The Impact of Global Financial Crisis on Shareholder Value and Operational Efficiency of Banks

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Abstract

This paper investigates whether banks were able to create value for their shareholders after the Global Financial Crisis (GFC) and whether operational efficiency is related to shareholder value creation in informationally efficient stock markets. The impact of GFC on bank efficiency and shareholder value creation is assessed for 29 large banks in the USA, UK, Canada, New Zealand, and Australia during the period 2003-15. These countries are studied as group because of the differing impacts of the GFC on what were otherwise relatively integrated markets. The significant impact of GFC is observed on bank efficiency and shareholder value during 2008-09. A significant relationship between profit efficiency and shareholder value creation is observed. Consistent with prior studies, we did not find a significant relationship between shareholder value and cost efficiency. Important determinants of shareholder value and bank efficiency are also identified, which suggest important policy implications.

Keywords: Shareholder Value, Bank Efficiency, Global Financial Crisis, Lerner Index

JEL Classification: E44;E58; E62; G01; G14; G21; G32; O57

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1. Introduction

The widespread positive impact of market competition on industrial organizations persuaded the governments of many developed and developing countries to introduce reforms in their financial sectors. The deregulation of global banking started almost half a century ago to promote more competition, which should lead to lower cost, enhanced efficiency, higher service quality, and heterogeneous products (Claessens & Laeven, 2004). However, many of the deregulated banking markets have become less competitive and more concentrated with time. Also during this half century, global banking has been transformed due to financial technology, product innovation, privatization, prudential regulation, internationalization, and changes in corporate behavior (Fu, Lin, & Molyneux, 2014). Currently, the majority of the shareholding of financial institutions is held by sophisticated and institutional investors. These shareholders possess tools and resources to assess the value creation of banks, which for them is essentially the evaluation of firm performance. Market forces and shareholder pressure have driven banks to focus strategically on maximizing shareholder value.

The GFC 2008-09 further accelerated the pressure and expectations that banks should have better risk management and more efficient asset utilization. There is consensus among researchers that less capital, lower liquidity and risk-taking activities were among the major reasons for bank failure during the GFC 2008-09 (Greenbaum, Thakor, & Boot, 2016). As a result, the regulators have forced banks to raise more capital, hold more liquidity, and refrain from capital-intensive activities in the post-crisis period (Fu et al., 2014). This phenomenon has created a dual challenge for banks in maximizing shareholder value. First, higher capital and liquidity level have negatively impacted returns on equity. Second, the restraints on banks from capital-intensive activities may further reduced their profitability. The pressure has also

mounted to create more shareholder value to regain the confidence of investors after the GFC 2008-09.

It is considered that bank efficiency is the most sophisticated and comprehensive measure to assess relative bank performance (Berger & Humphrey, 1997). A number of studies have argued for the superiority of bank efficiency as a measure of performance, and its relationship with shareholder value or stock performance of banks (Beccalli, Casu, & Girardone, 2006; Chu & Lim, 1998; Fiordelisi, 2007). Although only a few papers have investigated the relationship between bank efficiency and shareholder value prior to GFC 2008-09 (Beccalli et al., 2006; Chu & Lim, 1998; Fiordelisi, 2007; Fiordelisi & Molyneux, 2010; Kirkwood & Nahm, 2006), to our knowledge only one study has investigated this relationship in the post-crisis period (Fu et al., 2014). Also, the methodology used by many prior studies to estimate bank efficiency and its determinants has been criticised due to the problems of correlation, biased estimators, and data-generating process with two-stage models (McDonald, 2009; Simar & Wilson, 2007; Wang & Schmidt, 2002). Furthermore, the need to link bank efficiency with market-based indicators of performance is identified in recent studies (Berger, Imbierowicz, & Rauch, 2016; Molyneux, 2018).

This paper has used an improved frontier analysis methodology to observe the impact of GFC 2008-09 on bank efficiency and shareholder value, and to explore the potential determinants of shareholder value. A significant impact of the GFC is observed on bank efficiency and shareholder value during the period 2008-09. A set of firm-level and economic variables is also identified as determinants of shareholder value and bank efficiency. A strong and significant relationship between measures of profit efficiency and shareholder value is observed for major banks in the USA, UK, New Zealand, Canada, and Australia. Our tests find

a weak relationship between shareholder value and cost efficiency, consistent with prior studies (Chu & Lim, 1998; Fu et al., 2014; Pasiouras, Liadaki, & Zopounidis, 2008).

This paper makes several contributions. First, one-stage stochastic frontier analysis is used for the first time to estimate shareholder value efficiency and its determinants. Second, the important role of market power is identified in the value and profit efficiency of the banks. Third, to the knowledge of the authors, it is the first post-GFC study to assess the relationship between shareholder value and bank efficiency in four major world economies, potentially leading to insights around the different impact of the GFC in different countries. Important policy implications are also identified.

The rest of the paper proceeds as follows: the next section reviews the literature on the relationship between shareholder value and bank efficiency. Section 3 presents the methodology used to measure bank efficiency, shareholder value, and tests to explore association among them. This section also describes the sources of data used in the estimation models. The empirical results for bank efficiency, shareholder value, and their association are discussed in section 4. The last section concludes and discusses the possible implications of the study.

2. Shareholder Value and Bank Efficiency

There are a large number of prior studies on both bank efficiency and shareholder value. However, the literature on both issues has generally developed separately. Most of the initial bank efficiency studies were focused on improvement of methodology, comparison of estimation approaches, and sources of bank inefficiency (Berger & Humphrey, 1997; Kumbhakar, Lozano-Vivas, Lovell, & Hasan, 2001; Pasiouras, 2013). These studies introduced bank efficiency as a more comprehensive and sophisticated measure of relative bank

performance (Beccalli et al., 2006; Berger & Humphrey, 1997). On the other hand, the studies on shareholder value were focused on development and comparison of new measures of shareholder value, the relationship between market and accounting based value measures, and determinants of shareholder value or firm performance (Barth, Beaver, & Landsman, 2001; Liu & Ohlson, 2000; O'Hanlon & Peasnell, 1998). Only a few studies raised questions about the superiority of bank efficiency as a measure of performance and its relationship with shareholder value or stock performance (Beccalli et al., 2006; Chu & Lim, 1998; Fiordelisi, 2007). Only a few studies have been conducted so far on the relationship between bank efficiency and shareholder value, but using different methodologies and data sets.

