Determinants of Foreign-Owned Banks' Efficiency in New Zealand:

A Stochastic Frontier Approach

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Abstract

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The banking sector in New Zealand is characterised by the dominance of foreign-owned banks, and in particular from Australia. The objective of this study is to examine the efficiency performance of foreign-owned banks relative to domestically owned banks, with major focus on the determinants on the differences of foreign banks' efficiency. The parametric stochastic frontier approach (SFA) is employed to extend the existing bank efficiency studies that used the non-parametric approach--Data Envelopment Analysis (DEA). Ten major banks which have continuously operated over the period 2002 to 2011 were selected and both industry- and bank-specific characteristics are tested using quarterly data for 40 quarters with the consideration of macroeconomic conditions. The one-step SFA approach of model is used in order to obtain the cost and profit efficiency scores and the inefficiency effects simultaneously to avoid any bias on the results.

The empirical results suggest that the presence of foreign banks in New Zealand has contributed to the efficiency of New Zealand banking system as a whole. The results also support the limited global advantage hypothesis (Berger, DeYoung, Genay, & Udell, 2000) that foreign banks from specific nations (Australia in this study) have operated efficiently due to having less liabilities of foreignness in the host nation. Other distinguishing determinants factors on the differences in cost and profit efficiency between foreign and domestic banks are bank size, the level of equity, asset quality, as well as the market concentration and interest rate and inflation environment in New Zealand.

Keywords: Foreign Banks, Cost Efficiency, Profit Efficiency, Stochastic Frontier Analysis, New Zealand

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Table of Contents

List of Tables

List of Figures

ABBREVIATIONS

ASB	ASB Bank Limited
ANZ	Australian and New Zealand Banking Group
ANZ NZ	ANZ Banking Group (New Zealand) Limited
ANZN	ANZ National Bank Limited
APRA	Australian Prudential Regulation Authority
APE	Alternative profit efficiency
ASEAN	Association of Southeast Asian Nations
BC	Battese and Collie
BNZ	Bank of New Zealand
CBA	Commonwealth Bank of Australia
CEE	Central and East European
CER	Closer Economic Relations
CE	Cost efficiency
CPI	Consumer Price Index
DEA	Data Envelopment Analysis
DFA	Distribution Free Approach
EU	European Union
FDH	Free Disposable Hull analysis
FDI	Foreign direct investment
FIPS	Financial Institutions Performance Surveys
GDP	Gross Domestic Product
GFC	Global finance crisis
HSBC	Hong Kong and Shanghai Banking Corporation Limited
RBA	Reserve Bank of Australia
LLR	Log Likelihood Function
LR	Likelihood ratios
MLE	Maximum likelihood estimates
MNB	Multinational Bank
M&A	Merger and Acquisition

NAB	National Australia Bank
NPI	Negative profit indicator
NPL	Non-performing Loan
OCR	Official Cash Rate
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PE	Profit efficiency
PTA	Policy Targets Agreements
INF	Inflation rate
IFRS	International Financial Reporting Standards
IMF	International Monetary Fund
SD	Standard Deviation
SFA	Stochastic Frontier Approach (Analysis)
SCF	Stochastic Cost Function
TFA	Thick Frontier Approach
TC	Total Cost
TSB	TSB Bank Limited
TWI	The Trade-Weighted Index
TTMRA	Trans-Tasman Mutual Recognition Agreement
US	United States
UK	United Kingdom
WESTPAC	Westpac Banking Corporation
WESTPAC NZ	Westpac New Zealand Limited

Chapter 1
Introduction

1.1 Background

The New Zealand banking system is unique by world standards. Foreign banks dominate the New Zealand financial system to an extent seen in few other economies. Moreover, banks' foreign ownership is concentrated heavily in one country - Australia. For example, as at 31 December 2011, eighteen out of twenty one[1] total registered banks in New Zealand were foreign-owned banks, accounting for 92.3% of total New Zealand banking assets, while 87.6 % of total assets of the banking system were Australian-owned. The four largest dominant banks[2] are all Australian-owned banks.

Banks play a key role in the New Zealand financial system, mobilising and allocating the economy's resources and providing transactional services for customers (Chetwin, 2006). The banking system is particularly important for the nation's economy, regardless of whether the banks are locally or foreign owned. In general, foreign banks are expected to introduce new and diverse products, greater use of technologies, know-how spillovers, and human capital to the domestic banking system and contribute to greater local financial system efficiency (Claessens, Demirgüç-Kunt, & Huizinga, 2001). The New Zealand banking system was assessed by the Reserve Bank of New Zealand (Rodgers, 2003) as sound on the basis of strong underlying profitability, higher quality and generally well-diversified loan portfolios, low level of risks and foreign banks' strong parent banks. The recent global financial crisis (GFC) between 2007 and 2009, has tested the New Zealand banking system, and, unlike the case in many countries, the banking system has remained relatively resilient (Bollard, Hunt, & Hodgetts, 2011). Bollard (2004a) recognises that the

[1] The co-operative Bank limited was registered on 26 October 2011, and is not included in the calculation on market share.
[2] In 2003, the Australian and New Zealand Banking Group (ANZ) acquired the National Bank New Zealand (NBNZ) which was formerly owned by Lloyds TSB group in the United Kingdom. Since then, the four largest Australian banks have dominated the New Zealand banking system: ANZ National Bank Limited (ANZN). Bank of New Zealand (BNZ), ASB Bank Limited (ASB) and Westpac Banking Corporation (Westpac).

efficient and sound New Zealand banking system has benefited from the strong presence of foreign-owned banks.

Greater banks' efficiency can promote financial system soundness and economic growth, while an inefficient banking system can cause financial instability. Thus, the demand for bank efficiency analysis in any nation is primarily due to a desire for better policy decisions to enhance financial system stability and economic growth opportunities, which in turn helps to improve banks' managerial performance. In the New Zealand context, foreign-owned banks have dominated the nation's banking system for more than a decade (Reserve Bank of New Zealand, 2004a), and the evaluation of foreign-owned banks efficiency is therefore of particular interest to both policy makers and academics.

New Zealand was regarded as the most regulated country in the world prior to 1984. Competition between the banks was severely constrained by barriers to entry to limit foreign ownership (Walsh, 1988). Since 1984, the wave of reforms in financial markets, such as the removal of restriction on interest rates and lending criteria, and, in particular, the removal of the prudential restrictions on foreign ownership of financial institutions, has essentially opened the door to foreign banks' new entrants (Grimes, 1998). Foreign banks tend to be attracted to countries with higher per capital income, low taxes, and a stable and efficient financial market, and invest in a country with less regulatory restrictions (Claessens et al., 2001), New Zealand has exhibited such characteristics since the deregulation in 1984.

The historically closer Trans-Tasman integration between New Zealand and Australia in regulation and supervision of economic and financial markets, has allowed more Australian banks to establish their physical presence in the New Zealand financial market compared with other nations. Claessens and Van Horen (2014) explains that bilateral factors such as distance, trade linkage and institutional similarity between home and host countries can significantly contribute to the development of an integrated market. An increased integration of the financial market is supposed to bring price convergence and improvement in banks' cost efficiency via increased competition in the local market (Andrieş & Căpraru, 2012).

Foreign banks which operate in New Zealand are either locally incorporated banks or branches of overseas incorporated banks. As of December 2011, there were a total of 18

registered foreign banks, 8 locally incorporated compared with 10 foreign branches. The locally incorporated banks are subject to local capital and liquidity requirements, which rely on their local operations being supervised by the Reserve Bank of New Zealand. Branches can freely flow their capital and liquidity across business units and across borders with the supervision of the parent banks' authority. The foreign bank branches in New Zealand vary in size, but are relatively small and tend to focus on corporate banking activities, with the exception only of Westpac Banking Corporation [3](KPMG, 2012).

New Zealand has a prudential supervision system to ensure the banking system is efficient and sound (Grimes, 1998), despite the relatively small number of banks. The centrepiece of the regulatory requirement is that all registered banks are required to be adequately capitalised. Moreover, the most important feature of New Zealand's banking supervision framework is the public disclosure regime which came into force in 1996, where all registered foreign banks in New Zealand are required by the Reserve Bank of New Zealand to publish a disclosure statement quarterly, providing public attestations as to the soundness of the bank, the robustness of the system and its exposure to risk, including information about foreign banks and their overseas parent banks (Carr, 2001).

1.2 Related literature on foreign banks efficiency and determinants

This study reviews a total of 65 empirical foreign bank efficiency studies at an international level and in a New Zealand context[4]. The first strand of the literature compares the efficiency of foreign-owned banks with domestic-owned banks in both developed and developing countries. The overall results obtained from the studies in developed countries suggest that foreign banks exhibit lower efficiency than domestic competitors while the reverse is true for transition economies. The second strand investigates the factors influencing the difference between foreign-owned and domestic owned banks' efficiencies, with regard to banks' ownership features, general bank-specific characteristics (e.g. size, asset quality) and macroeconomic conditions (e.g. GDP growth, interest rates). The empirical evidence showed that the correlation of the determinant

[3] Westpac Bank Corporation registered as WestpacTrust in 1987, has operated as a foreign branch of Westpac Bank Corporation in Australia since 1996 until November 2006, when its retail business has been separately incorporated locally as Westpac New Zealand Limited.
[4] Details will be presented in the literature review chapter.

factors and foreign banks' efficiency levels are often debatable in the literature. The choice of efficiency measurement methods is also contestable among the various studies.

Foreign bank efficiency studies in developed countries have their origins in the US market. Early studies in the early-mid 1990s using the US data DeYoung and Nolle (1996); Mahajan, Rangan, and Zardkoohi (1996); Chang, Hasan, and Hunter (1998); Peek, Rosengren, and Kasirye (1999) found that foreign banks entering the well-developed US financial market generally had difficulties competing in the dominantly domestically-owned banking market in the US. Similarly, a study by Berger et al. (2000) of France, Germany, Spain, the UK, and the US during the 1990s, found, on average, domestic banks have higher efficiency than foreign banks in those countries. Recent studies in Australia (Sathye, 2001; Sturm & Williams, 2008, 2009, 2010) also support the US findings, despite its banking system being dominated by the big four domestic banks[5] which have acted as barriers to foreign banks' new entrants (Sturm & Williams, 2004).The common feature of the banking system in these developed countries is the dominant position of domestically-owned banks.

In contrast, studies in developing countries suggest that foreign banks are more efficient than domestic banks. Berger et al. (2000) and Isik and Hassan (2002), Havrylchyk (2006) suggest that foreign banks generally capitalise well on their advantages and exhibit a higher level of efficiency than their domestic counterparts. Cross-country evidence can be found in studies of Central and East European (CEE) countries (Kasman & Yildirim, 2006; Naaborg, 2007; Rossi, Schwaiger, Winkler, & Nationalbank, 2005) ; 40 African countries (Figueira, Nellis, & Parker, 2006), and 20 Latin American countries (Figueira, Nellis, & Parker, 2009). Some single-country studies in Asia-specific countries (for example Berger, Hasan, and Zhou (2009) in China; Tahir and Haron (2008) in Malaysia; Sharma, Gounder, and Xiang (2013) in India) support the general findings which suggest that economic reforms have significant effects on foreign bank entry and their efficiencies in developing countries.

[5] The big four domestic banks are Commonwealth Bank Australia(CBA), Westpac Banking Corporation (Westpac Australia), Australia and New Zealand Banking Group (ANZ Australia) and National Australia Bank (NAB), which are parent banks of ASB bank, Westpac bank, ANZ bank, and BNZ bank respectively in New Zealand.

The relationship between foreign ownership and foreign banks' efficiency has been examined among the previous foreign bank efficiency studies reviewed. Two popular hypotheses, the home field advantage hypothesis and limited global advantage hypothesis[6], have been developed (Berger et al., 2000) and tested in the literature. Berger and Mester (1997) reviews 130 bank efficiency studies, of which a few addressed the impact of foreign ownership on banks' efficiency, suggest that foreign banks in developed countries likely experience higher costs, lower profitability and diminished competitiveness with regards to domestic banks, thus the efficiency disadvantages of foreign banks relative to domestic banks, on average, tend to outweigh the efficiency advantages (home field advantage hypothesis). Previous studies in the US (Chang et al., 1998), European countries (Curi, Guarda, Lozano-Vivas, & Zelenyuk, 2013; Naaborg, 2007) and Australia financial market (Sturm & Williams, 2008, 2009, 2010) appear to support the home field advantage hypothesis.

Some foreign banks, however, are likely to be able to overcome some cross-border disadvantages when they operate in host nations with similar financial markets, regulatory, or supervisory conditions, as opposed to banks from nations with less similarity between home and host countries (limited global advantages hypothesis). Evidence can be found in Sturm and Williams (2009,2010) in Australia, Lensink, Meesters, and Naaborg (2008), Naaborg (2007) in the European Union (EU) market, Curi et al. (2013) in Luxembourg, Berger et al. (2009) in China, and Vu and Nahm (2013) in Vietnam. In the New Zealand context, To and Tripe (2002) found that Australia-owned banks were more competitive compared with foreign banks from other nations (Netherland, Germany, the US, Japan, Korea, etc.), which is attributable to the knowledge, experience and general managerial expertise their parent banks have in the New Zealand financial market.

Organisational form has also been documented in a few foreign banks' efficiency studies (for example, Curi et al, 2012, Luxembourg; Isik and Hassan, 2002, Turkey). Evidence in Luxembourg suggests that foreign branch banks are more efficient than subsidiary banks. However, Isik and Hassan (2002) suggest that organizational forms of foreign banks do not play an important role in determining foreign banks' efficiency in Turkey's banking

[6] Berger et al. (2000) developed home field advantage hypothesis and the global advantage hypothesis. There are two forms of global advantage hypothesis: general form and limited form. Under the general form, efficiently managed foreign banks, regardless of their parent nations, can overcome disadvantage and operate efficiently in a foreign market, which has not been supported by the foreign banks' efficiency literature.

sector, both subsidiary and branch forms exhibit higher cost and profit efficiency than domestic banks.

There has been a trend that foreign banks establish a physical presence in the host country through cross-border mergers and acquisitions (M&As) to improve scale, scope, product mix or X-efficiency (Berger et al., 2000). In recent times, mergers and acquisitions among foreign banks within one single nation have become more frequent in many countries. The impact of M&As has been addressed in several foreign bank efficiency studies (Berger et al., 2000; Havrylchyk & Jurzyk, 2011; Peng & Wang, 2004) which suggest that two larger merged banks have competitive advantages in pricing thus reflecting the banks' cost efficiencies and better risk management in the local market. Liu and Tripe (2003) and Tripe (2003) support the premise that banks' efficiency gains are associated with bank merger and acquisitions in New Zealand.

Some foreign bank efficiency studies have also sought to disentangle foreign banks' managerial inefficiencies by examining the general bank-specific characteristics such as bank size (Sabi, 1988) capital requirement (Yildirim & Philippatos, 2007), asset quality (Havrylchyk, 2006) and market concentration ((Berger & Hannan, 1998; Berger & Mester, 1997; Chan, Schumacher, & Tripe, 2007). Findings are not unanimous on the impact of bank size, capital requirement and market concentration on foreign banks' efficiency levels, however, efficient foreign banks generally are found to have a lower level of non-performing loans or impaired assets (Berger & DeYoung, 1997). More importantly, these bank specific factors can be part of accounting for different risk preferences, which affect the banks' goal of cost minimization or profit maximization. If these factors are excluded in the bank efficiency assessment, then banks' efficiency can be mismeasured (Berger & Mester, 1997).

Macroeconomic factors, generally included in cross-country bank efficiency studies, are, however, neglected in the single country studies due to foreign-owned banks and domestic banks operating under identical financial environment conditions. There are only a few studies examining GDP growth per capita and interest rates as economic indicators (Louzis, Vouldis, & Metaxas, 2012; Tripe, 2003; Vu & Nahm, 2013) which produce inconsistent findings.

