law countries. First, while strictly restricted capital improves operating performance, it devalues bank profitability and bank efficiency for shareholders since such income for banks' operations must be divided among shareholders. While capital provides its ability to absorb losses and plays a core part of resilience against adverse shocks, it is more expensive than other funding since investors expect additional compensation for the higher risk they bear. This paper suggests how banks can meet higher capital requirements but still enhance ROE and ROA. Firstly, banks are encouraged to diversify their lending activities, such as housing lending, capital-intensive and lower-return lending, the repricing of loans, repricing of deposit liabilities, a lengthening of the maturity of liabilities more generally and a continued shift towards more stable sources of funding. As a result, all modified lending activities are likely to increase in capital and have a direct effect on banks' return on equity (ROE). Moreover, short-term debt should be replaced with longer-term funding to strengthen banks' liquidity positions.

Secondly, holding liquid assets will make banks more resilient to liquidity shocks, thus reducing the negative externalities they might impose on other economic agents, while holding too many may impose a significant cost in terms of reduced profitability. Indeed, as retained earnings are the primary means of organic capital generation, low profits may prevent banks from expanding and extending additional credit to the real economy. These benefits and costs are equally applicable both for individual institutions and the financial system. Finally, provide the optimal capital structure which is roughly like the minimum common equity ratios meeting the Basel III requirements. It can be further suggested that while the increase in the inflation and interest rates in the UK will not harm the banking sector performance, it will have a negative effect to Australian banks, and therefore implicating a different policy for the central banks.

The role of policymakers is not merely the implementation of the post-crisis capital requirements, but also towards monitoring for any unexpected effects, the reforms are having, as well as being alert to new risks that emerge to ensure that the resilience we injected into the banking system post-crisis stands the test of time.

The paper is limited to exploring the effects of capital requirements on banking sector performance. Therefore, further analysis should account for different factors, for example, corporate governance or ownership structure will help to appraise whether the monitoring role of managers enhances bank performance. This study has focused on the UK and Australia, however, other countries are also applying capital requirements. There are also crucial differences between developed and developing countries banking structures. Nonetheless, digital currencies, fintech and blockchain are posing new challenges to the banking system. All these aspects are beyond the scope of the subject study, but further analysis by including these factors could offer more insights into the performance of the banking sector in the 21st century.

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Appendix A.1. Data description

Indicator	**Variables**	**Explanations**	**Sources**
Equity per assets	CR	Total common shares divided by total assets	Annual Financial Reports
Earnings before interest and tax per total revenues	EBITS	Net income before tax divided by total sales	Annual Financial Reports
Return on total asset	ROA	Net income after tax divided by total sales	Annual Financial Reports
Return on total common equity	ROE	Net income after tax divided by total common shares	Country Economic Indicator
Inflation	Inflation	Measured by CPI, month on month, based on source quarterly data	Country Economic Indicator
Real interest rate	RIR	Measured by nominal interest rate minus inflation, based on source quarterly data	Country Economic Indicator
Unemployment rate	Unemployment	Unemployment rate, Aged 16-64	Country Economic Indicator
Gross domestic product	GDP	GDP Rate, based on source quarterly data	Country Economic Indicator
Natural logarithm of total assets	Log(Asset)	Measured by natural logarithm of banks' total assets	Annual Financial Reports
Natural logarithm of equity	Log(Equity)	Measured by natural logarithm of banks' total common shares	Annual Financial Reports
Natural logarithm of net income	Log(Income)	Measured by natural logarithm of banks' net income after tax	Annual Financial Reports

Notes: Our quarterly dataset covers the period from 2000 to 2019 of ten banks in the United Kingdom and Australia