An initial study by Chu and Lim (1998) claimed to be first linking bank efficiencies with market returns. This study used DEA to estimate cost and profit efficiencies of six big banks operating in Singapore over the period of 1992-96. In a second stage, they regressed efficiency scores with the annual change in share price of banks and also examined correlations between the estimates. They got motivation from earlier studies which claim that the stock price incorporates all relevant publicly available information in informationally efficient stock markets, while efficiency scores are estimated with published accounting data. Therefore, a bank efficiency estimate should be relevant to the stock price in any informationally efficient market. They reported that a change in profit efficiency was reflected in a change in bank share prices, however, cost efficiency was not found to be related (Chu & Lim, 1998).

Many later studies also supported their conclusion that shareholders are more interested in bank profits as a source of higher dividends (Beccalli et al., 2006; Fu et al., 2014; Pasiouras et al., 2008). A study by Becalli et al. (2006) focused on similar objectives but concluded that the shares of cost-efficient banks outperform their inefficient counterparts. They regressed stock performance against a change in cost efficiency estimates, generated from both parametric and

non-parametric approaches, and accounting ratios. This study was based on publicly listed banks of major European countries for the year 1999 and 2000. They concluded that both parametric and non-parametric cost efficiency estimates were positively related to the stock performance of banks, but that accounting ratios were not able to significantly explain the stock returns (Beccalli et al., 2006).

Meanwhile, Fiordelisi (2007) introduced the concept of shareholder value efficiency, as improvements were being made in approaches to efficiency estimation. He used a parametric approach to estimate cost, profit, and shareholder value efficiency for listed banks of four major EU economies over the period of 1997 to 2002. In a second stage, he regressed shareholder value efficiency (SVE) against various bank efficiency variables in presence of some control variables. He also explored the correlation among traditional bank efficiency estimates and shareholder value efficiency. The results of this study found a weak relationship between cost, profit, and shareholder value efficiency. However, all efficiency estimates were positively and significantly associated with different measures of shareholder value creation (Fiordelisi, 2007). A later study by Fiordelisi and Molyneux (2010) further extended the literature on the relationship between bank efficiency and shareholder value, using similar estimation measures. Using correlation, regression, and Granger-causality tests, they explored potential determinants of shareholder value and bank efficiency in addition to looking at the relationship between them. They found a positive and significant relationship between bank efficiency and shareholder value, while loan losses, financial leverage, bank size, and liquidity were identified as major determinants of shareholder value (Fiordelisi & Molyneux, 2010).

Fu et al. (2014b) investigated the relationship between shareholder value and bank efficiency for the 274 commercial banks in 14 Asia-Pacific economies between 2003 and 2010. This study investigated the impact of GFC 2008-09 on the relationship between accounting and

market-based shareholder value with bank efficiency. The authors observed a significant impact of post-crisis regulatory and economic reforms on the banking environment; therefore, they expected a change in the relationship between shareholder value and bank efficiency. They regressed accounting and market-based shareholder value variables with cost and profit efficiency in presence of control variables. The results indicated a positive relationship between profit efficiency and stock returns. However, the impact of cost efficiency on shareholder value takes more time to be observed, consistent with earlier studies (Beccalli et al., 2006; Fiordelisi & Molyneux, 2010; Fu et al., 2014).

It may be concluded from prior literature that profit efficiency has a strong relationship with shareholder value but the relationship of cost efficiency is based on "time dynamics". The literature on the relationship between bank efficiency and shareholder value is relatively both new and spaced. Therefore a need is felt to further investigate this relationship in different banking markets with improved measurement approaches to capture "time and location dynamics". Most prior studies have used two or three stage approaches to measure bank efficiency and its determinants, which have been widely criticised in some prior studies (McDonald, 2009; Simar & Wilson, 2007; Wang & Schmidt, 2002). The changes in the banking environment of many developed countries have been recognized after the GFC 2008-09 (Fu et al., 2014), but only one study has investigated the relationship between bank efficiency and shareholder value, with those based on 14 Asia-Pacific economies only. This study uses improved econometric models to explore the relationship between bank efficiency and shareholder value in five developed economies covering the period before and after the GFC 2008-09. Potential determinants of bank efficiency and shareholder value efficiency are also identified.

3. Methodology

Three main parametric methodologies have been used to estimate bank efficiency in prior studies. These include the two-stage model, two-stage mixed model, and one-stage model. The problems of correlation, biased estimators, and the data-generating process with two-stage methodologies are well documented in the literature (McDonald, 2009; Simar & Wilson, 2007; Wang & Schmidt, 2002). Therefore, this study has used the one-stage Stochastic Frontier Approach (SFA) model (Battese & Coelli, 1995) to estimate cost (CE), profit (PF), alternative profit (APE), and shareholder value efficiency (SVE). Prior studies have recommended selection of relatively homogenous economies for cross-country bank efficiency studies: five economies based on the common Anglo-Saxon banking model are therefore selected and the remaining banking market differences are controlled with inclusion of the control variables in estimation models (Berger & Mester, 1997; Xiang, Shamsuddin, & Worthington, 2015).

The Stochastic Frontier Approach (SFA) is one of the most frequently used parametric approach in prior studies to estimate efficiency of the banks in one-stage (Berger & Humphrey, 1997). SFA provides a single value for bank efficiency and can show its relationship with potential determinants. There are three benefits of including potential efficiency determinants in one-stage SFA approach. First, this gives us more precise efficiency scores in the presence of potential determinants. Second, it solves the statistical problems (Wang & Schmidt, 2002) of the two-stage approach. Third, it allows us to estimate the relationship of selected determinants with inefficiency.

3.1 Cost Efficiency Model

The equation of SFA cost function in translog form can be specified as follows:

$$\ln TC_{it} = \alpha_o + \sum_{n=1}^{3} \alpha_n \, lny_{nit} \; + \frac{1}{2} \sum_{k=1}^{3} \sum_{n=1}^{3} \alpha_{nk} \, lny_{nit} lny_{kit} \; + \; \sum_{j=1}^{2} \beta_j \; lnw_{jit} + \frac{1}{2} \sum_{m=1}^{2} \sum_{j=1}^{2} \beta_{jm} \, lw_{jit} lw_{mit} \; + \sum_{j=1}^{2} \sum_{n=1}^{3} \omega_{nj} \; ly_{nit} lw_{jit} \; + \gamma_t t + \frac{1}{2} \, kt^2 + v_{it} + \mu_{it} \quad (3.1)$$

Where TC_{it} is the total cost of i-th bank in each year t. y_{it} is vector of three outputs and w_{it} is vector of three input prices. v_{it} are normally distributed random error terms and independent of inefficiency error terms. μ_{it} are truncated half normal positive inefficiency error terms and independent of random error terms.

$$\mu_{it} = \delta z_{it} + \omega_{it} \quad (3.2)$$

The inefficiency errors are based on z vector of exogenous variables which may contribute to inefficiency of the bank. Detail of *y, w, p*, and *z* variables is given in table 3.1.