With regard to the measurement techniques in foreign banks' efficiency literature, frontier efficiency estimations[7] have been applied intensively. The basic framework is to identify the best practice firms as efficiency leaders to represent the technical efficiency optimal frontier, then compare the efficiency degree of other firms or groups with the optimal performance under the assumption that the firms face the same market conditions (Farrell, 1957). The two principal frontier efficiency estimation methods when measuring foreign banks efficiency are Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA), which involve mathematical programming and econometric methods, respectively. The choice of the techniques can be affected by the data sample, data availability: (in particular pricing data), the purpose of the research, and other factors (Coelli, Rao, O'Donnell, & Battese, 2005).

The **DEA** approach[8] is a linear mathematic programming method which constructs a non-parametric frontier over the data to calculate the efficiency measures relative to the frontier. Comprehensive details of the method are available in the discussion on the frontier efficiency studies by Berger and Mester (1997) and Coelli et al. (2005). The DEA method can be used when price data is not available and works well with small data samples, for example, Gaganis and Pasiouras (2009) in Greece; Sharma et al. (2013) in Fiji; Lozano-Vivas, Pastor, and Hasan (2001) in 10 small European countries; Anayiotos, Toroyan, and Vamvakidis (2010) in 14 emerging European countries, and in the New Zealand literature. This non-parametric technique typically focuses on technological optimization rather than economic optimization, and usually does not allow for random error in the data (Berger & Mester, 1997).

In contrast, the Stochastic Frontier Analysis[9] (**SFA)** approach as a parametric frontier measurement method requires assumptions to be made about the distribution of inefficiency in a functional form to reveal the relationship between inputs and outputs, thus it generally accounts for both random error and systematic difference (Berger & Mester, 1997; Coelli et al., 2005); (Kumbhakar & Wang, 2005). Berger and Humphrey

[7] According to Berger and Mester (1997) there are five common efficiency estimation techniques: data envelopment analysis (DEA), free disposable hull analysis (FDH), stochastic frontier approach(SFA), thick frontier approach (TFA) and distribution-fee approach (DFA). More discussion can be found in their study.
[8] DEA approach was originally defined by Fried, Lovell, and Schmidt (1993) and has been developed by Coelli et al. (2005).
[9] Stochastic Frontier Analysis (SFA) was originally defined by Aigner, Lovell, and Schmidt (1977), Battese and Corra (1977) and Meeusen and Van den Broeck (1977).

(1997) suggest that parametric techniques correspond well with the cost and profit efficiency concept, and the specifications of SFA function forms contain greater explanatory power to disentangle the source of banks' inefficiencies. This suggestion is also supported by some of the foreign bank efficiency studies (Chan & Karim, 2010; Isik & Hassan, 2002; Miller & Parkhe, 2002; Naaborg, 2007; Weill, 2003; Yildirim & Philippatos, 2007; Zajc, 2006).

1.3 Problem statement

To the best of our knowledge, currently, the foreign bank efficiency literature on small developed countries is scarce. It is evident from the literature that research on foreign bank efficiency has mostly been performed in large developed countries such as the US, UK and Australia, or transition and developing markets such as the EU and other countries. There are only a few studies on foreign banks' efficiency in small developed economies such as Luxembourg and New Zealand. Curi et al. (2013) examined the impact of home host characteristics on foreign banks' efficiency in Luxembourg, suggesting that home-host regulation schemes do not successfully foster banks' efficiency in Luxembourg. There are a total of six bank efficiency studies (Liu & Tripe, 2003; Tripe, 2002, 2003, 2004, 2005a, 2005b) in New Zealand, measuring both foreign banks' and domestic banks' X-efficiency.

The main findings suggest that New Zealand has an efficient banking sector. More specifically, New Zealand banks' X-efficiency has improved over time (Liu & Tripe, 2003; Tripe, 2003), however, there are no significant efficiency differences between domestically owned and Australian-owned banks in New Zealand (Tripe, 2004). The banks' efficiency gains are likely associated with mergers and acquisitions (Liu & Tripe, 2003) and interest rates (Tripe, 2003, 2005a, 2005b). It appears no studies have systematically addressed the issues of determinants of foreign banks' efficiency in the New Zealand literature**.**

The bank efficiency analyses in New Zealand literature relate only to the time period over which they were conducted (between 1989 and 2003). Since 2002, there have been significant structural changes in the New Zealand banking sector, mainly due to the newly

established domestic Kiwibank in 2002, and ANZ's acquisition of the National Bank in 2003. Thus, bank efficiency evaluation should have been promoted by addressing these changes in the competitive environment in New Zealand, particularly following the global financial crisis during 2007 and 2009 (Bloor & Hunt, 2011). Unfortunately, no empirical studies in New Zealand literature have undertaken this task.

Previous New Zealand bank efficiency studies mostly focus on estimating the efficiency of major, locally incorporated foreign banks and domestic banks between 1989 and 2003, with all large foreign-owned banks (ANZ, The National Bank, BNZ, ASB and Westpac bank) and TSB (a small regional domestic bank) included in the data sample for all six bank efficiency studies. However, the studies have neglected some specialist foreign branches that have concentrated on a particular market niche in which they have a comparative advantage in the New Zealand banking industry (Rhoades, 1998),for example, Rabobank, specialising in rural banking and Deutsche bank in investment banking. Excluding these banks in the data sample could have possibly resulted in overestimated efficiency levels for the major banks in those studies.

In addition, the techniques of efficiency measurement in the New Zealand studies are not diversified and tested, with the DEA approach the principal technique used in all existing New Zealand bank efficiency studies. This could be the result of the small bank sample size and data availability in New Zealand (Tripe, 2005b), as the DEA approach can avoid imposing specific functional forms on pricing data and bypass problems associated with price data and data heterogeneity in the New Zealand banking sector. However, the method has no control of measurement errors, which could also lead to overestimated efficiency scores (Tripe, 2003).

According to Berger and Mester (1997), estimates of bank efficiency can vary substantially across studies due to differences in data sources, efficiency concepts and measurement methods. In light of the gap in the literature, the purpose of this study is to employ a parametric frontier estimation-Stochastic Frontier Analysis approach - to extend the existing bank efficiency studies in order to seek new empirical evidence on foreign-owned banks efficiency in New Zealand.

1.4 Research objectives and questions

The New Zealand banking system is unique and an interesting environment in which to evaluate foreign-owned banks' efficiency. The objective of this study is to measure the levels of major foreign banks' efficiency in the New Zealand banking market, and to identify the determinants of bank efficiencies over the period 2002 to 2011.

The research questions are:

1. Is the Stochastic Frontier Analysis (SFA) approach an appropriate estimation technique for measuring New Zealand foreign bank efficiency?
2. Do foreign-owned and domestic-owned banks' efficiency differ in New Zealand?
3. What determines differences in foreign-owned banks' efficiency in New Zealand?

To investigate the determinants of foreign-owned banks' efficiency, New Zealand banking industry characteristics (such as bank ownership, bank origins , organisational form, market concentration) and general bank-specific characteristics (such as bank size, equity level and asset quality) are examined.

The macroeconomic conditions in New Zealand are also investigated, such as GDP growth per capita, interest rates and inflation rate. Our study also attempts to examine the impact of the unemployment rate and exchange rate on New Zealand bank efficiencies.

1.5 Importance of the study

The efficiency of financial systems can have an important bearing on a nation's economic growth and can be influenced by a broad range of factors. Financial system efficiency, however, is a complex economic concept and its measurement can be extremely challenging (Bloor & Hunt, 2011), particularly with the trend towards the increased presence of foreign-owned banks in many nations. Thus, the importance of this empirical study is to provide policymakers with an overview of the New Zealand banking system's efficiency through the lens of individual banks' efficiency. The empirical findings could also be of interest to bank management, investors and academics.

The increasing presence of foreign banks in many countries has stimulated foreign banks' efficiency studies globally. Foreign banking activities are complex by nature due to the

involvement of entities operating in two or more national financial markets and regulatory systems (Goulding & Nolle, 2012). The measurement of foreign-owned banks' efficiency is therefore of particular interest to both policy makers and academics. The distinctive feature of New Zealand's banking system (high concentration of foreign ownership, by one nation) provides a laboratory to satisfy the demand for foreign bank efficiency studies in a small developed economy, also a controlled market with high presence of foreign banks. The findings of our study are expected to contribute to the literature, particularly in small, open economies.

This is the first study employing the Stochastic Frontier Analysis (SFA) approach in estimating and analysing foreign bank cost and profit efficiency in the New Zealand banking industry. The thesis therefore contributes to the literature by using Stochastic Frontier Analysis (SFA) to study foreign banks' efficiency in a small and less diversified open economy.

This study is also the first attempt to include both Kiwibank and ANZ bank with four major foreign branches: Rabobank, Deutsche Bank, HSBC and Citibank, in the data sample. Furthermore, the study period covers the global finance crisis (GFC) period between 2007 and 2009. This is to enhance the quality of the sample data and therefore improve the quality of the results by investigating more factors such as mergers and acquisitions, market concentration and organizational form.

1.6 Organisation of the Thesis

The remainder of the thesis is organised as follows: Chapter 2 presents a succinct overview of the banking sector in New Zealand, in particular since the deregulation in 1984. Chapter 3 reviews the recent foreign banks' efficiency literature at the international level, particularly in the US, EU, Australia and New Zealand banking markets, presenting an overview of efficiency estimations, theory, and evidence of foreign banks efficiency results along with a discussion of the impact of internal and external factors on banks' efficiencies. Chapter 4 describes the frontier estimation (SFA) methodology and outlines the sample panel data used in the study. Chapters 5 and 6 present the empirical results and discussions in line with the research questions and, finally, Chapter 7 concludes the study and identifies its limitations plus some directions for future research.

Chapter 2

The New Zealand Banking Sector

2.1 Introduction

The first part of Chapter Two (sections 2.2, 2.3) reviews the key structures of the New Zealand banking system, and some significant historical background on the banking industry, including the deregulation in the 1980s, merger and acquisitions (M&As) since 1984, the disclosure regime since 1996, the global financial crisis between 2007 and 2009, and the development of the integrated market with Australia.

The second part of the chapter (sections 2.4 and 2.5) provides major banks' profiles and a look into the profitability and risk management of the New Zealand banking sector over the study period between 2002 and 2011.

2.2 Key structures of the New Zealand banking system

All banks operating in New Zealand must be registered by the Reserve Bank of New Zealand (RBNZ) to use the word "bank" in their name. The RBNZ performs both the registration and supervision functions independently under the Reserve Bank of New Zealand Act 1989. The Reserve Bank's regulatory focus is on systemic soundness and efficiency, rather than the financial health of individual banks per se (Bollard, 2004a).

The regulatory barriers to entry and exit to the New Zealand financial system are low by international standards since the deregulation in the 1980s (OECD, 2006). Banks seeking registration must meet minimum qualitative and quantitative criteria required by the RBNZ to ensure their entry to the New Zealand market is consistent with the soundness and efficiency of the financial system.

The number of the registered banks in New Zealand changes from time to time as new banks are registered and existing banks relinquish their registration in the market or are taken over by other banks and therefore deregister. Table A.1. (see Appendix A) lists a total of 26 banks registered or relinquished during the period 1987[10]to 2011 in New Zealand, including 18 foreign owned banks and 8 domestic banks. Bank registration

[10] On April 1987, Reserve Bank of New Zealand introduced the banks' registration requirement policy.

peaked at 24 in 1990, but fell to below 20 by 1994, then remained fewer than 20 until March 2011(Matthews & Rex, 2013). The relatively static number of registered banks has been largely due to the highly competitive New Zealand financial market and the costs of setting up a new banking operation given the small scale of the market (Bollard et al., 2011).

As at 31 December 2010, there were a total of 20 registered banks in New Zealand, with total assets of $380 billion, accounting for 195% of New Zealand GDP and 80% of the total financial system assets. Of the total 20 registered banks, 17 were foreign-owned banks, accounting for 89% of total banking assets in the banking system (Bollard et al., 2011). The high degree of foreign ownership by large offshore parent banks has particular implications for New Zealand banking regulatory regimes, such as the disclosure and capital adequacy requirements.

Based on the Financial Stability Report (Reserve Bank of New Zealand, 2012a) as at 31 December 2011, the highest percentage of market share[11] of foreign-owned banks in New Zealand is held by Australia (87.6%), followed by banks from the Netherlands (2.7%), the UK (1.3%), the US and Germany (0.8% each), Japan (0.6%) and South Korea (0.1%).

The big-four Australian-owned banks in New Zealand [12] have significant market shares (measured by the percentage of the total banking sector assets) in New Zealand, with 29.2% for ANZ National Bank Limited (ANZN[13]), 18.25% for Bank of New Zealand (BNZ), 17.1% for Westpac Banking Corporation, New Zealand Branch (Westpac NZ), and 16.6% for ASB Bank limited (ASB).Their parent banks are the four major domestic banks in Australia: Australia and New Zealand Banking Group (ANZ), National Australia Bank Limited (NAB), Westpac Banking Corporation (Westpac) and Commonwealth Bank of Australia (CBA) respectively. This implies that the structure of New Zealand's banking

[11] Total registered banks' assets as a proportion of the total assets of the banking system, including domestic banks but excluding the Co-operative Bank limited and Bank of Baroda (New Zealand) Limited and Bank of India (New Zealand) limited. (Reserve Bank of New Zealand: (Reserve Bank of New Zealand, 2012a)

[12] There were 'big five' banks in New Zealand before National bank was acquired by ANZ Banking Group (New Zealand) Limited in 2003.

[13] ANZ Banking Group (New Zealand) Limited amended their registered name to ANZ National Bank Limited in 2004 after the acquisition of the National Bank, and on October 2012 amended again to ANZ Bank New Zealand Limited (Reserve Bank of New Zealand, 2014a).

system is heavily dependent on developments in the Australian banking system (Rodgers, 2003).

No domestic banks have held a dominant position in any segment of the financial market in New Zealand. For example, there were only four domestic banks in New Zealand by December 2011 accounting for only 5.7% of total banking assets in 2011: Kiwibank Bank Limited (3.7%), TSB Bank Limited (1.3%) and The Southland Building Society (0.7%) (Reserve Bank of New Zealand, 2012). TSB, registered in 1987, was a regional bank with branches in certain areas only while Kiwibank, registered in 2002, operated from government owned Post Shops throughout the country. The other two new banks, The Southland Building Society (registered in 2008) and the Co-operative Bank Limited (registered in October 2011) were formerly building societies.

The dominant position of foreign-owned banks in New Zealand's banking system raises the issue of the relationship between the home and the host supervisory agencies and central banks. The RBNZ openly acknowledges the New Zealand banking system derives benefits from the home regulatory authorities of the parent banks. Foreign banks in New Zealand have, for example, access to the expertise and technology present in the foreign operations of global companies, and funding and operational support from parent banks and related parties (Chetwin, 2006). However, the RBNZ also recognizes the potential diverging and conflicting interests between home and host authorities, such as in the allocation of capital and risks across a multinational group of banks (Bollard, 2004b).

In order to be a responsible host supervisor to foreign-owned banks in New Zealand, and also maintain a sound and efficient financial system in New Zealand, the RBNZ has adopted a local incorporate policy in 2006, which requires that all systemically important foreign banks, (all of which are Australian owned) must be incorporated rather than operate as a foreign branch in New Zealand, and that foreign-owned banks in New Zealand are not to be overly reliant on parent bank or other outsources' functionality (Chetwin, 2006). After RBNZ introduced the locally incorporated policy in 2006, Westpac Banking Corporation was required to incorporate its retail banking business (as Westpac New Zealand Limited), separated from its wholesale banking business in New Zealand (Matthews & Rex, 2013).

There are three main categories of foreign-owned banks in New Zealand: large multi-purpose banks, wholesale banks and retail banks(Grimes, 1998) . The large multi-purpose banks provide a wide range of lending services to individuals, small businesses and large corporate entities, and a range of non-traditional banking products and services to corporates, with funding from both the wholesale and retail markets (for example ANZ, BNZ). The wholesale banks (Rabobank Nederland, Citibank) generally provide services to large corporates and other banks, while the retail banks (ASB, Rabobank New Zealand; Kookmin Bank) obtain funds mainly from small depositors and businesses and lend to households and small businesses.