3.2 Profit Efficiency Models

The equation of SFA profit efficiency model in translog form can be specified as follows:

$$\ln PBT_{it} = \alpha_o + \sum_{s=1}^{2} \alpha_s lnp_{sit} + \frac{1}{2} \sum_{k=1}^{2} \sum_{s=1}^{2} \alpha_{sk}\ lnp_{kit} lnp_{sit} + \sum_{j=1}^{2} \beta_j\ lnw_{jit} + \frac{1}{2} \sum_{m=1}^{2} \sum_{j=1}^{2} \beta_{jm}\, lw_{jit} lw_{mit} + \sum_{j=1}^{2} \sum_{s=1}^{2} \omega_{sj}\ lp_{sit} lw_{jit} + \gamma_t t + \frac{1}{2}\, kt^2 + v_{it} - \mu_{it} \quad (3.3)$$

In equation 3.3, to estimate profit efficiency, the independent variables are the same as equation 3.1 but the dependent variable is the amount of profit before tax plus Θ, which is the absolute value of minimum normalized profit before tax plus 1. The constant Θ is used to transform all value of the dependent variable to be positive for log purpose for the estimation model. Also, the y_{it} vector of three outputs is replaced with p_{it} , the vector of two output prices. The equation for alternative profit is similar to that for cost efficiency for explanatory variables, but the dependent variable is profit before tax of each bank plus constant Θ. In standard profit efficiency, the price of output is given, so a bank changes the quantity of output and input to get optimal revenue for maximum profit. However, when estimating alternative profit efficiency, the quantity of output is given so a bank can set different prices to get optimal revenue for maximum profit (Berger & Mester, 1997). The inefficiency errors are similar to equation 3.1 with a negative sign. The variables of total cost *(TC),* profit before tax *(PBT),* and

two inputs *(w_1, w_2)* are normalized by price of funds *(w_3)* to impose linear homogeneity on all models. Furthermore, total cost *(TC),* profit before tax *(PBT),* all inputs, and outputs are normalized with total equity to reduce the bias from differing bank size.

3.3 Shareholder Value Efficiency Model

The model for estimation of shareholder value efficiency (SVE) is similar to alternative profit and cost efficiency models. In this case the dependent variable is replaced with the variable economic value added (EVA). The amount EVA is normalized by w_3 and equity before adding the constant of φ, which is the absolute value of minimum normalized EVA plus 1.

$$\ln EVA_{it} = \alpha_o + \sum_{n=1}^{3} \alpha_n \, lny_{nit} + \frac{1}{2} \sum_{k=1}^{3} \sum_{n=1}^{3} \alpha_{nk} \, lny_{nit} lny_{kit} + \sum_{j=1}^{2} \beta_j \, lnw_{jit} + \frac{1}{2} \sum_{m=1}^{2} \sum_{j=1}^{2} \beta_{jm} \, lw_{jit} lw_{mit} + \sum_{j=1}^{2} \sum_{n=1}^{3} \omega_{nj} \, ly_{nit} lw_{jit} + \gamma_t t + \frac{1}{2} kt^2 + v_{it} - \mu_{it} \quad (3.4)$$

Annual EVA is calculated for each selected bank using the formula of Fiordelisi (2007), as follows:

$$EVA_{it} = NOPAT_t - (CI_{t-1} * K^e_{t-1}) \qquad (3.5)$$

Where NOPAT is net operating profit after tax, CI is shoulder's equity, and K^e is the estimated cost of equity. EVA is the amount of profit a bank earns in excess of the returns shareholders require on the contributed equity to the bank- in other words, the bank's cost of capital.

Various methods of estimating cost of capital are discussed in prior studies (Damodaran, 2007; Fiordelisi, 2007; Maccario, Sironi, & Zazzara, 2002). It is argued that historical realized returns are good indicators of expected returns and therefore can be used as proxies for the cost of equity (Maccario et al., 2002). Either the ROE for year t-1 or an average ROE for past years can be used. Banks' return on equity (ROE) is generally steady in good times but fluctuates significantly during economic shocks; it is better therefore to take ROE of year t-1, as the

minimum expectation of shareholders for the next year. Although, this is not an ideal method for estimating cost of equity, it is selected due to data limitations. The amount of equity invested is also taken from year t-1 because shareholders are expecting returns on their capital which is already invested in the bank.

3.4 Data

Panel data for 6 Australian, 6 Canadian, 8 US, and 5 UK banking holding companies (BHC) is collected from DataStream. The data for 4 New Zealand banks is collected from their annual reports for the period of 2003-15. The list of selected banks is provided in Appendix 3. The data for exogenous variables is collected from IMF, Central Banks, and World Bank reports. Data for the Australian banks is based on their globally consolidated statements excluding New Zealand. The banks in the sample hold the majority of banking assets in each country's banking sector. The countries in the sample share a common inheritance in their banking operations, structure, and regulations (Xiang et al., 2015). The remaining variation in their economic environment is minimized by introducing control variables in the measurement model. The selection of input, output, and dependent variables is based on the intermediation role of banks as discussed in prior studies (Sealey & Lindley, 1977; Xiang et al., 2015). In this case, banks convert their own and borrowed capital into loans, investments, and other services while using labor and office fixtures. The control variables have been used by different cross-country studies in past (Carbó-Valverde, Humphrey, & del Paso, 2007; Mergaerts & Vander Vennet, 2016; Wheelock & Wilson, 2017; Xiang et al., 2015). It is expected that the control or environment variables will help to estimate more precise bank efficiency scores and the efficient frontier. Further detail of selected variables is given in Table 3.1.