2.3 Historical background

The New Zealand banking sector prior to deregulation in 1984 and the transformation of the banking sector thereafter are well documented in Tripe (2005b) .

This section reviews the historical background of the New Zealand banking system in terms of foreign banks' entry and activities in New Zealand, the banking industry deregulation in the 1980s, bank mergers and acquisitions in the 1990s, the disclosure regime in 1996, the impact of the global financial crisis from 2007 to 2009, and the development of New Zealand and Australia in the Trans-Tasman financial market.

2.3.1 Deregulation in the 1980s

New Zealand has a long history of foreign participation since the arrival of the earliest European settlers. The first trading bank was the Union Bank of Australia, which was established in 1840 when Britain incorporated New Zealand into its empire. The Australian colonies united in 1901 while the Union Bank, the Bank of Australasia, and Bank of New South Wales were represented in New Zealand with Australian operations but headquartered in London at the time (McKinnon, 2013). ANZ Bank is the oldest New Zealand bank, dating back to the arrival of the Union Bank in 1840 (Matthews & Rex, 2013).

Prior to the deregulation in 1984, the New Zealand banking industry was shaped by legislation, with the level of competition within the banking industry highly restricted. Regulations in interest rates, lending, foreign exchange, and segmentation of domestic financial markets limited new bank entrants into the financial industry (Walsh, 1988). For

example, the Act of Parliament 1989 virtually ruled out new bank entrants into New Zealand, and there had been no new entrants for over 30 years, since 1951(Grimes, 1998).

The legislation prior to the financial reforms in 1984 split the financial service market into different segments and restricted their products and services' boundaries. Trading banks and savings banks were the two major types of banks. Prior to 1987, the legislation required a specific Act of Parliament to establish a trading bank, which were mainly allowed to serve business clients and provide cheque accounts to individuals. Savings banks were also governed by legislation and were largely restricted to providing services to meet individual's other financial needs(Grimes, 1998). There were only four designated trading banks and some smaller savings institutions prior to 1984.

The financial reform process was completed in 1984, although the New Zealand Government started to ease the restrictions on financial institutions in 1957 (Evans, Grimes, Wilkinson, & Teece, 1996). The major reforms of 1984 include the removal of all interest rate controls and directed lending criteria; the removal of credit ceilings; the elimination of exchange controls, and the move to a floating exchange rate (Grimes, 1998). The most significant effect of the removal of those restrictions was to put financial institutions on an equal footing to compete more actively for market share, and develop, defend and retain a secure niche in the market place (Russell, 1985).

The deregulation was not intended to discriminate against particular types of institutions, however, along with pressures from the continued recession in the late 1980s and 1990s, the registered banking sector underwent substantial restructuring, involving mergers and acquisitions, withdrawals, reorientation of strategic direction, internal restructuring and cost cutting. The new operating environment thus caused some adjustment difficulties for many financial institutions, and, eventually, some of the domestic banks sought shelter in foreign ownership and converted to foreign-owned banks, while some of the existing foreign and domestic banks were acquired by other financial institutions or withdrew from the New Zealand market (To & Tripe, 2002). For example, the Post Office Savings Bank was acquired by ANZ in 1989; Trust Bank by the Westpac Banking Corporation in 1996 to form WestpacTrust and ABN Amro New Zealand (a foreign branch bank) left the

market due to changes in their international banking group's global operations strategies[14] (KPMG, 2009a).

The reforms of the 1980s were committed to achieve a more competitive and efficient financial sector and allocation of resources to those sectors which use financial services. Ultimately, a more open and competitive economy in New Zealand can respond better to external pressures (Russell, 1985).

2.3.2 Disclosure requirements since 1996

As part of an overall banking supervisory framework designed to promote a sound and efficient banking system, on 1 January 1996 the RBNZ introduced disclosure requirements for all banks operating in New Zealand to disclose their financial conditions and publish a quarterly disclosure statement. These statements are administered by the RBNZ with the objective of strengthening the market discipline for registered banks to maintain sound banking practices and to assist depositors and other investors to make well-informed decisions on where they should bank (Reserve Bank of New Zealand, 1998).

The disclosure statements take two forms: a brief Key Information Summary[15] and a more comprehensive General Disclosure Statement[16] which contains detailed information on a bank and its banking group, including credit rating information, profitability and total assets, capital adequacy, impaired assets, exposure concentration, connected lending and other information. The General Disclosure Statement is aimed principally at the professional analyst thus is subject to a full audit (Brash, 1997). There is no audit requirement for off-quarters' (the first and third quarter of a bank's financial year) statements, and the half year disclosure is subject to a lower level audit by a qualified auditor (for example, a chartered accountant) (Reserve Bank of New Zealand, 2012c). All disclosure statements are required to be readily available in New Zealand.

[14] ABN AMRO was acquired by Royal Bank of Scotland (RBS) and as part of a global review of RBS operations, ABN AMRO New Zealand relinquished its banking registration in New Zealand in favour of the RBS banking group operating from a single regional hub in Australia(KPMG, 2010a).

[15] The Key Information Summary, which is aimed at the ordinary depositor, contains a short summary of key information on a bank including credit rating, capital adequacy, peak exposure concentration, asset quality, profitability and ownership. The information must be drawn from the information contained in the General Disclosure Statement (Mortlock, 1996).

[16] Banks are also required to publish a Supplemental Disclosure Statement, containing information relating to guarantees and banks' conditions of registration, unless that information is contained in the General Disclosure Statement (Mortlock, 1996).

There are some differences in the disclosure requirement for overseas incorporated banks (foreign branch banks),as foreign branch banks are only required to comply with the disclosure requirement on the basis of the banks' operations in New Zealand and its New Zealand banking group. However, each branch bank is required to make available the most recent financial disclosure of the overseas banks' operations on the basis of the bank's publicly available disclosure in its country of incorporation. Another objective of the disclosure statement requirements by the RBNZ is to reinforce the role of directors in overseeing and taking ultimate responsibility for the prudent management of their bank. The disclosure statements must not be false or misleading (Mortlock, 1996).

All foreign banks are required by the RBNZ to disclose the name of their ultimate holding companies, the name of their parent bank and the country in which those companies are incorporated. This required information reflects that a bank's ownership plays an important role in determining the financial soundness of a bank (Reserve Bank of New Zealand, 1998).

2.3.3 Mergers and acquisitions in 1990s and 2000s.

In response to the Asian and Russian Financial crises in the late 1990s, New Zealand's banking industry was described as being in a phase of rapid consolidation. This process has been highlighted by seven major mergers and acquisitions since 1988: the acquisition of the Post Office Saving bank by Australia and New Zealand Banking Group limited in 1989; three acquisitions (Westland Bank by ASB Bank; the Rural bank by National Bank of New Zealand and the United Bank by Countrywide); one absorption of National Australia Bank (NZ) Limited in 1992; and the acquisitions of Trust Bank New Zealand by Westpac Banking Corporation in 1996, and Countrywide Bank by National Bank in 1998 (Liu & Tripe, 2003). As a result, there were 17 registered banks in 1996, of which foreign banks accounted for about 90% of the total assets of the New Zealand banking sector (KPMG, 1997).

The latest significant acquisition is The National Bank of New Zealand by ANZ Banking Group (New Zealand) Limited, acquired in 2003. The National Bank was founded in London in 1872, purchased the Rural Bank in 1994 and bought Countrywide Banking Corporation in 1998. In 2002, it ranked third in profitability behind Westpac Banking Corporation and the Bank of New Zealand (which was owned by National Australia Bank

Limited). With 4800 staff, it was ranked third largest with 169 outlets, according to a survey by KPMG (2002-2011a). The two banks retained separate banking licences and both continued to operate their individual brands until 2012, the reason for remaining separate entities being to ensure that there was no movement to Australia of any functionality of The National Bank (Matthews, 2004)

The National Bank had a leading brand and market share in some key segments such as consumer mortgages, small to medium business and rural markets, thus the ANZ's acquisition of the National Bank has complemented ANZ Group's strong position in the corporate market (KPMG, 2004). It also enhanced the geographic coverage of ANZ Group in New Zealand through the National Bank's extensive nationwide branch network.

The acquisition has also created ANZ National Bank New Zealand Limited, (ANZ NZ) the largest banking group in New Zealand, which held 34% of the total assets of the New Zealand banking sector, followed by Westpac 20%, BNZ 18% and ASB Bank 11% in 2003 (Matthews, 2004). Another effect of the merger was to increase the concentration of Australian-owned banks operating in New Zealand, with 87% of total banking system assets held by them as at 31 December 2003 (Reserve Bank of New Zealand, 2004a).

2.3.4 Global Financial Crisis in New Zealand (2007-2009)

New Zealand has not experienced systemic bank problems since the 1980s, despite occasions of serious bank distress in the late 1990s[17] (Brash, 1997). Recently, between 2007 and 2009, the New Zealand banking system has been significantly tested by the global financial crisis (GFC) and the slowdown of the domestic economy in New Zealand[18] .

Unlike the cases in many other countries, however, especially small developed countries where banks dominated the financial system such as Ireland, Switzerland, and Singapore, the New Zealand banking system remained relatively resilient over the crisis period (Bollard et al., 2011). The registered banks sector recorded an increase in performance of 5.1% in 2008, despite an increase in impaired asset expense (KPMG, 2009b). The

[17] For example, the Bank of New Zealand (government-owned at the time) had to be recapitalised by the New Zealand Government and its parent in Scotland from 1989 to 1990, to avoid a severely adverse impact on the country's economy and financial system (Brash, 1997).
[18] The impact of the global financial crisis in New Zealand between 2007and 2009 is more associated with finance company collapses than with the registered banking sector (Chiang & Prescott, 2010).

conservative application of the regulatory capital regime assured the level of banks' capital was sufficient to absorb the rise in impaired assets.

The RBNZ uses several different approaches to promote New Zealand's financial system's stability, such as relying less on direct regulation and more on the use of market discipline, and improving the internal governance of individual banks in New Zealand. In times of potentially damaging financial stress, regulation has to harness market forces to maintain a sound and efficient financial system.

The RBNZ and New Zealand Government actively monitored the financial market conditions and took a number of steps to provide increased liquidity to the banks during the period between 2007 and 2009. At the height of the international uncertainty regarding the stability of banks worldwide, in October 2008, following other countries such as Ireland, the UK, the US, and also Australia, the New Zealand Government announced the introduction of deposit guarantee schemes to guarantee the safety of bank depositors' funds.

The wholesale guarantee scheme was also set up on 14 November 2008 (closed on 30 April 2010) to help banks in New Zealand to access offshore funding resources during the liquidity crisis. There were a total of 22 whole guarantee certificates issued, however, none has been redeemed. This may reflect that the banks in New Zealand stood up well during the global financial crisis period. The four systemically important Australian-owned banks were able to utilise their Australian parent banks' government deposit guarantees to access offshore term funding (Bollard et al., 2011).

During the global financial crisis period, the RBNZ also rapidly reduced the official cash rate (OCR) by 525 base points (5.25%), and interest rates were significantly reduced from 8.25% to a low of 3% maintained since July 2008.

2.3.5 Development of an Integrated Market with Australia

Given the significant presence of Australian banks operating within New Zealand's financial system, there have always been efforts between the two countries to work together towards an effective integration of trans-Tasman banking regulation and supervision.

The process of integration between New Zealand and Australia, formerly referred to as Closer Economic Relations (CER), was inaugurated in 1983 before major reforms began in New Zealand in 1984. CER is a series of agreements and arrangements with the objective of expanding free trade by eliminating barriers to trade and promoting fair competition between New Zealand and Australia.

Since 1990, both countries have moved progressively towards much deeper cooperation in policies, laws and regulation regimes through the process of coordination, mutual recognition and harmonisation (Ministry of Foreign Affaris and Trade, 2013) . The Trans-Tasman Mutual Recognition Agreement (TTMRA) of 1998 is the key driver in the integrated Trans-Tasman market for the sale of goods and the registration of occupations, lowering compliance costs for business and reducing technical barriers to trade, and has contributed significantly to increasing the Trans-Tasman mobility of goods and labour (Conway, Meehan, & Zheng, 2012).

In the banking sector also efforts were made, with longstanding bilateral support for improving the degree of cooperation between the systems in New Zealand and Australia (ANZ, 2012). These included areas such as taxation (e.g. mutual recognition of franking and imputation credits, capital and withholding tax reform), prudential standards (e.g. Basel Committee on Banking Supervision), crisis management and bank resolution (alignment of bank resolution schemes such as deposit insurance), transaction banking (seamless transaction banking) and super portability (movement of retirement savings accounts across the Tasman).

The successful implementation of prudential standards in capital requirements by RBNZ generally required liaising with the Australian Prudential Regulation Authority (APRA) (Orr, 2010). For example, RBNZ and APRA worked closely to smooth the implementation of Basel II for Australian-owned banks in New Zealand. The development of the Terms of Engagement (ToE) in 2005, in particular, recognises APRA's rights as the home supervisory for Australian banking groups and RBNZ's rights as the host supervisory for Australian-owned incorporated banks in New Zealand when setting up minimum levels of capital requirement. The ToE optimises the use of supervisory resources and reduces compliance costs, aiming to enhance the efficiency of the RBNZ and APRA by sharing

information and assessments for the purpose of supervisory review (Yeh, Twaddle, & Frith, 2005).

Despite the integration between the two countries, there has still been a high level of interdependency between the two countries' financial systems. For example, Australia and New Zealand have taken different approaches to ensure the banking system in each country continues to operate in the event of a bank failure. The Reserve Bank of New Zealand (2004a) requires local incorporation of large foreign-owned banks and the development of an outsourcing policy in a crisis, while the Australian framework emphasises intensive supervision by the APRA and deposit insurance regimes (IMF, 2012).

In early 2004, the New Zealand Minister of Finance and the Australian Treasurer proposed working towards closer integration in Trans-Tasman banking regulation and supervision with the so call enhanced home-host model[19]. However, the assessment of the effectiveness of domestic regulation and the cost and benefit of further integration. This reflects that there is still a need to further develop existing working arrangements, mutual recognition and harmonisation of prudential regulation, and achieve greater co-ordination in financial crisis management, while retaining separate regulatory frameworks (Reserve Bank of New Zealand, 2004b).

The establishment of the Trans-Tasman Council on Banking Supervision in February 2005 allows the two countries' regulatory frameworks and regulators to operate with fewer points of potential friction, so as to avoid disruption in the financial stability of either country.

2.4 Major Banks' Profiles

Table 2.1 lists a total of 20 registered banks in New Zealand over the period 2002-2011 (Reserve Bank of New Zealand, 2014a).

[19] The key elements of enhanced home-host supervision are reciprocal undertakings in relation to information sharing; adopting a consultative approach to the development of new regulations; aligning New Zealand policy with Australian policy on financial crisis management and open banking solutions, where relevant, and forming arrangements and understandings for responding to crisis events (Reserve Bank of New Zealand, 2004b).

Table 2.1: Registered Banks: 2002-2011

Foreign-owned Banks	Details	
Locally incorporated banks	**Registered**	**Ownership**
ANZ National Bank Limited	2004	Australia
(ANZ Banking Group (New Zealand) Limited)[b]	1987	Australia
Bank of New Zealand	1987	Australia
ASB Bank Limited	1989	Australia
Westpac New Zealand Limited	2006	Australia
Branches of overseas-incorporated banks		
Westpac Banking Corporation	1987	Australia
The Hongkong and Shanghai Banking Corporation Limited	1987	The UK
Citibank N.A	1987	The US
Deutsche Bank A G	1996	Germany
Kookmin Bank	1997	Korean
Rabobank Nederland	1996	Netherland
Rabobank New Zealand Limited	1999	Netherland
The bank of Tokyo-Mitsubishi (UFJ), Ltd	2004	Japan
JP Morgan Chase Bank NA	2007	The US
Baroda (New Zealand) Limited	2009	India
Commonwealth Bank of Australia	2000	Australia
BOI (New Zealand) Limited	2011	India
Domestic-owned Banks		
TSB Bank Limited	1989	
Kiwibank Limited	2001	
The Co-operative Bank of New Zealand	2011	
Southland Building Society	2008	

Sources: Reserve Bank of New Zealand

Notes:
a. Banks locally incorporated in New Zealand all have 100% of foreign ownership by 2011

b: ANZ Banking (New Zealand) Group Limited was amended to ANZ National Bank Limited after the acquisition of the National Bank in 2003.

c: In November 2006, Westpac New Zealand Limited was registered to separate the retail business of Westpac Banking Corporation New Zealand branch and incorporate it to Westpac New Zealand Limited.

For the purpose of this study[20], we provide profiles for the banks[21]which were in continuous operation over the study period between 2001 and 2011[22].

They are the four systematically important Australian-owned banks (ANZ National Bank, BNZ, ASB and Westpac as a branch), four major foreign branch banks (Citibank, Deutsche Bank, Rabobank Nederland and HSBC), and two major domestic banks (Kiwibank and TSB Bank). In addition, we include the ANZ Banking Group (NZ) Limited and The National Bank due to the involvement of the ANZ's acquisition of the National Bank. Rabobank New Zealand Limited and Westpac New Zealand Limited are also discussed in the profile of their consolidated group (Rabobank Nederland and Westpac branch) in New Zealand.

Table A.2 in Appendix A summarises the reviews of the New Zealand banking industry between 2002 and 2011 to provide readers a better understanding of the performance of the industry.

The profiles of the major banks which operated in New Zealand over the period 2002-2011 are summarised below based on information from the Financial Institutions Performance Survey Reviews by KPMG (2002-2011a), the Reserve Bank of New Zealand website (www.rbnz.govt.nz), individual banks' websites, and Matthews and Rex (2013):

Foreign banks' profiles:

ANZ Banking Group (New Zealand) Limited (ANZ NZ): The fourth largest banking group in New Zealand by total assets prior to acquisition of the National Bank in 2003. ANZ acquired Post Bank from the New Zealand government in 1989 and operated it for five years before amalgamating the legal entity into ANZ Bank in 1994, then acquired EFTPOS New Zealand Limited during 2000. ANZ has a significant market share in funds management and business banking.

[20] The banks not listed here are either those with a small market share or newly established. Price data is not available for our study. The four banks with small market shares as at 31 December 2011 were: CBA branch, 1.5%, Kookmin Bank, 0.1%, JPMorgan Chase Bank, 0.3% and the Bank of Tokyo-Mitsubishi, 0.6%). The 4 newly established foreign banks are Bank of Baroda (New Zealand) Limited and Bank of India (New Zealand) Limited, while domestic banks are Southern Building Society (SBS, registered in 2008), and the Co-operative Bank Limited which registered on 26 October 2011 (Reserve Bank of New Zealand, 2012a).

[21] For complete bank profiles, see (Matthews & Rex, 2013) and (KPMG, 2002-2011a).

[22] Table A.1 in Appendix A provide the list of banks registered in 1987 but relinquished before 2011.

ANZ National Bank Limited (ANZN). In December 2003, the ANZ Banking Group (New Zealand) Limited acquired the National Bank from Lloyds TSB Group PLC, and became the largest banking group in New Zealand in terms of total assets. The two banks operated for a further 10 years as separate brands until 2013. There has been increasingly intense competition across both wholesale and retail banking since 2003, when ANZ acquired the National Bank.

The National Bank of New Zealand Limited (NBNZ): Founded in London in 1872, The National Bank was a 100% owned subsidiary of Lloyds TSB Group PLC before being acquired by the ANZ Banking Group (New Zealand) Limited in 2003. It was recognized for its strong retail network, securities and derivatives market, funds management and wholesale banking and rural lending.

Bank of New Zealand (BNZ): BNZ was owned by the New Zealand government before being sold to the National Australia Bank in November 1992. It is one of the largest banks in total assets with significant market share in all areas, especially business banking, rural banking and credit cards.

Westpac Banking Corporation (Westpac): Westpac (Australia) is Australia's first bank, dating back to 1817, focusing on domestic markets in Australia, with some overseas operations**.** It registered with the RBNZ on 1 April 1987 as Westpac Trust, formed by the merger of Westpac and Trust Bank in 1996, and operated in New Zealand as a branch of Westpac Banking Corporation (Australia) until November 2006, when its retail business was separately incorporated as **Westpac New Zealand Limited**.

ASB Bank Limited (ASB): 100% owned by Commonwealth Bank of Australia (CBA) since October 2000 when CBA purchased the remaining of 25% share from the ASB Community Trust, ASB is stronger in the traditional Auckland market. It has undertaken expansion throughout New Zealand since the 1990s and achieved strong asset growth and profit over the last decade. ASB has been recognized as the leader in the use of technology in the banking industry.

Citibank: A registered bank since deregulation of the banking industry in 1987, it is part of Citibank's network of 100 world-wide locations. The bank's focus in New Zealand is to serve international customers in New Zealand and make the bank's international

network available to their customers, specialising in foreign exchange, derivatives, and a full range of balance sheet lending.

Deutsche Bank: Registered as a branch in New Zealand in 1996, it is not a trading bank, its activities are more in investment banking and securities trading. The bank's business strategy is to focus on the integrated delivery of high value products to a broad range of domestic and international, global, corporate, and institutional clients in New Zealand.

Rabobank: The Netherland based Rabobank is an international bank with a focus on the food and agri-business industry with a credit rating of triple "A". It registered two entities in New Zealand --- Rabobank Nederland branch (in 1996) and Rabobank New Zealand Limited (in 1999). The branch conducts corporate banking, food and agribusiness banking and structured finance activities while Rabobank New Zealand limited is responsible for the rural banking business. The disclosure statements for Rabobank Nederland are consolidated with Rabobank New Zealand Limited.

The Hong Kong and Shanghai Banking Corporation Limited (HSBC): Operates in New Zealand as a branch, wholly owned by The Hong Kong and Shanghai Banking Corporation Limited. The London-based multinational bank primarily focusses on the corporate market but has seen recent rapid growth in both commercial and personal financial service sectors. The New Zealand branch employs around 200 people on average.

Domestic banks:

TSB Bank Limited: Registered in 1989, TSB bank is the most established New Zealand owned registered bank and has marketed its services beyond its community in Taranaki to a national customer base.

Kiwibank Limited: Registered in 2001, this is a subsidiary of the Government owned New Zealand Post Limited, providing New Zealanders with a locally owned, more accessible and cheaper banking service. In the early years, Kiwibank launched a range of services with low or no fees for home loan applications, tertiary and child accounts. The bank changed the dynamics of the retail banking industry and took a price leadership position in terms of home loan and term deposits.

Notably, some of the multinational banks (MNBs) have both subsidiaries and branches operating in New Zealand. For example, Commonwealth Bank of Australia (CBA) has ASB bank as its locally incorporated subsidiary, supervised under New Zealand law, whilst also establishing a CBA branch in New Zealand, operating more freely and providing the parent bank with complete access to customers in New Zealand but remaining subject to Australian supervision. The branch bank can only run with a limited operation in New Zealand, often focusing on inter-bank activities. Foreign incorporated subsidiaries operate both in wholesale and retail markets, the same as domestic banks, and are supervised under New Zealand regulations.

2.5 Profitability and Risks (2002-2011)

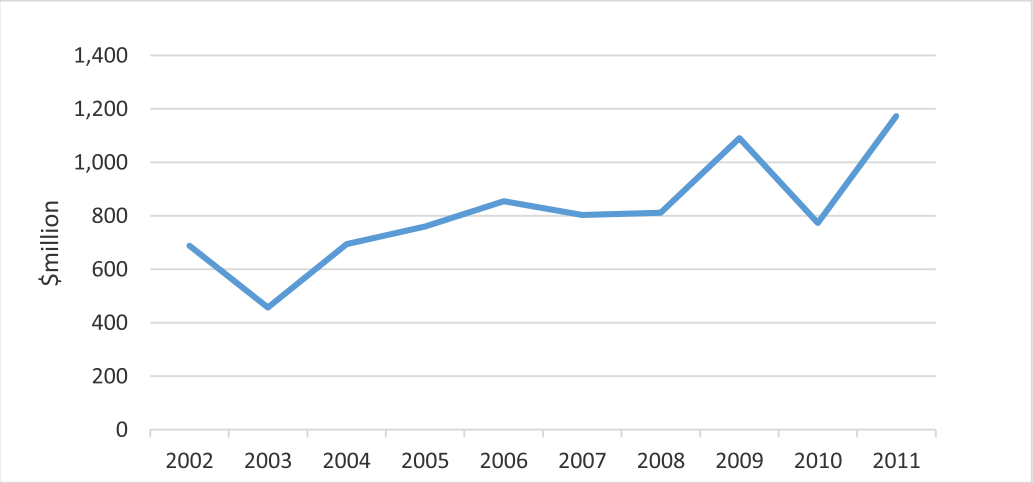
This section reviews the profitability and risk management performance of New Zealand registered banks.

The reviews are based on aggregate data from Reserve Bank of New Zealand Statistic, compiled from registered banks' disclosure statements over the period 2002-2011 and annual surveys on the performance of financial institutions in New Zealand by KPMG (2002-2011b)

2.5.1 Profitability

Figure 2.1 shows a strong movement in profitability (measured by net profit after tax) for the registered banks in New Zealand between 2002 and 2011, although down some years.

Figure 2.1 Registered Banks: Total Profit before Tax (2002-2011)



Source: Reserve Bank of New Zealand Statistic

According to KPMG (2003), the year 2002 exhibited a record 16.9% improvement in profitability for New Zealand's registered bank sector. The overall net profit after tax for the sector increased by 25.8%, equivalent to 2.2% of GDP in 2002 (Reserve Bank of New Zealand, 2004a).

Prior to the global financial crises, the four major banks contributed almost 90% of the total sector profit which reflects the variation in performance of some smaller registered banks. ANZ National, ASB and BNZ increased their profit, on average, by 16.20% compared to the 7.0% increase across the sector (KPMG, 2006).

During the global finance crisis period between 2007 and 2009, banks experienced significant falls in profit which were mainly driven by the increase in impaired assets and reduced interest margins. With liquidity support from the New Zealand government and the RZBN, there was no bank failure during the crisis period, rather a continuation of profit growth in registered banks from 2010 (KPMG, 2011).

In fact, the total profit of registered banks increased from 2.09% in 2010 to 2.20% in 2011 while the net profit after tax increased by 19.2% from $2,775 million to $3,306 million . The low interest rate environment and increased borrowing volume played their parts in the increased interest income while interest expenses increased, but to a lesser extent in a flat lending environment (KPMG, 2011).

Foreign banks clearly enjoyed an advantage and achieved high profits before tax over the study period 2002 to 2011. Domestic banks also seemed to be responding positively to foreign banks' competitive pressure, especially during the global financial crisis period, due to less dependency on off shore funding resources.

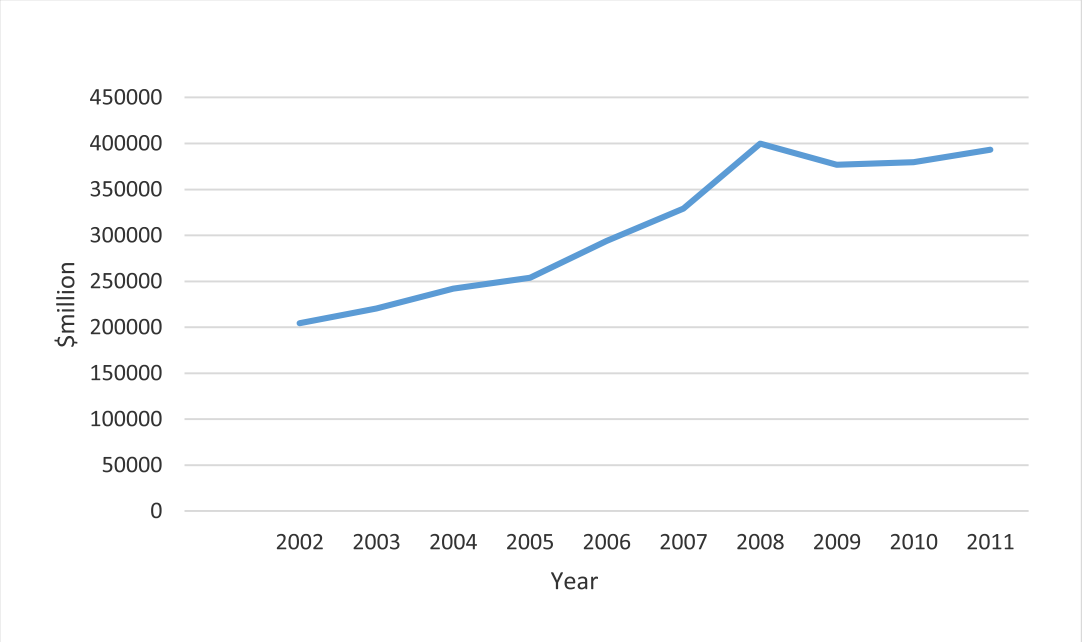
The performance of the parent banks in Australia has a direct relevance to the performance of the Australian-owned banks in New Zealand. According to the Reserve Bank of New Zealand (2004a), the financial system in Australia was in a sound condition and banks were profitable, with low levels of impaired assets and adequate capital, maintaining a credit rating of A or better.

Bollard et al. (2011) compared the performance of the New Zealand banking sector among 22 OECD countries[23] for the period 2002-2007. The return on equity (ROE) appeared to be the highest of the OECD group, and was also ahead of Australian banks. The operating costs for the New Zealand banking system were the second lowest in the sample and the loan loss provisions were also at the lower end suggesting the New Zealand banks were highly cost-efficient and profitable overall.

2.5.2 Asset quality

The increase in banks' profit can be attributed the reduction in impaired assets and the growth of net interest income and cost control. Figures 2.2 and 2.3 show the trends of the total assets of registered banks and the ratio of impaired assets to total assets of the registered banking sector, respectively, during the period 2002 to 2011.

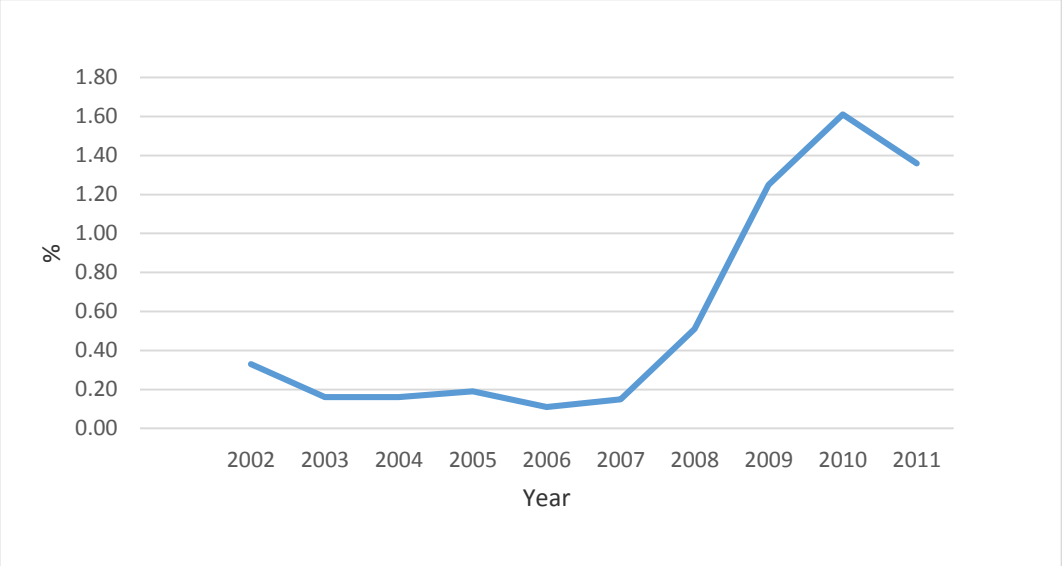
Figure 2.2 Registered Banks: Total Assets (2002-2011)



Source: Reserve Bank of New Zealand Statistic

[23] Including Japan, Germany, Switzerland, Italy, Austria, France, US, Luxembourg, Norway, Belgium,Czech,Poland,Ireland,Netherland,Mexico,Denmark,Korea,Sweden,Chile,Canada, Australia, New Zealand and Slovak Republic.