Table: 3.1

Symbol	Definition
Dependent Variables	
TC	Total cost includes interest expenses and operating expenses. It is used to calculate cost efficiency.
PBT	Profit before tax plus a constant Θ. The constant is the minimum profit of a bank over the profit of all banks plus 1. PBT is the dependent variable for profit and alternative profit efficiency models.
EVA	The process of calculating EVA is discussed earlier.
Variable Input Prices	
w_1	Price of labor is personnel expenses per employee.
w_2	Price of physical capital is operating expenses, less personnel expenses, divided by net value of buildings & equipment.
w_3	Price of funds is interest expenses divided by total borrowed funds including deposits and other borrowings.
Variable Output Quantities	
y_1	Total amount of loans, advances, and other receivables.
y_2	All investments assets and securities.
y_3	Commission, fees, and all other operating income.
Variable Output Prices	
p_1	Price of loans is interest income dividing by total loans, advances, and receivables.
p_2	Price of other assets is noninterest income dividing by net other assets.
Exogenous Variables	
GDC (z_1)	GDP per capita in each country in year t which is a measure of market size available to the banks of each country.
IR(z_2)	The five-year bond rate in each country in year t. It is a measure of potential profitability in given banking system.
NIM (z_3)	Net interest margin is average net interest margin of all banks in each country.
TA(z_4)	Bank size is measured with the total amount of assets.
LOSS(z_5)	The ratio of loan loss expenses from income statement by total loans of each bank for each year.
Z-Score(z_6)	Z-score of each bank as a measure of bank stability. The Z-score is calculated with following formula; $\frac{\text{ROA+ (Equity/Asset)}}{\sigma(\text{ROA})}$. Where ROA and equity to asset ratio is calculated for each bank in each financial year but standard deviation of ROA is computed using rolling window of 4 years.
LAT(z_7)	Loans to total assets ratio show dependence of bank on the lending portfolio.
HHI (z_8)	The Herfindahl-Hirschman Index is calculated on the basis of bank assets and is a proxy for concentration.
Lerner(z_9)	Lerner Index is a measure of market power of banks in each country in given year and is measure of market competition. Detail of its estimation is given later in this section.
DGFC(z_{10})	Dummy variable for year 2007 to 2009 which are the years most impacted by the GFC.
DEQ (z_{11})	Ratio of total liabilities to total assets or capital which represents the ratio of bank debt compared to equity.

This study has selected the Lerner index as a proxy for market power and the Herfindahl-Hirschman Index (HHI) for market concentration (Akins, Li, Ng, & Rusticus, 2016; Casu & Girardone, 2009). Both of these variables are very important determinants of bank efficiency. The HHI is the sum of the squared market share of each bank in the system and applies to the system as a whole. The Lerner index represents the markup of price over the marginal cost a bank may set for its customers, which is an indicator of market power. It is calculated as:

$$Lerner_{it} = (P_{TAit} - MC_{TAit}) / P_{TAit} \qquad (3.4)$$

Where P_{Tait} is the price of total assets proxies by the ratio of total revenue to total assets by bank *i* at time *t*, and MC_{TAit} is the marginal cost of the total assets for bank *i* at time *t*. The Lerner index is calculated for each year in each country over the study period as an average of all selected banks. The MC_{TAit} is derived using the following translog cost function:

$$\ln TC_{it} = \beta_0 + \beta_1 \ln Q_{it} + \beta_2 \frac{1}{2} \ln Q^2_{it} + \sum_{j=1}^{2} \alpha_{jt} \ln w_{jit} + \frac{1}{2} \sum_{k=1}^{2} \sum_{j=1}^{2} \alpha_{jk} \ln w_{kit} \ln w_{jit} + \sum_{j=1}^{2} \delta_j \ln Q_{it} \ln w_{jit} + \gamma_t t + \varepsilon_{it} \qquad (3.5)$$

Where Q_{it} is a proxy for bank output or total assets for bank *i* at time *t*, w_{jit} is vector of three input prices which indicate the price of labor, borrowed funds, and fixed assets respectively. The price of labor is the ratio of total personnel expenses to total number of employees, the price of borrowed funds the ratio of total interest expense to total liabilities, and the price of fixed assets the ratio of operating expenses except personnel expenses, to fixed assets. The variables total cost *(TC)*, total assets *(Q)*, and two inputs (w_1, w_2) are normalized by price of funds (w_3) to impose linear homogeneity on the model. Furthermore, total cost *(TC)*, total assets *(Q)*, and all inputs are normalized by total equity to reduce the bias from differing bank size.

Marginal cost *(MC)* is then computed with the following equation:

$$MC_{TAit} = Cost_{it}/Q_{it}\,[\beta_1 + \beta_2\, lnQ_{it} + \sum_{j=1}^{2} \delta_j\, lnw_{jit}\,] \qquad (3.6)$$

The result from equation 3.6 is used in equation 3.4 to calculate Lerner index of each year *t* of all banks which is used in equation 3.2 to test its association with bank efficiency. A higher value for the Lerner index indicates higher market power for the bank in setting prices on its products and services, which is likely to reflect lower competition in the given banking industry of the country. The marginal cost (MC) and efficiency scores are estimated with similar translog equations which may give rise to the problem of simultaneity (Koetter, Kolari, & Spierdijk, 2012). Although variables and estimation process are different for both outcomes, there are chances of a simultaneity problem due to similar functional form and similarity of some variables.

4. Empirical Results

As discussed in the previous section the inputs and outputs for the stochastic frontier analysis are selected on the basis of the intermediation approach (Sealey & Lindley, 1977). The descriptive statistics are given in Table 4.1 for each data variable. There is a big variation in values of each data variable across the time and countries. Some variation in data is due to different size of banks in each country and rest is due to changes in the banking environment over the study period. There is not much variation in selected economic variables of interest rate, GDP per capita, or net interest margin but there is large variation in most of the firm-level variables.

The result from the Pearson Correlation test among environment variables is given in Appendix 1. The correlation among most of the selected environment variables is at a statistically acceptable level except for that between loans to asset ratio (LAT) and total assets (Size) of the bank. The amount of total assets is used as denominator in LAT ratio so this higher

correlation is expected. We tested the models without the LAT variable but it didn't make any significant change to reported results.