Figure 2.3 Registered Banks: Impaired Assets ratios (2002-2011)



Source: Reserve Bank of New Zealand Statistic

The trend in Figures 2.3 reflects that New Zealand major banks enjoyed a relatively flat, low, impaired asset level (between 0.11% to 0.19%) from 2003 until a significant increase in 2007, which suggests a significant reduction in banks' credit quality due to the global financial crisis (GFC) and domestic recession between 2007 and 2009. One should be aware that data on impaired assets tend to be lagging indicators of changes in credit quality while credit quality in turn can be lagging indicators of changes in the economic cycle. Therefore, banks should be alert to signs of any deterioration in asset quality and ensure that provisioning levels are adequate to the circumstances.

KPMG (2012) also reported that banks' asset quality improved and moved away from the legacy issues of the GFC in 2011, with the total banking sector impaired asset expenses decreasing by 35%. The total impaired asset expenses of average loans and advances in 2011 was 0.28%, compared to the peak of 0.7% in 2009, due to the best value recovery strategies realised and implemented by the banks. Kiwibank had the highest ratio of 0.72% among the major banks in 2011 due to the Christchurch earthquake and certain specific business lending accounts, followed by Westpac with 0.39%.

The level of impaired assets of foreign banks' branches (excluding Westpac) were, however, different from the foreign subsidiaries. For example, while the subsidiaries commanded 54% of the lending in residential mortgages in 2005, branch banks had only

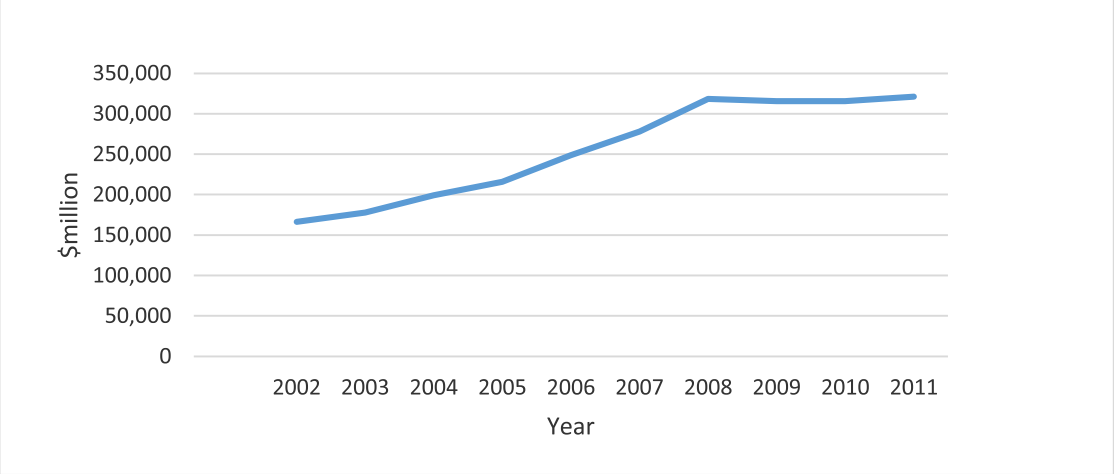
20% of their lending in the same category. This suggests that the difference could be indicative of their differing business focus. Foreign branch banks' highest concentration of lending is generally in finance, investment and insurance categories (KPMG, 2006).

When assessing the banks' asset quality, one generally focuses on the level of gross impaired assets, however the discussion should not be undertaken in isolation. Looking back to the early study period, the registered bank sector enjoyed a strong credit quality as banks were well capitalised for any economic downturn.

2.5.3 Funding and Liquidity

Figure 2.4 shows that New Zealand registered banks enjoyed growth in total interest-bearing funds over the period 2002 to 2011 despite the flat movement since 2009, post the global finance crisis.

Figure 2.4 Registered Banks: Total Interest-bearing Liabilities (2002-2011)



Source: Reserve Bank of New Zealand Statistic

In the New Zealand banking environment, there has been an argument whether foreign banks in New Zealand have relied too heavily on the international funding market. Previous studies (Tripe, 2005a; Wong, 2012) support the existence of a reliance on offshore funding by banks in New Zealand, with major banks having over 30% of their disclosed balance sheet funded from offshore, as a result of the global credit crunch resulting from the US sub-prime crisis in 2007.

The global financial crisis between 2007 and 2009 revealed the downside of a New Zealand banking system characterised by relatively low levels of liquid assets (i.e., lower

level of savings) and a heavy reliance on short term offshore funding markets (Fiennes & O'Connor-Close, 2012). However, with the liquidity support from the RBNZ and the government's wholesale funding guarantee, banks gained access to international markets and parent banks in Australia also provided funding to their subsidiaries in New Zealand supporting the New Zealand banking system's liquidity and confidence[24] (Jang & Kataoka, 2013).

Short term variable funding sources from offshore make up a large percentage of the banks' total funding in New Zealand for some of the years during the study period. For example, the major banks had over 30% of their disclosed balance sheet funded from offshore in 2007 and around 49% of the total funding was short term debt at the beginning of 2009 (KPMG, 2010b). During the global financial crisis period between 2007 and 2009, short term funding sources from international financial markets were significantly affected, banks faced liquidity risks that were much greater than the RBNZ's expectation. At the height of the crisis, in late 2008 and early 2009, the liquidity shortfall was met through special liquidity facilities at the RBNZ, additional parent bank funding, and the Deposit Guarantee Scheme on bank deposits and debt securities by the New Zealand Treasury (Spencer, 2012).

Based on the IMF's assessment, New Zealand has had lower net national savings than most other advanced countries over past decades (IMF, 2011). However, there has been a trend for banks to boost local deposits and achieve core funding ratios required by the RBNZ core funding policies (70% set in 2011) through savings and investment competition. As a result, the total customers deposits disclosed in the year 2011 for the registered banking sector increased by about 5.4% (Reserve Bank of New Zealand, 2012a).

2.5.4 Capital adequacy

The RBNZ exercises its banking regulation responsibility for the purpose of promoting the soundness and efficiency of New Zealand's financial system and avoiding any bank failure that could damage it. One of the key regulatory tools used by the RBNZ to achieve their objectives is to specify the minimum capital requirements for locally-incorporated

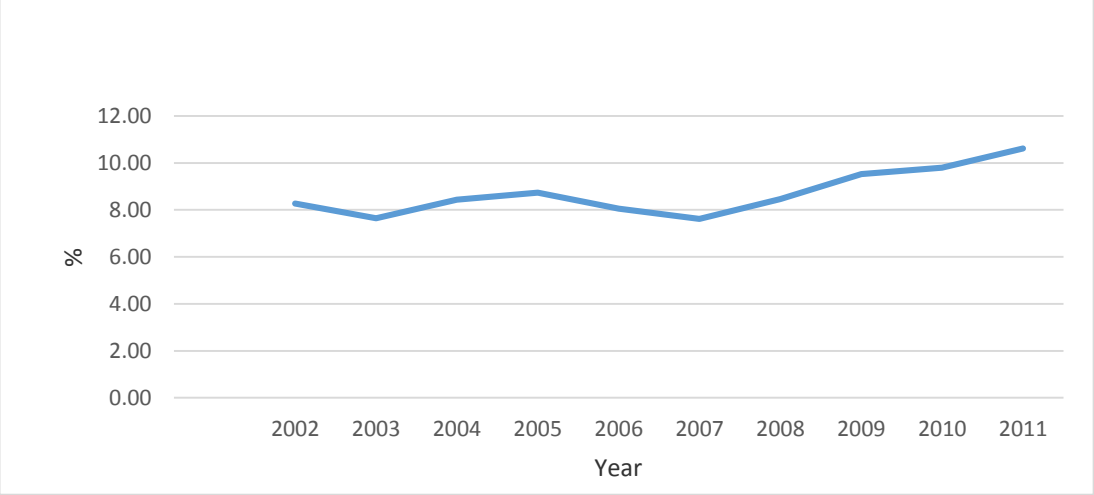
[24] For more detailed information on the liquidity measures see (Cassino & Yao, 2011)

banks (foreign-owned and domestic-owned) in New Zealand. Branches of overseas incorporated banks are not required to maintain capital in New Zealand.

Capital serves as a buffer against banks' unexpected losses and as a basis for their medium-term growth (Yeh et al., 2005). The challenge for banks and regulators is determining an appropriate amount of capital to be held to absorb unexpected losses in the event of bank' failure. Like many other countries (such as Australia, the US), Basel I had been applicable as a capital adequacy requirement in New Zealand from 1988 (until Basel II was introduced in 2008). Basel I designates banks' capital as Tier 1 and Tier 2, according to the banks' loss-absorbing or creditor-protecting characteristics. Tier 1 capital includes common stock and retained earnings, while Tier 2 includes subordinated debts to provide some protection to depositors in the event of bank failure. In New Zealand, all registered banks are required to maintain a minimum ratio of 4% Tier 1 capital to total risk-weighted exposures, and 8% as total capital (Tier 1 plus Tier 2 capital) to total risk-weighted exposures.

Figures 2.5 shows registered banks in New Zealand's Tier 1 ratios ranging from 7.62% to 10.61% over the period 2002 to 2011 (Reserve Bank of New Zealand, 2015a), which is above the 4% minimum Tier 1 capital ratio required by the RBNZ. It indicates the banks' own capital capacity to absorb losses while still continue their business growth. Retained earnings have the best ability to absorb unexpected losses to a certain level without a significant disruption to banks' trading (Yeh et al., 2005).

Figure 2.5 Registered Banks: Tier 1 Capital Ratios (2002-2011)



Source: Statistic, Reserve Bank of New Zealand

From 1 January 2008, Basel II was introduced as the risk-based capital requirement for banks and applies to all locally registered incorporated banks (foreign-owned and domestic owned) in New Zealand. It focuses on the conflict between home and host regulators regarding how to verify and share information and how to allocate banks' capital to account for the exposure to insolvency risks (Kane, 2007). A major development of Basel II is allowing banks to use their own models and techniques to measure the major risks they face, along with the probability of loss and the capital requirement to meet that loss (Yeh et al., 2005).

During the GFC and domestic recession period between 2007 and 2009, the capital position of New Zealand banks compared favourably to most overseas banks, which reflects the relative quality and simplicity of the New Zealand banks' assets (KPMG, 2010b). Since 2011, New Zealand banks have predominantly relied on retained profits to provide increases in capital.

The incorporated bank sector had a total capital ratio of 12.5% in 2011, with Tier 1 capital ratio increased to 10%, consistent with global trends to strengthen Tier 1 capital (KPMG, 2011). The major domestic bank, TSB bank, exhibited the highest total capital ratio of 15.8% while retaining a sizeable portion of its profit, which essentially reflects the domestic ownership model of the bank requiring higher capital in the event of a crisis due to the difficulties in raising capital in a crisis compared with foreign-owned banks. However, Kiwibanks' capital ratios decreased significantly in 2011, possibly driven by the increase in risk weighted exposure, primarily through the increase in lending without any assurance of further capital (KPMG, 2011)

Basel III was released by the Basel Committee in late 2010 and incorporates lessons learned from the GFC. It was implemented by international banking authorities and focused on quality of banks capital, consequently, from 1 January 2013, all locally incorporated registered banks in New Zealand are required to comply with the new framework of a common Equity Tier 1 capital ratio of 4.5%, a Tier 1 capital ratio of 6% and a total capital of 8% [25] (Reserve Bank of New Zealand, 2013).

[25] Reserve Bank of New Zealand (2013) provides the regulatory impact assessment of Basel III capital requirements in New Zealand.

2.6 Conclusion

Despite the highly concentrated foreign ownership in the banking system, particularly by one nation Australia, developments in prudential banking regulation and supervision have made the Reserve Bank of New Zealand a responsible host supervisor for foreign-owned banks in New Zealand, and contributed to a well-functioning, sound and efficient New Zealand banking system.

This is reflected in the registered banking sector recording a strong underlying performance despite the distortion during the global financial crises (GFC) and domestic recession in New Zealand from 2007 to 2009. This strong performance has been attributable to the strong asset growth overall, low level of impaired assets, and increased risk management. Although individual banks displayed different levels of financial performance, asset quality and capitalisation over the period, none of the banks breached the prudential limits imposed by the RBNZ over the years (Bollard et al., 2011).

Chapter 3
Literature Review

3.1 Introduction

This chapter reviews the literature on foreign bank efficiency, both at the international level and in New Zealand.

Section 3.2 provides an overview of the underlying efficiency framework and frontier efficiency measurement techniques in the banking industry. In order to understand the features of foreign banking activities, Section 3.3 reviews the motivations of foreign bank entry, the choices of the entry mode, foreign banks' organizational forms and the impact of foreign bank activities on the host country's financial system.

Section 3.4 provides empirical comparisons of foreign banks' efficiency relative to domestically owned counterparts in developing (including transition economies) and developed countries (including New Zealand). Finally, Section 3.5 discusses the determinants of foreign-owned banks' efficiency, such as bank ownership, market characteristics, bank regulations and the macro environmental conditions in host countries.

3.2 Overview of Bank Efficiency Measurement

In this section, the theoretical background and existing literature on bank efficiency measurement is presented. Theoretical reviews of efficiency measurement approaches focus on two main streams of frontier efficiency estimations in the banking industry: non-parametric and parametric approaches. According to Berger and Mester (1997), estimates of bank efficiency often vary substantially across studies according to the efficiency concepts and measurement techniques used.

3.2.1 Concept of Bank Efficiency

The standard definitions of efficiency used in the bank efficiency literature include economies of scale and scope and X-efficiency, which consists of technical efficiency, allocative efficiency, and economic efficiency with respect to banks' objectives of maximising profit and minimising costs.

Economies of scale refer to how the banks' scale of operations (size) is related to cost while economies of scope refer to how the banks' choice of product mix is related to cost. X-efficiency measures how well bank management aligns technology, human resources management and other resources to produce given levels of output; it gauges the degree of friction and waste in the production process (Berger, Hunter, & Timme, 1993). Scale and scope economies and X-efficiency are different aspects of performance, with scale economies and scope economies referring to selecting the appropriate outputs, while X-efficiency refers to selecting the appropriate inputs (Mester, 2003).

X-efficiency has two components: technical and allocative efficiency. Technical efficiency refers to a firm operating below the production frontier due to unmeasured factors ("X" inefficiency), such as managerial or motivational issues. Different from technical efficiency, allocative efficiency measures how optimally mixed inputs minimise total input costs at given output quantity and input prices (Berger et al., 1993).

To achieve technical efficiency, a firm must seek the minimum combination of inputs to produce given outputs or the maximum combination of outputs obtainable from given inputs. From an economic perspective, a firm's economic objective is cost minimization and profit maximization. Cost minimization requires technical and allocative efficiency to avoid excessive input use and a non-optimal input mix, while profit maximization also requires both, as well as operating at a right scale to achieve these efficiencies (Kumbhakar & Lovell, 2003). The production of a given output is economically efficient if there are no other ways of producing the output that use a smaller amount of inputs (Pearson Education Canada Inc., 2005).

Berger and Mester (1997) considered the most important economic efficiency concepts cost and profit efficiencies. The authors believed these concepts "have the best economic foundation for analysing efficiency of financial institutions because they are based on economic optimization in reaction to market prices and competition rather than being based solely on the use of technology" (Berger & Mester, 1997, p. 898).

Cost efficiency measures how close a bank's cost is to what a best practice bank's cost should be to produce the same output using the same input. It is derived from a cost function in which the cost variables depend on the prices of variable inputs, the quantities

of variable outputs, any fixed inputs or outputs, and macro environmental factors (Mester, 2003).

Profit efficiency estimation is only possible if input and output prices are available. Profit efficiency measures the extent to which a firm's profit falls below the profit of the best-practice firms. It incorporates cost X-efficiency, scale and scope efficiency. Analysing profit efficiency contributes more important sources of information on the revenue side, thus, cost and profit efficiency evaluated together can achieve a comprehensive assessment of a bank's efficiency (Maudos, Pastor, Pérez, & Quesada, 2002).