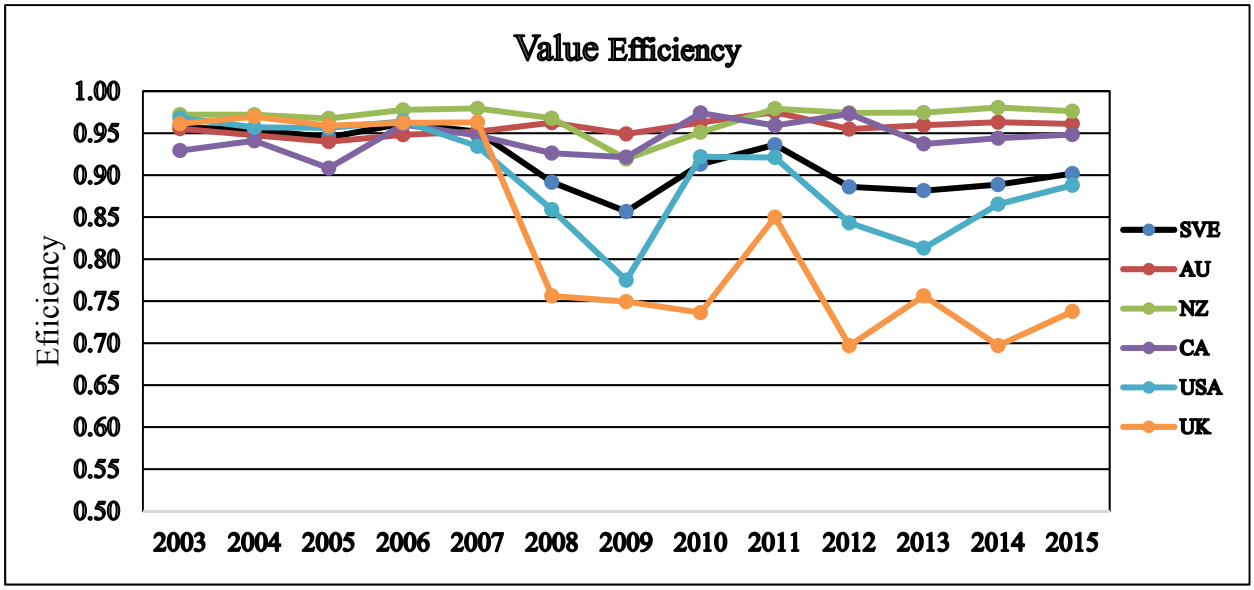
Table 4.1 Descriptive Statistics

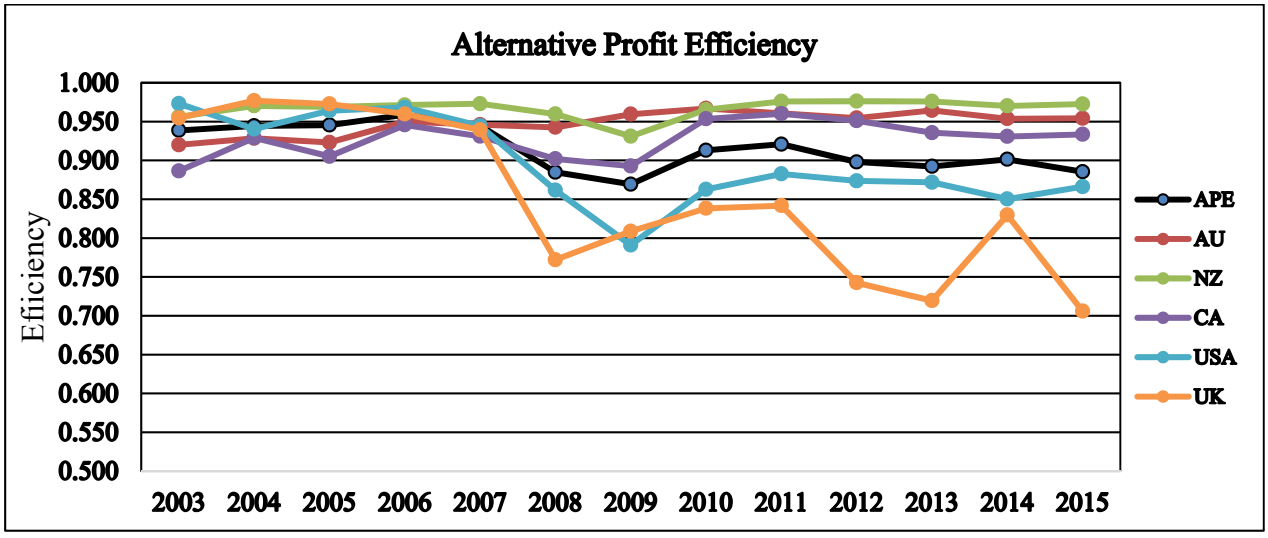
	Mean	Max	Min	SD
Dependent Variable (US$M)				
Total Cost (TC)	26,265	157,045	50	31,141
Profit Before Tax (PBT)	5,376	37,014	-60,492	8,749
Economic Value Added (EVA)	766	12,570	-54,060	5,730
Input Variables (US$M)				
Price of Labour (w_1)	0.083	0.154	0.017	0.024
Price of Funds (w_2)	0.024	0.069	0.002	0.015
Price of Physical Capital (w_3)	2.56	17.23	0.53	1.89
Output Variables (US$M)				
Net Loans (y_1)	313,133	2,211,669	318	322,225
Total Investment (y_2)	265,016	2,211,865	125	396,900
Non-interest Income(y_3)	11,280	65,356	-35,532	15,021
Price of Loans (p_1)	0.069	0.163	0.020	0.021
Price of Other Assets (p_2)	0.049	0.259	0.000	0.029
Environment Variables				
Interest Rate (z_1)	3.42	6.86	0.72	1.60
GDP per Capita (z_2)	43,662	67,524	21,712	10,053
Net Interest Margin (z_3)	2.57	4.30	0.59	0.79
Total Assets (z_4)	652,616	3,929,498	489	764,916
Loan to Assets (z_5)	0.61	0.90	0.25	0.16
Loan Losses (z_6)	3,134	37,390	0.00	5,643
Z-Score (z_7)	39.84	140.45	1.59	27.53
HHI (z_8)	1266	2516	252	538
Lerner Index (z_9)	0.27	0.56	0.03	0.13
DEQ (z_{10})	0.93	0.98	0.86	0.03