3.2.2 Intermediation Approach

Once the efficiency concept is established, judgement has to be used to define the appropriate inputs and outputs for the frontier specifications.There are two main approaches favoured in the bank efficiency literature: the intermediation approach and the production approach.

The production approach focuses on the bank's operating costs, for example, the cost of labour and physical capital. The bank's outputs are measured by the types of loans, mortgages, deposits and other operating costs (Mester, 2003).

The intermediation approach regards the banking sector as providing financial intermediation and economic acceleration by converting deposits into productive investment. This approach views banks as the main channels of savings and allocation of credit in an economy. Under the intermediation approach, banks employ inputs such as labour, equity and deposit funds to produce outputs such as loans and other earning assets and the objective of the bank is to implement the transfer process efficiently with outputs maximised and/or inputs minimised (Sealey & Lindley, 1977). If the bank is efficient, it should exhibit profitability improvements, increase in volume of funds flowing from depositors to borrowers and improvement in the quality of service to customers (Sufian & Habibullah, 2012).

3.2.3 Accounting Efficiency Measurement

In the bank efficiency literature, accounting ratios are widely used by banks to measure bank performance and efficiency, as the information can be obtained from the banks' financial statements. Standard financial efficiency ratios commonly measure operating costs against total assets, the return on equity or assets, and operating costs compared to operating income, which are also most widely used to compare the bank's operating efficiency (Tripe, 2003). These simple financial indicators of banks' operating performance have been used in several foreign banks' efficiency studies (Hess & Francis, 2004; Tahir, Bakar, & Haron, 2010; Tripe, 2003), and Tahir et al. (2010) found that the smaller the cost the more efficient the bank is in terms of operating cost ratios. In most of the studies, accounting ratios are generally used as robustness checks against the frontier efficiency scores.

There are, however, arguments concerning the limitations in solely using financial ratios for bank efficiency analysis. According to Berger et al. (1993), financial ratios do not control product mix or input prices, and cost to assets ratios assume that all assets are equally costly to produce and all locations have equal costs of doing business, thus could be misleading when measuring banks' performances. The use of these simple accounting ratios cannot distinguish between X-efficiency gains and scale and scope efficiency (Tahir et al., 2010),

Performance related pay, and option values for lead executives and managers, may also drive up the accounting measure of costs, together with the firm's income, hence affect the efficiency ratio, which could further mislead the efficiency analysis.

3.2.4 Frontier Efficiency Estimation

Recent academic research on bank efficiency has predominately focused on frontier efficiency. Frontier measurement is an objectively determined quantitative measure which uses programing or statistical techniques to remove the effects of endogenous and exogenous factors affecting the standard financial performance ratios (Bauer, Berger, Ferrier, & Humphrey, 1998).

Farrell (1957) explains that the basic framework for measuring efficiency by the frontier method is to identify the best practice bank as the efficiency leader to represent the technical efficiency frontier, then compare the efficiency degree of other firms or groups with the optimal performance, assuming the bank faces the same market conditions (Bauer et al., 1998; Von Furstenberg, 2008) . Berger and Humphrey (1997) describe the frontier efficiency analysis as essentially a sophisticated way to benchmark the relative performance of production units" within the financial industry. It provides an overall, objectively determined, numerical efficiency value and ranking of financial institutions, which is not otherwise available. Thus, frontier efficiency analysis can be used by bank managers to improve their managerial performance by identifying the "best practise" and "worst practise" banks associated with high and low efficiency measurements, respectively.

Overall, there are two main streams of frontier approach employed in the empirical literature; non-parametric (or programing) and parametric (or econometric). Fried et al. (1993) identified the two essential differences between them. First, the programming approach is deterministic, with a combination of noise and inefficiency, whereas the econometric approach is stochastic, attempting to distinguish the effects of noise from the effects of inefficiency. Second, the nonparametric approach is less prone to specification error while the econometric approach is parametric, confounding the effects of misspecification of the functional form.

The large variations in banking data necessitates the application of frontier analysis in a number of bank efficiency studies, despite there being no consensus on the best method for estimating bank efficiency. Berger and Humphrey (1997) surveyed 130 previous studies on efficiency and identified the five most common estimation techniques : Data Envelopment Analysis (DEA) and Free Disposable Hull analysis (FDH), which are nonparametric techniques, and the Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and Distribution Free Approach (DFA) being the parametric methods.

3.2.4.1 Non-Parametric Approaches

The non-parametric frontier approach employs mathematical programming techniques to estimate efficiency scores with the two main nonparametric frontier approaches, Data Envelopment Analysis and Free Disposable Hull (FDH), as previously stated. DEA is a

linear programming model introduced by Charnes, Cooper, and Rhodes (1978) and extended by and Banker, Charnes, and Cooper (1984). The technique envelopes observed production possibilities to obtain an empirical frontier and measures efficiency as the distance to the frontier (Ruggiero, 2007). FDH is a special form of DEA, where the points on the lines connecting the DEA vertices are excluded from the frontier. Both approaches permit efficiency to vary over time and make no prior assumptions regarding the form of the distribution of inefficiencies across observations.

DEA has been extensively used to examine banks' X-efficiency (in particular, technical efficiency) and scale efficiency. The objective of DEA is to measure the relative efficiency among similar units that share the same technology for similar goals using similar resources (Toby, 2006). The primary advantages of the DEA approach, according to Ruggiero (2007) and (Tripe, 2005a, 2005b), are the nonparametric nature of the method and the ability to handle multiple outputs and inputs. It also has the advantage of being computationally simple as it does not require assumption of a particular functional form of relationship between outputs and inputs. In addition, DEA generally works well with small samples.

The main drawback of the DEA method is that it assumes no random fluctuations, so that all deviations from the estimated frontier represent inefficiency (Rangan, Grabowski, Aly, & Pasurka, 1988). This could lead to two biased results with either the unit under analysis biased relative to the frontier or the frontier biased upwards because of measurement error (Ruggiero, 2004).

DEA efficiency studies generally use a two-steps approach to obtain efficiency estimates then regress the efficiency scores on a number of explanatory variables using popular regression models such as Tobit or Ordinary Least Squares (OLS). However, the second step regression correlates with one side of the error term in the first-step, and the covariates in the second-step are likely to correlate with that of the first step. This means the errors and covariates in the first-step cannot be independent and generally require further complex methods to overcome the drawbacks discussed above. Furthermore, most of them do not examine the determinants of efficiency (Duygun-Fethi & Pasiouras, 2009).

3.2.4.2 Parametric Approaches

Parametric approaches, as alternative frontier estimation methods, can be dated back to Aigner et al. (1977) and Meeusen and Van den Broeck (1977). This approach assumes a given functional form for the relationship between outputs and inputs where, in a specified functional form, unknown parameters are estimated using econometric techniques. There are several parametric frontier approaches, including the Stochastic Frontier Approach (SFA), Thick Frontier Approach and Distribution Free Approach.

The SFA approach employs econometric techniques to estimate efficiency scores by allowing an error term with two components: a normally distributed random effects component and an asymmetrically (typically half-normally) distributed technical inefficiency component, estimated via maximum likelihood. This approach has a purported advantage of having the ability to measure efficiency in the presence of statistical noise (Coelli et al, 2005). Further reviews on SFA are provided in the data and methodology chapter.

Berger (1993) developed a "distribution free" approach (DFA) to separate efficiencies from random error in a different way when panel data are available. It assumes an average efficiency for each firm which is constant over time, while the random error tends to average out over time. Although DFA is less dependent on a priori distributional assumption than SFA, it relies on the strong assumption that the firm's X-efficiencies are constant over time, and if there are changes in the X-efficiencies, then one can only predict the firm's average inefficiency over the past (Wagenvoort & Schure, 1999).

Berger and Humphrey (1991) consider another "distribution free" way to estimate cost frontiers using panel data, the so called 'Thick Frontier" approach. The TFA does not assume a precise cost or production frontier edge, instead, it sorts the data in arbitrarily selected groups of firms (i.e., instead of quartiles other quantiles can be chosen), then estimates a "thick-frontier" cost function for two frontiers, one with the lowest average and one with the highest average quartiles, with inefficiency then measured as the difference between the upper and lower frontier.

Comparisons of the above parametric methods and DEA, a non-parametric method, can be found in a number of studies (Bauer et al., 1998; Berger & Mester, 1997); Ferrier and Lovell (1990); (Hasan & Hunter, 1996) and, more recently, Coelli et al. (2005).

There are some common functional forms used in the above approaches, as summarised by (Coelli et al., 2005, p. 211): the linear, Cobb-Douglas, normalised quadratic and translog functional forms. Among these forms, the second order translog function, is more flexible, thus usually preferred, although it could face econometric difficulties due to the possibility of excessive parameters being estimated in the function.

Panel data, a time series of information for a cross-section of firms in the market, are commonly used in studies that are interested in investigating the efficiency of each firm using either non-parametric or parametric frontier analysis. Under the general framework of parametric frontier efficiency analysis, efficiency is essentially a measurement of the distance between the estimated frontier and the observed firms, which, in most situations, is captured by a residual. With panel data, the residuals of each firm are available, which allows the testing of structural hypotheses on the efficiency or statistical significance of the efficiency of each firm (Kneip & Simar, 1996).

It is widely accepted that comparisons of bank efficiency should be between banks undertaking similar activities, producing the same outputs and service quality, and operating in a similar environment, so that a common frontier can be defined for a meaningful comparison. However, different expertise and strategic objectives between foreign and domestic banks, and subsidiaries and foreign branches, can lead to differences in product lines, which can distort the definition of the common frontier. Without a common frontier or benchmark, it is difficult to compare the efficiency level and ranking in a frontier efficiency analysis, in either parametric or non-parametric methods (Bos, Koetter, Kolari, & Kool, 2009) . Thus, using a common frontier, controlling for systematic differences due to the data heterogeneity across the banks, has been favoured by some studies (Bos et al., 2009; Cavallo & Rossi, 2002; Valverde, Humphrey, & del Paso, 2007). If the sample data does not fully capture the heterogeneity in bank inputs and outputs, unmeasured differences in product quality could lead to incorrect measures of the bank's efficiency (Berger & Mester, 1997).

3.3 Foreign-Owned Banks Activities

A foreign-owned bank is defined as a bank in which more than 50% of the shares is owned by non-domestic residents (Lensink et al., 2008). This is different from the concept of "multinational" and "international" although the terms are often used interchangeably. Foreign-owned banks establish their physical presence in the host country with different motivations, which partially affect their choice of entry mode and their organizational form.

Claessens and van Horen (2012) documented a sharp increase in foreign bank ownership worldwide over the period 1995 to 2009. Barriers among products and between markets have been rapidly reduced through the channels of new technologies and distribution while consolidations are in progress globally, such as the European Union single market, the Trans-Tasman market between Australia and New Zealand, and others in the Latin American common market . International deregulation and harmonization of the financial sector has led to a rise in foreign banking since the 1980s. Bilateral factors such as distance, trade linkage and institutional similarity between home-host countries have also contributed significantly to the development of the integrated global and national market (Claessens & Van Horen, 2008).

3.3.1 Motivations of Foreign Banking

There are a number of studies examining the motivations of banks going abroad, with Naaborg (2007) identifying three main motives The first motive is known as the defensive expansion theory (Grubel, 2014) or the follow the customers approach (Walter & Murray, 1988), which states that banks expand across borders with the purpose of following clients of the same nationality in order to build or preserve an existing relationship, or to prevent losing an existing relationship, rather than generating profits in the new host locations. This motive is related to the foreign activities of non-financial firms (Naaborg, 2007).

The second motive is associated with the growth of profitability, as there is a general consensus on the reason for increased foreign bank presence where benefits outweigh the cost. Another way to interpret the same motivation is as risk diversification since foreign banks are expected to benefit from the diversification of the risk-return profile in the host market (Berger & DeYoung, 2000). The competitive pressure of a home country has been

confirmed for foreign banks entering other countries which have lower costs of capital, tax rates, higher rates of return on investment, and more access to financing with better quality of local regulation and enforcement. Multinational banks tend to establish more presence abroad to share the advantages of information technology platforms which manage their global assets and liabilities and facilitate faster flow of information internationally while also controlling the internal flow of funds thus reducing transaction costs to increase profits (Claessens, 2006).

The final foreign bank entry motive is related to the quality of the institutional environment in the host market, which can be a set of parameters including such areas as financial regulation and quality of the financial supervisory functions, law enforcement and the openness of foreign liabilities, and information cost, which mainly depends on the distance between the home and host country and the cultural similarity of both countries (Naaborg, 2007).

3.3.2 Choice of Foreign Banks Entry

Studies on the choice of foreign banks' entry generally suggest that banks can enter a foreign country through acquiring a local bank by virtue of a joint venture or via a Greenfield Investment or foreign direct investment (FDI).

The primary motivation of the Greenfield Investment is usually to follow clients of the bank abroad (Aliber, 1984), increasing the total number of banks in the local market thus inducing more competition. However, Greenfield Investment takes time and involves risks, due to the unfamiliarity with local market condition, thus more FDIs are likely to take place in countries where home and host countries are similar to each other (Berger, Dai, Ongena, & Smith, 2003).

In contrast, acquisitions involve taking a minority or majority interest in a bank in the local market, which requires internal restructuring and the transfer of staff and operational processes from the foreign parent bank, raising arguments about the advantages or disadvantages of an acquisition. When foreign entrants acquire an existing local bank, they potentially benefit from the existing customers' contacts, access to valuable practices and local market knowledge, but still need to build a reputation in the local market (Buch, 2000).

The mode of entry a foreign bank takes plays a crucial role in the foreign bank's performance and also the transmission of benefits to domestic customers(Naaborg, 2007). Empirical studies have not yielded unanimous conclusions, however, under uncertainty, a Greenfield Investment is likely to entail higher cost than an acquisition (Buch, 2000), and Fries and Taci (2005) found that acquired banks are more efficient than Greenfield banks.

When banks extend their business abroad, especially when entering into a new host country, they tend to learn more about the country and become better integrated into the host environment thus foreign barriers can be reduced and initial difficulties diminish as its legitimacy improves (Miller & Parkhe, 2002).

With regard what really matters when cross border banking activities occur in an integrating market, Lozano-Vivas et al. (2001) investigated this subject in the context of the integrated European Union market, and analysed bank's efficiency for 10 member countries. Their results indicate that foreign banks in countries with good macro-environmental conditions, such as Luxembourg, the Netherlands, Belgium and Germany, have more opportunities to perform efficiently and support national market integration as an effective way to enhance foreign banks' competition.

3.3.3 Choice of Organizational Form (Subsidiary or Branch)

There are two common organisational forms of foreign bank entry: foreign incorporated independent subsidiary or foreign branch. A subsidiary generally enters a host country as a legal entity through acquiring local financial institutions. These subsidiaries, in the host country, are subject to local capital and liquidity requirements and are highly reliant on their local operations, under the supervision of the host authority (Buch, 2000).

In contrast, foreign branch banks have low local cost structures and an ability to leverage off product developments elsewhere in the parent banking group (Naaborg, 2007). Branches can freely flow their capital and liquidity across business units and across borders under the supervision of the parent bank's authority (Buch, 2000). They are particularly strong in trade related and other international services, which remain the core activities of the bank's parent group. Foreign branch banks are generally small banks operating in the host country under the defensive expansion hypothesis, with different output mixes and specialised services (Williams, 2002).

With regard to bank lending practices, the key difference is that a subsidiary is protected by limited liabilities at the affiliate level, but is generally subject to local lending limits associated with their minimum capital requirement, while foreign branches rely on the capital of the foreign parent bank, with no local lending limits, as the capital requirement can be satisfied at the consolidated level. Parent banks are, of course, still legally responsible for the branches' liabilities (Dell'Ariccia & Marquez, 2010).