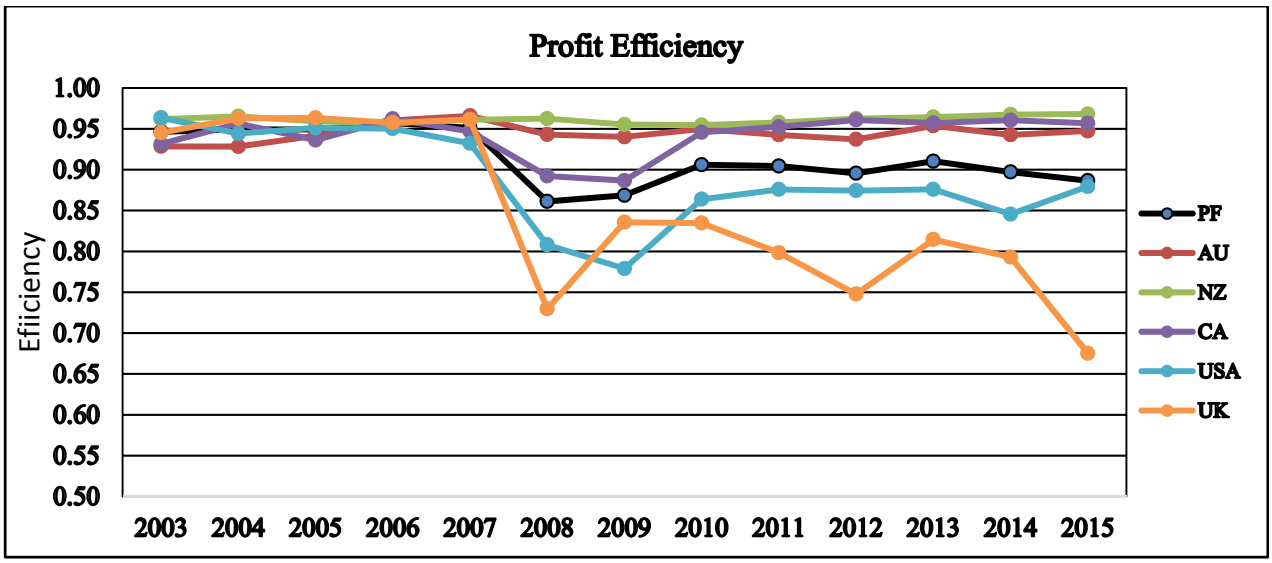
MEAN is calculated for all banks over the period 2003-15. MAX is maximum value, MIN is minimum value, and SD is standard deviation of each variable among all banks during all years of study period.

The convergence in profit and value efficiencies between the countries in the pre- GFC period is evident in Figure 4.1. The impact of GFC can be observed in 2008 and it worsened in 2009 for most countries. The divergence in level of profit and value efficiencies among selected countries can be observed in the post-GFC period. The value and profit efficiencies of the US and British banks significantly declined in the post-GFC period. However, the banks of Australia, Canada, and New Zealand achieved better level of value and profit efficiencies in

Figure 4.1: Value and Profit Efficiencies

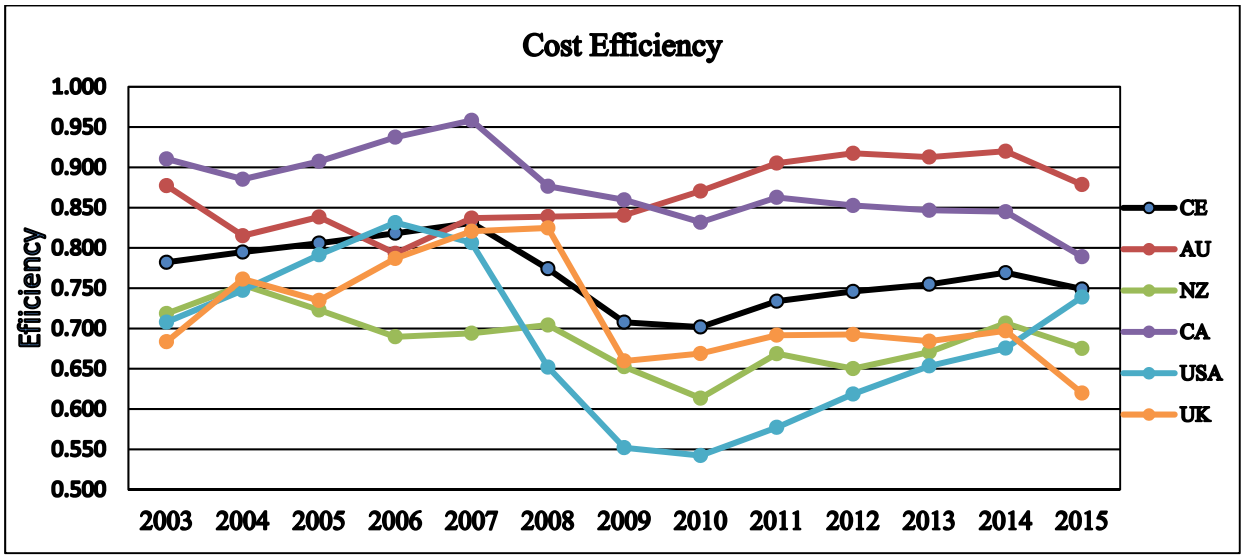






the post-GFC period. The value and profit efficiencies of British banks were superior before GFC and deteriorated in the post-GFC period. It seems the banks of USA and UK are more impacted by the post-GFC regulatory and economic reforms. The level of value and profit efficiencies is consistent among the Australian, Canadian, and New Zealand banks, improving for the US banks, while there are no signs of improvement for British banks. The average level of profit and value inefficiencies among selected countries is less than 10% over the study period, which is better than in most developed and emerging economies (Altunbas, Carbó-Valverde, Gardener, & Molyneux, 2007; Belke, Haskamp, & Setzer, 2016; Carvallo & Kasman, 2016; Pasiouras, Tanna, & Zopounidis, 2009). The efficiency scores change with inclusion and exclusion of certain variables but overall trends didn't change significantly. The movement of profit and alternative profit efficiency graphs is more similar compared to value efficiency, which justifies use of value efficiency as a separate measure of bank performance. The association among these measures is discussed at end of this section.

Figure 4.2: Cost Efficiency



The movement of cost efficiency graphs is different from value and profit efficiencies as is visible in Figure 4.2. The divergence in cost efficiency among the banks of each country is apparent in the pre-GFC period and it has further increased in the post-GFC period. The

impact of the GFC is also prolonged compared to profit efficiency. The initial impact can be observed in 2008 and the noticeable recovery started in 2011. The level of cost efficiency has worsened in the post-GFC period among banks from all sample countries except Australia. The cost efficiency of Australian banks increased for few years in the post-GFC period and came back to the 2003 level in last year of study period. The superiority of Australian and Canadian banks in cost efficiency is evident throughout the study period. The results are consistent with argument of "regulatory cost" for banks in the form of higher capital and liquidity in the post-GFC period as mentioned by Fu et al. (2014). A number of sources of cost inefficiency are discussed in literature but two most prominent are moral hazard and higher cost of business. Our next question is about the financial variables which may play role in deterioration or improvement of bank efficiency.