In terms of the factors which affect foreign banks' decisions on the choice of organizational forms, according to Fiechter et al. (2011), there are five incentives driving the choice of legal model between foreign branches and subsidiaries: (1) differences in regulatory arrangement applicable to branch and subsidiary; (2) tax and cost incentives. Banks tend to incorporate local business and operate as a foreign branch in host countries with higher corporate tax rates, since this would facilitate avoidance of the higher burden via profit shifting across borders; (3) macroeconomic and political risks in the host country. The greater the idiosyncratic macroeconomic risk in the host country, the more attractive a subsidiary model becomes; (4) fitting the business model to market penetration strategy. Banks adapt their incorporation strategies to their objective in entering a host market; (5) level of development of the local markets. When banks seek to penetrate a local market, they establish large and mostly in retail markets with liberal capital retail regulations and high income per capita.

However, most foreign banks nowadays operate with fairly complex activities and can run operations through a hybrid structure that includes both branches and subsidiaries in different jurisdictions to respond to differences in regulatory and tax regimes. For example, HSBC is viewed as closest to the subsidiary-based structure, but they also have branches in some countries, such as New Zealand (Fiechter et al., 2011).

3.3.4 Impact of Foreign Banks

The measurement of the impact of foreign banks on local markets generally focuses on the dimensions of efficiency, access and stability. However it appears to depend on certain conditions. Theoretically, an increase in foreign bank participation in a host country can bring competition into their domestic banking market, increase access to financial services, enhance financial and economic performance of their borrowers and generate greater financial stability (Claessens & van Horen, 2012).

The empirical literature, however, provides mixed evidence regarding the impact of foreign banks on the banking system of the host markets. Bonin, Hasan, and Wachtel (2005a), Fries and Taci (2005) and Havrylchyk and Jurzyk (2011) provide evidence that foreign banks' entry generates substantial efficiency gains to domestic commercial banks in Emerging Europe. Claessens et al. (2001) stated that lower costs and better quality of financial intermediation and lower profitability are associated with greater foreign banks' presence. Furthermore, foreign banks introduce new and diverse products, greater use of technologies, know-how spillovers, and human capital to the domestic banking system, while also contributing to its greater efficiency.

In terms of the effect of foreign banks' entry on access to credit, empirical evidence from Clarke, Cull, and Peria (2006) suggests that foreign banks' entry improved access to credit for all borrowers (small and medium-size enterprises) in the host countries. Large banks might be more likely to expand abroad, and generally have the technological advances in credit scorning, coupled with greater computer power and data availability, thus, larger foreign banks appear to make greater efforts to provide financial services to both small and medium-sized enterprises, while smaller banks are more niche players (Beck, Demirguc-Kunt, & Maksimovic, 2004). However, foreign banks may simply be more efficient because they "cherry pick" the best customers, or use techniques that rely on hard information, and leave the difficult clients to domestic banks, especially in low-income countries (De Haas, 2014).

It is also suggested that foreign banks can be a stabilising influence before or during financial crises, as they tend to have access to a more diversified (international) pool of liquidity than domestic banks. In the case of external funds drying up, foreign banks may still have access to financial support from their parent banks. Foreign banks entering into host countries are also likely to pressure local governments to improve regulation and supervision, increase transparency and catalyse domestic reform, thus enhancing the financial stability of the host country (Levine, 1996).

3.4 Reviews of Recent Studies on Foreign Banks' Efficiency

The foreign bank efficiency literature focuses on comparing the efficiency of foreign-owned banks versus domestically owned banks. What follows is a review of 65 recent bank efficiency studies, which address the effects of foreign ownership, summarised and

categorised, for better understanding, into five panels (see Table B.1-B.7 in Appendix B): the US (Table B.1), The European market, including cross-country studies (Tables B.2) and studies in single nations (Tables B.3), Australia (Table B.4), other cross-country (Table B.5) and singal-country studies (Table B.6) and New Zealand (Table B.7).

3.4.1 Evidence in the U.S Banking Market

Foreign banks' activities in the US increased dramatically in the 1970s, for several possible reasons: foreign business entry into the US, the universal acceptance of the US dollar, the size of the US market, more investment opportunities and the deregulation of foreign bank entry (Goldberg & Saunders, 1981). However, foreign banks' activities in the US did not dominate the banking market.

Table B.1 lists four foreign banks' efficiency studies (Chang et al., 1998; DeYoung & Nolle, 1996; Hasan & Hunter, 1996; Peek et al., 1999) on the US market between 1984 and 1997. The rapid increase in cross-border consolidation during that period also contributed to the growth of foreign banks' presence in the US market (Berger et al., 2000).

DeYoung and Nolle (1996) investigate the cost and profit efficiency of 62 foreign-owned banks (subsidiaries) and 240 US-owned banks located in the same statistical metropolitan areas between 1980 and 1990. Despite foreign banks making significant inroads into the US market, foreign banks were found to be significantly less profit efficient than those which were US-owned. Foreign banks entering into the US market spent excessively on purchased funds due to the weak local deposit market over that period, while some foreign banks faced difficulties employing effective strategies in loan pricing when compared with their domestic competitors.

Chang et al. (1998) estimated the cost efficiency of foreign owned and US owned multinational commercial banks between 1984 and 1989 using the SFA method. Their results indicated that foreign-owned multinational banks operating in the US were less efficient than their domestic counterparts, and the larger the foreign presence in terms of foreign ownership, the more inefficient the bank, indicating that foreign-owned multinational banks had difficulties in adapting to the customers and service systems in the US market. Hasan and Hunter (1996)further investigated the cost and profit efficiency

of Japanese banks in the US, and found that Japanese multinational banks operating in the US market were significantly less cost and profit efficient than domestically owned banks.

Berger et al. (2000) performed a cross-border banking efficiency study in France, Germany, Spain, the United Kingdom, and the United States during 1993 and 1998, and suggested that domestic banks on average exhibit both higher cost and profit efficinecy than foreign banks operating in these countries, in particular, financial insitutitions from the US were found on average more efficient than those from other countries. In the US, domestic banks are more profit efficient but on average slightly less cost efficient than foreign banks. During the period 1993-1998, there were some changes in foreign bank presence in the US, with banks from Japan reducing their US presence while banks from the Netherlands increased their presence in the market. Japanese banks faced a serious financial crisis during the Asian financial crisis of the late 1990s, therefore those changes possibly contributed to the improvement of foreign bank cost efficiency as a whole in the US.

3.4.2 Evidence in the European Banking Market

The banking market in Europe has become increasingly concentrated, partially due to the competition fostered by technological advances, deregulations in the EU and the introduction of a single market for financial services through the mergers and acquisitions of the 1990s. The increased competitive environment forced European banks to improve their efficiency by seeking overseas expansion to build up their market power and presence in a region which has massive market potential (Ibanez & Molyneux, 2002). The majority of the foreign banks' efficiency studies are performed in transition countries such as Central and East European countries (CEEs) due to the sharp increase in foreign bank participation in the region. For example, the average market share of foreign-owned banks in the integrated market grew from 14% in 1995 to 80% in 2006 (Poghosyan & Poghosyan, 2010), while, in the UK, it reached 49.84% in 2003 (Dermine, 2006).

In this section, 21 recent bank efficiency studies in the European market (EU), including cross-country studies (see Table B.2) and single nation studies (see Table B.3) are reviewed. SFA methods are favoured by the majority of the studies, which compare bank efficiency scores derived from frontier estimation of both cost and profit functions.

The SFA results from several of the cross-country studies (see Table B.2) in transition economies show that foreign banks are more cost and/or profit efficient than domestic banks (Bonin et al., 2005a; Fang, Hasan, & Marton, 2011; Fries & Taci, 2005; Kasman & Yildirim, 2006; Rossi et al., 2005; Yildirim & Philippatos, 2007). For example, (Fries & Taci, 2005) examined the cost efficiency of a sample of 289 banks in 15 East European countries for the period 1994-2001. The authors found evidence that privatised banks with foreign ownership of at least 50% of the shares were the most cost efficient banks, compared to the least efficient privatised banks which had major domestic ownership. Kasman and Yildirim (2006) found that foreign banks were more profit efficient on average than domestic banks in 8 CEEs from 1995 to 2002, although all banking systems displayed significant levels of cost and profit inefficiency over that time. Yildirim and Philippatos (2007) reported that foreign banks were more cost efficient but less profit efficient than domestically owned banks in 12 European transition countries over the period 1993-2000.

Similarly, some single nation studies in EU emerging markets (see Table B.3) also show that foreign banks are more efficient than domestic banks. Styrin (2005) employed both SFA and DEA methods to measure banks' X-efficiency in the Russian banking sector between 1998 and 2002. Isik and Hassan (2002) found that foreign banks in Turkey strongly outperformed domestic banks, while El-Gamal and Inanoglu (2005) explained that foreign banks utilised advanced technology compared with domestic banks in Turkey. Havrylchyk (2006) in Poland employs the DEA technique and reports that foreign banks exhibit higher technical and allocative efficiency compared with domestically-owned banks between 1997 and 2001, despite the Polish banking system not improving over the study period.

Conversely, a few studies in emerging EU countries, such as Turkey, show foreign banks as less efficient than domestic banks, with Zajc (2006) finding supporting evidence in 6 CEEs, between 1995 and 2002. Aysan, Karakaya, and Uyanik (2011) examined banks' efficiency in the Turkish banking sector using the SFA method on a sample of 32 banks between 2002 and 2007. Their empirical results suggest that foreign banks overall exhibited poorer cost efficiency compared with state-owned and domestic-owned Turkish banks, despite foreign banks exhibiting strong profit efficiency in comparison.

Interestingly, there are limited studies on foreign banks' efficiency in developed economies in the European banking market. A cross-country study by Berger et al. (2000) in France, Germany, Spain, the United Kingdom and the US, and single nation studies by Gaganis and Pasiouras (2009) in Greece, Béjaoui Rouissi and Bouzgarrou (2012) in France and Curi et al. (2013) in Luxembourg are reviewed here.

Berger et al. (2000) test the cost and profit efficiency in France, Germany, Spain, the United Kingdom and the US, finding domestic banks in most of the countries have both higher cost and profit efficiency than foreign banks operating in France, Germany and the UK. Foreign banks in Spain, however, exhibited lower cost efficiency but higher profit efficiency than domestic banks over the study period 1993-1998. In addition, Béjaoui Rouissi and Bouzgarrou (2012) compared cost efficiency between 62 domestic and 40 foreign-owned commercial banks in France. The authors' SFA results showed foreign commercial banks were more cost efficient than domestic counterparts in France over the period 2000-2007, supporting the findings of Berger et al. (2000).

Gaganis and Pasiouras (2009) examined banks' efficiency in a sample of 18 foreign and 21 domestic banks in Greece from 1999-2004 using a DEA model. Their results showed that foreign banks were more scale efficient despite having lower technical efficiency (TE) than domestic banks in almost all the years during the study period. However, both TE and scale efficiency (SE) were not statistically significant, which implies foreign banks were less efficient than domestic banks in Greece over the period 1999-2004, during which Greece was considered a small but developed country .

Curi et al. (2013) employed the DEA method to test foreign bank efficiency in Luxembourg over the period 1991-2009. Their results indicate that foreign branch banks are more diversified and foreign banks from the European region exhibited higher technical efficiency, on average. The banking sector in Luxembourg is highly dominated by foreign banks with a total of 148 foreign banks in 2009 compared with only two domestic banks, where most banks are subsidiaries and foreign branch banks.

It should be noted that one should be cautious with efficiency results from cross country comparisons in the European banking markets, as they are easily distorted by differences in the distribution of banks, in terms of size and type (foreign versus domestic banks) (Bikker & Bank, 2002).

3.4.3 Evidence in the Australian Banking Market

Since the deregulation of foreign-bank entry restrictions in 1984, and further liberalisation of the entry condition for operating in Australia in 1992, the number of foreign banks in Australia has increased steadily. As of December 2011, there were 48 foreign owned banks operating in Australia, of which 39 are branches and 9 are subsidiaries. The market share of foreign banks however is only 12% (Reserve Bank of Australia, 2012) with the Australian banking system dominated by four large domestic banks (Big Four) and a number of smaller banks, which are mostly regional retail banks.

Foreign bank efficiency studies in Australia are summarised in Table B.3 with mixed results. Major studies (Sturm & Williams, 2004, 2008, 2009, 2010) include examining the foreign bank efficiency and the determinants of the foreign bank efficiency in Australia during the post-deregulation period 1988-2001.

First, however, Sathye (2002) employed the DEA method to investigate 29 banks (17 domestic, 12 foreign) in Australia in 1996, and found that the overall efficiency (technical and allocative) for foreign banks was less than the domestic banks' efficiency scores. Foreign banks in Australia do not necessarily seek competitive advantage by traditional means, instead, they focus on alliances, specialization and acquisition, such as the alliance of Rabobank with credit unions in Australia.

Sturm and Williams (2004) examined the impact of foreign bank entry on 39 banks (19 foreign, Big Four Australian , and 16 other domestic banks) in post-deregulation Australia from the late 1980s. The study compared the technical and scale efficiency between foreign and domestic banks in Australia. Their DEA results revealed that foreign banks experienced superior scale efficiency, on average, compared to the Big Four banks and other domestic banks, which is inconsistent with finding documented by Berger et al. (2000). Strum and Williams' findings suggest that the Big Four banks acted as a barrier to entry by new banks.

Strum and Williams' (2008, 2009, 2010) studies extended their 2004 study by employing parametric distance functions with the same sample of banks over the same study period, but explored factors (such as home nation, parent bank and host nation effects) that affect differences in estimating foreign-owned banks' efficiency in Australia. Despite the three

studies having the same objectives, the authors conducted their studies under different theoretical frameworks: the global limited advantage hypothesis in Sturm and Williams (2008), and comparative advantage theory and new trading theory in Sturm and Williams (2009,2010) . Foreign banks were found by all three studies to be less efficient, on average, than domestic banks, which was inconsistent with the DEA results from Sturm and Williams (2004), but supported Sathye's results (2001).

Although foreign banks were found to be less efficient, on average, than domestic banks in Sathye (2001) and Sturm and Williams (2008, 2009, and 2010), the studies also found that some foreign banks from certain nations overcame the diseconomies in operating away from their home nation. They were operating more efficiently compared with other foreign banks from other nations. For example, banks from the UK were found to be significantly more efficient than the average foreign bank operating in Australia. Interestingly, banks from the US and Switzerland were significantly less efficient than the average of other foreign banks in Australia.

3.4.4 Evidence from Other Regions' Banking Markets

In this section, both cross-country (see Table B.5) and single-nation (see Table B.6) foreign bank efficiency studies, predominantly from emerging economies, are reviewed. There are also a few studies conducted in high income countries such as Japan and Malaysia.

Miller and Parkhe (2002) conducted a profit efficiency study on a sample of 1300 banks, of which 428 are foreign-owned, in 13 different countries over the period 1989-1996. Their results indicate that the average level of X-efficiency for foreign-owned banks was significantly less than that of the host country banks. The study also found that US-owned banks enjoyed competitive advantages compared with other foreign-owned banks operating in Belgium, France, Germany, Italy, Portugal, Spain and Switzerland from 1989 to 1996. Lensink et al. (2008) compare the efficiency of foreign and domestic banks, using the SFA method, over a sample of 2095 banks in 105 countries, with their results also suggesting that, on average, foreign banks are less efficient than domestic banks.

In Latin America, foreign banks participation has increased sharply since the 1990s. Figueira et al. (2006) investigated the role of ownership in bank cost efficiency for a

sample of 204 banks in 20 Latin America countries during 2001. Their DEA and stochastic cost function (SCF) results showed that foreign-owned banks were not as efficient as their domestically owned counterparts in 2001, with differences in efficiency more related to the national regulatory and economic environment than banks' ownership, in each country. Similarly, Wezel (2010) investigated the X-efficiency of domestic and foreign banks in the Central American region from 2002-2007. The author's DEA and SFA results show that foreign banks in Central America were not necessarily more efficient, on average, than the local or regional banks from Brazil (Tecles & Tabak, 2010) showed that foreign banks were less cost efficient but more profit efficient over the post-privatisation period of 2000-2007.