Potential determinants of bank efficiency are reported in Table 4.2. The variables net interest margin, loans to assets ratio, and loan losses played a significant role in reducing bank's cost efficiency. Theory suggests that banks will have lower interest margins when interest rate are lower (Delis & Kouretas, 2011; Keeley, 1990); therefore, banks' lower net interest margins during the study period is negatively impacting their cost efficiency. Furthermore, the size of bank (Total Assets) has not provided any support for scale economies in cost, value or profit efficiencies. The debt to assets ratio positively influences cost efficiency which means banks' equity level is negatively affecting cost efficiency. The country's interest rate level has helped to improve cost efficiency which might be due to better non-interest income and returns on banks' investments.

Table 4.2: Determinants of Cost, Alternative Profit, Value and Profit Efficiency

Variables	Cost Efficiency	Alt. Profit Efficiency	Value Efficiency	Profit Efficiency
Environmental Variables				
Interest Rate	0.28***	0.78***	0.86***	0.30***
GDP Per Capita	7.93***	25.60***	16.00***	13.96***
Net Interest Margin	-0.23***	-0.10**	-0.065*	-0.041*
GFC Dummy	-0.41*	-0.37***	-0.33***	-0.28***
Risk Variables				
Loans to Assets Ratio	-1.31***	1.18***	2.24***	3.92***
Debts to Assets Ratio	3.30***	20.93***	0.87***	19.83***
Loan Losses	-0.23***	0.87***	0.95***	0.95***
Z-Score	0.90**	0.77***	0.54***	0.88***
Market Structure Variables				
Total Assets	-0.011	-0.22***	-0.23***	-0.18***
HHI	0.071*	-0.088*	-0.11*	-0.10*
Lerner	0.11	2.11***	3.25***	3.80***

This table presents the results from second-step of SFA for the entire sample (N=377) with INEFFICIENCY as the dependent variable which is estimated with equation 3.1 using FRONTIER 4.1 software. The signs of reported results are reverse of actual results to present their relationship with efficiency. First column reports potential correlates of bank efficiency, second column reports relationship of potential correlated with COST EFFICIENCY, third reports with ALTERNATIVE PROFIT EFFICIENCY, fourth with SHAREHOLDER VALUE EFFICIENCY, and last column with traditional PROFIT EFFICIENCY. INTEREST RATE is average annual five-year bond rate, GDP PER CAPITA is average annual GDP per person in US$, NET INTEREST MARGIN is average annual net interest margin of all banks in each selected country. GFC DUMMY is for years 2007-09 to observe the impact of the GFC. LOANS to ASSETS is ratio of total loans to total assets as proxy of liquidity and lending portfolio. DEBTS to ASSETS is ratio of total liabilities to total assets as proxy of equity/leverage; LOAN LOSSES is ratio of loan loss expenses to total loans; Z-SCORE is estimated of each bank for each year as proxy of bank stability; TOTAL ASSETS in US$ is proxy of bank size, HHI is industry-level proxy of market concentration; and LERNER is industry-level proxy of market power/competition.
***, **, and * indicate 1%, 5% and 10% significance levels.

The relationship of selected determinants is the same for all measures of value and profit efficiency. Net interest margin, total assets and HHI negatively influenced these efficiencies. Liquidity and equity can be examined using the loans to assets and debt to assets ratios. The positive impact of debts on efficiency may be a negative impact of equity on efficiency and the positive impact of loans may be negative impact of liquidity. The sources of value and profit efficiency for banks are interest rate, GDP per capita, higher risk level and market power. The importance of market power in bank efficiency is well recognized in prior studies as it may help banks to increase price of their products and services in relatively concentrated banking markets to achieve higher levels of profit efficiency and cover their

higher cost (Berger & Hannan, 1998; Berger, Klapper, & Turk-Ariss, 2009; Koetter et al., 2012; U-Din, Tripe, & Kabir, 2017). The detail of rising market power among the countries in the study is reported in appendix 2. Higher risk, interest rate, and GDP per capita also positively contribute to profit efficiency and shareholder value.

Table 4.3: Correlation Efficiency Measures

Efficiency Measures	Value Efficiency	Alternative Profit Efficiency	Profit Efficiency	Cost Efficiency	EVA
Value Efficiency	1				
Alt. Profit Efficiency	0.80***	1			
Profit Efficiency	0.78***	0.90***	1		
Cost Efficiency	0.16***	0.14***	0.19***	1	
EVA	0.71***	0.56***	0.60***	0.13***	1

The values of SHAREHOLDER VALUE, ALTERNATIVE PROFIT, PROFIT, and COST lies between 0-1 and are estimated with One-stage Stochastic Frontier Analysis. ECONOMIC VALUE ADDED (EVA) is annual profit before tax less cost of capital for each bank and its value lies between -54,060 and 12,570 US$.
***, **, and * indicate 1%, 5% and 10% significance levels.

The other motivation of this paper is to assess the relationship between bank efficiency and shareholder value. Correlation estimates are reported in Table 4.3. A stronger and significant relationship among value, profit, alternative profit efficiency, and EVA is apparent from reported results. It means all these measures are reporting similar information about firm performance, consistent with the claim that stock prices incorporate all publicly available information in informationally efficient markets including efficiency scores based on published accounting data. Prior studies have reported a positive association among EVA, value, and alternative profit efficiency (Fiordelisi, 2007). However, the present study contributes by finding a relationship with profit efficiency which is a different measure from value and alternative profit efficiencies (Berger & Mester, 1997). This new relationship might be uncovered due to either the different set of environment variables or different sample countries being used in this paper. An association of cost efficiency with EVA, value, and profit efficiency is not very strong but is statistically significant as shown in Table 4.3. Although the relationship of cost efficiency is weak with shareholder value and profit efficiency, it is a valid

measure of bank performance. Overall results of Table 4.3 are consistent with prior studies, suggest that bank shareholders are more interested in profitability, which supports dividends, than cost efficiency (Chu & Lim, 1998; Fiordelisi & Molyneux, 2010; Fu et al., 2014).

5. Conclusion

The paper investigates the impact of GFC 2008-09 on the relationship between bank efficiency and shareholder value using a sample of 29 commercial banks from Australia, Canada, New Zealand, USA, & UK during the period 2003-15. An improved methodology is used and some new determinants of operational and value efficiencies are identified. A significant impact of the GFC 2008-09 is observed on value, cost, and profit efficiencies. Average level of all efficiencies declined during and after the crisis. The divergence in efficiency scores has also increased which means the impact of post-crisis reforms is asymmetrical among the five countries. The reforms of higher capital and liquidity are implemented uniformly under Basel III, but the asymmetric impact of these reforms indicate some role of bank management and financial practices in lowering their efficiency. The higher values for bank-level variables net interest margin, level of loans, and loan losses play an important role in undermining bank's cost efficiency. The variables bank size, net interest margin, equity, liquidity, and market concentration are lowering profit and value efficiencies. These variables have highlighted the partial role of post-crisis regulatory reforms in reducing banks' efficiency.

A strong and significant relationship between EVA, value, profit, and alternative profit efficiencies is found, but only a weak relationship with cost efficiency. First, this confirms the notion that operational efficiency scores are comprehensive measures of bank's accounting and market performance (Beccalli et al., 2006; Berger & Humphrey, 1997). Second, shareholders are more interested in profit efficiency of banks to maximize shareholder value rather than cost

minimization (Chu & Lim, 1998; Fiordelisi & Molyneux, 2010; Fu et al., 2014). Although the determinants of shareholder value and operational efficiency are different due to location and time dynamics, the superiority of bank efficiency as a measure of bank performance is pertinent during study period in sample countries.

It may be concluded that analysts and shareholders may use operational efficiency as a more comprehensive measure of bank performance. Regulators may need to introduce initiatives to control bank size and concentration as has already started in a few developed economies (Scott, 2017; U-Din et al., 2017). Also policymakers need to boost and regulate market power and lower the business cost for banks. Banks needs to improve their management and financial practices to lower moral hazard and risky activities.

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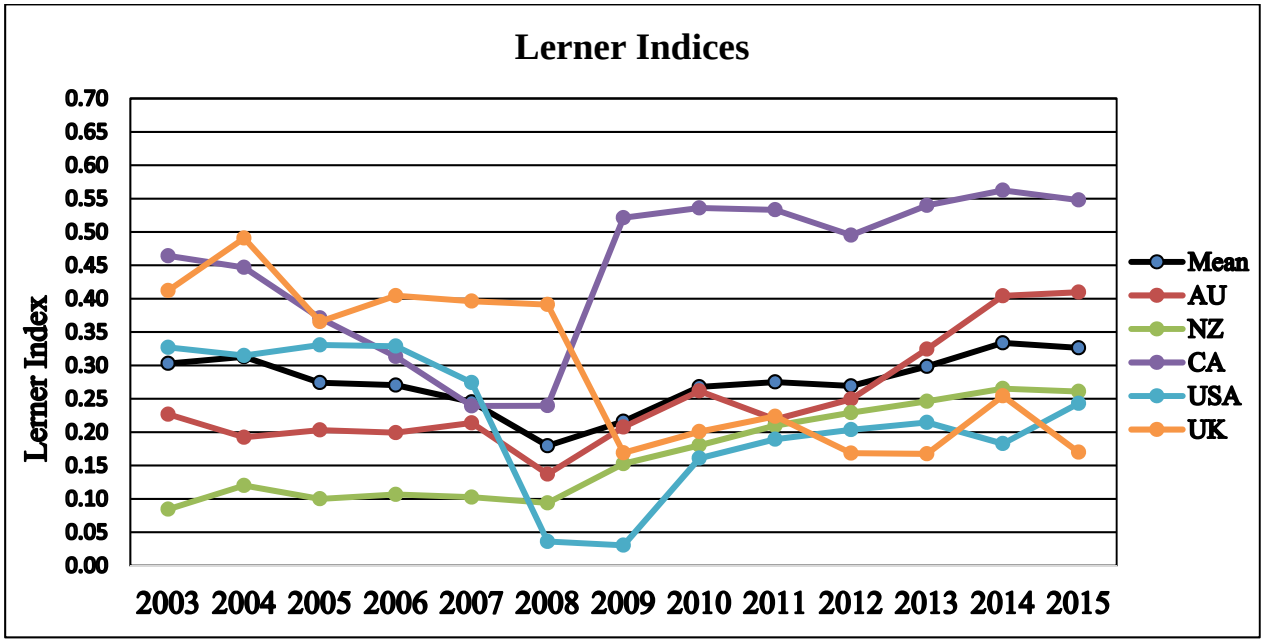
Appendix 1: Correlation among Environment Variables

	Interest Rate	GDP	NIM	Size	LAT	Loan Losses	Z-Score	HHI	Lerner Index	DEQ
Interest Rate	1.00									
GDP	-0.51	1.00								
NIM	-0.14	0.20	1.00							
Size	-0.50	0.44	0.27	1.00						
LAT	0.46	-0.23	-0.31	-0.74	1.00					
Loan Losses	-0.43	0.27	0.49	0.56	-0.57	1.00				
Z-Score	0.21	-0.07	-0.07	-0.16	0.26	-0.35	1.00			
HHI	0.10	-0.27	-0.48	-0.24	0.23	-0.37	-0.28	1.00		
Lerner Index	-0.15	0.21	-0.08	0.23	-0.24	-0.25	0.13	0.07	1.00	
DEQ	0.33	-0.28	-0.41	-0.05	0.04	-0.38	-0.16	0.59	0.29	1.00

Appendix 2: Lerner Indices



Appendix 3: List of Selected Banks

Sr.	Name of Bank	Country
1.	J.P. Morgan Chase	USA
2.	Bank of America	USA
3.	Wells Fargo	USA
4.	Citigroup	USA
5.	US Bancorp	USA
6.	PNC Financial Services	USA
7.	Capital One Bank	USA
8.	BB & T	USA
9.	ANZ Bank NZ	NZ
10.	Westpac Bank NZ	NZ
11.	Bank of New Zealand (BNZ)	NZ
12.	ASB NZ	NZ
13.	Commonwealth Bank of Australia	Australia
14.	Westpac Bank Australia	Australia
15.	NAB Australia	Australia
16.	ANZ Australia	Australia
17.	Bendigo and Adelaide Bank Ltd.	Australia
18.	Bank of Queensland Ltd.	Australia
19.	TD Canada Trust Bank	Canada
20.	RBC Bank Canada	Canada
21.	BNS Bank Canada	Canada
22.	CIBC Bank	Canada
23.	BMO Bank Canada	Canada
24.	National Bank Canada	Canada
25.	HSBC Bank UK	UK
26.	Barclays Bank UK	UK
27.	Royal Bank of Scotland UK	UK
28.	Lloyds Bank UK	UK
29.	Standard Chartered Bank UK	UK