Foreign banks have played a smaller role in most Asian financial systems than in CEEs and Latin America, reflecting regulatory limits on foreign banks entry into Asia. Chan and Karim (2011) provided cross-country evidence on four selected ASEAN (Association of Southeast Asian Nations) countries that foreign banks were more profit efficient than cost efficient relative to their domestically-owned banks. On the other hand, foreign banks operating in Malaysia exhibited higher cost and profit efficiency compared to foreign banks in Indonesia, Thailand and the Philippines.

There are also some single nation studies investigating the efficiency of foreign and domestic banks operating in Asian countries such as China, Malaysia, India, Vietnam, and Japan. Berger et al. (2009) reported in their study that China's state-owned banks were the least X-efficient banks while foreign banks were the most efficient with the presence of foreign banks in China challenging the domestic banking system to become more competitive and efficient, according to Xu (2011). However, Jiang and Yao (2010), using the SFA method in their study, showed that foreign banks were less cost efficient than domestic banks in China, but outperformed major domestic banks in their profit efficiency model. Tahir et al's (2010)study showed similar results in the Malaysian banking sector with Sufian 's (2011) DEA results revealing foreign banks from North America were the most efficient banking group in Malaysia. Sensarma (2006) showed that foreign banks had poor cost efficiency and productivity in India over the study period 1986-2000. Vu and Nahm's (2013) study showed that Vietnam's state-owned banks were more profit efficient than other domestic banks in the country. However, their study also found that foreign

banks headquartered in the US, European countries, Australia and Japan were more profit efficient than Vietnamese banks.

examined the technical efficiency of Japanese trust banks (foreign-owned versus domestically owned) from 1994-2005 using a Stochastic Distance Function approach. Their results show that the traditional domestic trust banks experienced superior technical efficiency compared with foreign-owned trust banks.

3.4.5 New Zealand Banking Market

New Zealand studies on foreign bank efficiency (see Table B.7) employed the DEA approach and focus on examining X-efficiency. The studies (Adjei-Frimpong, Gan, Ying, & Cohen, 2014; Liu & Tripe, 2003; Tripe, 2002, 2003, 2004, 2005a, 2005b; Vedula & Tripe, 2004) address the trends in bank efficiency, bank mergers and efficiency gain, the impact of cost of funds on efficiency in New Zealand's banking market, as well as efficiency in the integrated market between Australia and New Zealand.

Tripe (2003) examines the trend of banks' efficiency in New Zealand over the period of 1996 to 2002, using the DEA method on time-series quarterly data. The author's constant return to scale model confirms the efficiency improvement achieved by eight banks in New Zealand during the study period. Adjei-Frimpong et al. (2014) examines the efficiency of six major banks (Big four and two main domestic banks) during the period 2007-2011. Their DEA findings indicate that the six major retail banks gnerally have higher levels of efficiency.

Liu and Tripe (2003) use accounting ratios and the DEA method to also explore the efficiency gains of six bank mergers in New Zealand over the period 1987-1999. Based on the accounting ratios, the authors found that five out of six merged banks had efficiency gains, excepting the acquisition of ANZ in 1989. The mean DEA efficiency scores for New Zealand's banking industry were greater than other countries' over the same period, supporting the premise that bank efficiency gains were associated with bank mergers and acquisitions in New Zealand.

Vedula and Tripe (2004) extended the study of Liu and Tripe (2002) using 14 DEA models with different inputs and outputs to examine the efficiency gains for six major banks in

New Zealand over the period 2000-2002. New Zealand's banking industry was found to be competitive, and banks in New Zealand became more efficient over the study period, with supremely high efficiency scores ranging from 0.86 to 0.96, which are consistent with the results reported in Liu and Tripe (2003), Tripe (2003) and Adjei-Frimpong et al. (2014). The National Bank was highly efficient over the study period before being acquired by the ANZ in 2003(Vedula & Tripe, 2004).

Tripe (2004) is one of the few studies which addresses the effect of foreign ownership on bank efficiency in New Zealand. Tripe's study shows that New Zealand banks (ANZ, ASB, BNZ, NBNZ, TSB, and Westpac NZ) with branch networks are more efficient than Australian banks (ANZ, CBA, NAB and Westpac Australia) with branch networks over the period 1996-2003. Using a DEA model with capital as the input, Tripe's results show significant differences in average efficiency scores (0.908 for Australia major banks and 0.868 for New Zealand businesses) comparing Australian major banks and their New Zealand counterparts. However, no significant difference was found when taking into account the level of equity suggesting a strong link between the New Zealand banking system and the major Australian banks.

Tripe (2005a, 2005b) then measured the efficiency levels of six major retail banks (ANZ, ASB, BNZ, NBNZ, TSB, Westpac NZ) in the New Zealand banking market from 1996 to 2003. The author applied the DEA panel data approach as it allows the use of a range and size variables and is less constrained, which is more applicable than the traditional DEA method in the New Zealand case (Tripe, 2005b). The studies found that improvement in bank efficiency in New Zealand is possibly due to reductions in the general interest rate over the study period.

Chan et al. (2007), examining the efficiency of major banks in New Zealand between 1996 and 2005, indicated that the New Zealand banking market exhibits oligopolistic behaviour to new entrants to the banking sector. The efficient structure hypothesis revealed that larger banks enhanced the whole banking sector performance in New Zealand during the study period.

It is apparent that the DEA model applies to all the existing efficiency studies in the New Zealand literature. The authors explained one of the reasons for choosing DEA as the frontier estimation method was the difficulty in constructing sufficiently large data

samples. In addition, the DEA method does not require any specified functional form for the data (see section 3.2.4.1), the major problem being that no allowance for measurement error and luck could lead to higher estimates of inefficiency than might be derived using a parametric approach, such as the SFA. The authors also recommend SFA as an alternative approach to investigate bank efficiency in New Zealand (Tripe, 2005b).

3.5 Determinates of Foreign Banks' Efficiencies

This section discusses determinants of foreign bank efficiency. The main determinants include ownership features, market power, bank regulation and macroeconomic conditions (the level of GDP growth, interest rates and inflation) in host countries.

3.5.1 Ownership Features

The foreign bank efficiency literature has focused extensively on whether differences in banks' efficiency are associated with foreign ownership. Berger et al (2000) proposed two alternative hypotheses to investigate the matter: the home field advantage hypothesis and global advantage hypothesis. Whether a bank's organizational form can impact foreign bank efficiency is also discussed.

3.5.1.1 Home field advantage hypothesis

Under the home field advantage hypothesis, domestic firms have a comparative advantage over their foreign competitors because of the intensive accumulation of tacit knowledge of economics, and social, legal and cultural conditions in their home country. The domestic banks' efficiency advantage is sourced in costs borne by foreign banks, often called the liability of foreignness (Berger et al., 2000).

Berger et al., (2000) tested the comparative (cost and profit) efficiency advantages of a large number of foreign banks in the US, Spain, France, Germany and the UK, and found that foreign banks had organizational diseconomies in operating or monitoring an institution from a distance, or other disadvantages in the legal, cultural, political and economic environments in the host nation when competing with domestically owned banks.

DeYoung and Nolle (1996) found that foreign banks in the US exhibited an inability to develop customer relationships necessary to raise and maintain core deposits, consequently, foreign banks financed their growth in the US market with higher-cost funding sources (such as offering higher deposit rates than domestic banks). Supporting evidence can also be found in other US efficiency studies by Chang et al. (1998), Hasan and Hunter (1996), and Peek et al. (1999).

There are also other single nation studies in developing countries, Hasan and Marton (2003) in Hungary; Gaganis and Pasiouras (2009) in Greece; Aysan et al. (2011) in Turkey, Jiang and Yao (2010) in China, supporting the home field advantage hypothesis that foreign banks are less efficient than domestic banks in these nations. For instance, Jiang and Yao (2010) employed the SFA approach to examine the effect of ownership on bank efficiency in China. The authors found that foreign ownership participation has a negative effect on foreign banks' profit efficiency, despite foreign banks initially acquiring profitable Chinese-owned banks. The authors suggest that the profit inefficiency of banks with foreign ownership participation could be caused by investing more in upgrading their technology to improve service quality or being required to hold more loan loss provisions by bank regulation in the host country. China's legal and financial systems are not well developed compared with those in developed countries (Berger et al., 2009).

3.5.1.2 Global advantage hypothesis

In contrast to the home field advantage hypothesis, under the global advantage hypothesis, foreign banks might benefit from competitive advantages relative to domestic owned banks. Berger et al., (2000) considered two forms: the general global advantage form and limited global advantage form.

Under the general global advantage form, efficient foreign banks from several nations are able to overcome competitive disadvantages when operating in distant markets with foreign economic, cultural and regulatory environments.

According to Berger (2007), there are two types of efficiency advantage for foreign-owned banks. Firstly, foreign banks generally have a multinational presence, which may allow the foreign banks to serve customers in multiple nations. Secondly, foreign banks also diversify their risks across nations or regions. Foreign banks, therefore, may be able to

lower their cost of funds by providing superior financial stability (global reputation) to customers, lower cost risk management, cost of capital, and better risk-return profiles to compete with domestic banks in the host country.

Supporting empirical evidence for the general form of the global advantage hypothesis can be found in the context of the Australian banking market in Sathye (2001), and in the European market by El-Gamal and Inanoglu (2005) in Turkey, and Béjaoui Rouissi and Bouzgarrou (2012) in France. Sathye (2001) finds that foreign banks with superior management or production technologies generally have higher efficiency (lower cost) compared with domestic banks in Australia. Béjaoui Rouissi and Bouzgarrou (2012) investigate the efficiency levels of 62 commercial domestic banks versus 40 foreign banks in France between 2000 and 2007. Their SFA results reveal foreign banks exhibit higher cost efficiency than domestic banks. The deterioration of the cost efficiency of domestic banks allowed foreign banks to increase their market share in France, and to settle easily in France.

Under the limited global advantage hypothesis, efficient foreign institutions headquartered in specific nations with specific favourable markets, and/or regulatory or supervisory conditions, can operate more efficiently than domestic institutions (Berger et al., 2000). Cross-border banking is more likely to take place when the home and host countries are geographically close, share common languages and legal systems, have similar sized economies and similar levels of economic development, share a common labour market, and agreements over trades and services, competition policies and public purchasing (Berger, Demirgüç-Kunt, Levine, & Haubrich, 2004). The macroeconomic conditions can reduce the liability of foreignness for foreign banks, which has significant positive impact on foreign banks' efficiency (Miller and Parkhe, 2002).

The limited global advantage hypothesis has been tested in some foreign banks' efficiency studies (for example, Naaborg, 2007; Lensink et al. 2008; Sturm and Williams, 2009, 2010; Sufian, 2011; Vu and Nahm, 2013) with their findings similar to studies under the limited global advantage hypothesis. At the international level, Lensink et al. (2008) examined the relationship between the foreign banks' efficiency and the quality of financial institutions in the home and host countries, confirming that foreign bank inefficiency is reduced with greater similarity between home and host country. Mian

(2006) supports that closer institutional distance between the home and host country may reduce informational, agency, or enforcement costs for foreign banks operating abroad.

Similar findings from Havelchyk (2005) in Poland and Vu and Nahm (2013) in Vietnam also support the limited global advantage hypothesis. Havelchyk (2005) finds Dutch banks in Poland achieved higher efficiency than banks from other countries, while bank efficiency was inversely related to US banks' ownership. Vu and Nahm (2013) find that the level of profit efficiency for banks from Australia, Japan, the US and Europe are higher than domestic banks' and those from other Asian nations in Vietnam.

Sturm and Williams (2009) test the limited global advantage hypothesis of Berger et al (2000) when examining the factors that affect differences in foreign bank efficiency in Australia. The study considers foreign banks' efficiency from the perspective of the host nation, Australia, and found that banks from Japan and the UK displayed superior revenue creation efficiency relative to domestic banks. On the other hand, banks from the US and Switzerland were less efficient than domestic banks The results are consistent with the limited global advantage hypothesis of Berger et al., (2000), which suggested that banks from the UK and Japan are able to overcome the diseconomies of cross-border operations in Australia due to various unspecified advantages. Sturm and Williams (2010), extending their 2009 study, concluded that the limited global advantage hypothesis of Berger et al., (2000) was relevant for banks from the UK, while banks from the US were again, on average, less efficient compared with domestic banks in Australia.

Minh To and Tripe (2002) examining the performance of foreign-owned banks in New Zealand, suggest that the Australian parent banks have advantages in knowledge and experience in the New Zealand market, including managerial expertise. These are the most important factors determining the foreign banks' performance in New Zealand.

However, Miller and Parkhe (2002) compared the differences in X-efficiencies of foreign banks from home countries with similar and dissimilar regulatory and financial system environments to the host country. Their results provide no evidence that the X-efficiency of foreign-owned banks is affected by similar or dissimilar regulatory environments between home and host countries, which suggests that foreign-owned banks from dissimilar environments are able to conform to the new host country environments and overcome the liability of foreignness.

3.5.1.3 Organisational form

In the foreign banking literature, the choice of organisational form, i.e. foreign branch or subsidiary, is largely influenced by regulations in the host countries, meaning foreign banks are less likely to operate as branches in countries that limit their activities (Cerutti, Dell'Ariccia, & Peria, 2007). In New Zealand, systemically important foreign-owned banks are required by the Reserve Bank of New Zealand to be locally incorporated subsidiaries, under the financial crisis management supervisory legal framework (Bollard, 2004). However, the literature on the relationship between organizational form and foreign bank efficiency is scarce, and findings are inconclusive.

In the US banking market, subsidiaries were found unlikely to benefit from large gains in efficiency compared to a foreign branch bank with wholesale or investment banking markets focus. This may imply that lower scale efficiency is associated with higher cost when establishing a subsidiary in the host country (Casson, 1990).

Foreign subsidiary entrants in Australia are found to provide more strategic and valuable information compared to similar domestic firms in the Australian market, contributing to the competitive advantages in pure technical efficiency for foreign bank subsidiaries (Sturm and Williams, 2004). The authors also report that foreign banks in Australia do not dominate the banking sector in terms of sizes, however, the diversity in the types of foreign banks participating in the host market is likely an important source of competitive improvement in foreign banks' efficiency.

Curi et al (2012) estimated foreign banks' efficiency in Luxembourg, after controlling for heterogeneity due to different organization forms, the level of asset diversification and exchange rate risk. The authors' results showed that foreign bank branches were 50% more efficient than subsidiary banks; however, the difference in foreign banks' efficiency between branches and subsidiaries disappeared when controlling for other characteristics such as macroeconomic conditions. The study also found that specialised foreign bank branches performed more efficiently than specialised subsidiaries, while subsidiaries performed better when their banking activities were more diversified.

3.5.2 Market characteristics

Theoretically, an increase in foreign bank participation in host nations can increase domestic market competition and improve domestic banking performance (Lehner & Schnitzer, 2008). A greater market share of foreign-owned banks in a stable macroeconomic and competitive environment (such as in the European market) can promote efficiency for foreign banks (Fries and Taci, 2005).

In a highly concentrated market dominated by domestic banks, such as the Australian banking sector, foreign banks are found to display superior technical efficiency due to superior scale efficiency in Australia's banking market (Strum and Williams, 2004). The Reserve Bank of Australia states that foreign banks in Australia innately possess economies of scale and are able to offer an immediate competitive stimulus to the Australian banking system. However, Australian banks exhibit high level of cost and profit eficiency in several bank efficiency studies using SFA approach (Shamsuddin & Xiang, 2012; Vu & Turnell, 2011; Xiang, Shamsuddin, & Worthington, 2015). The key factors playing a cruical role in shaping the efficiency of Australian banks in those studies include bank size, market concentraion, and bank capitalication . Results from a recent DEA study by Moradi-Motlagh and Babacan (2015) reveal that more than half of Australian banks during the period 2006-2012 are fully technical efficient. Sturm and Williams' (2008,2009) found that competitor market share reduces foreign bank profit efficiency, which reflects the increased dominance of the Australian market by the incumbent banks. The foreign entrants increased expenditure by domestic banks to produce the same level of outputs, thus resulting in lower profits and efficiency.

Borovicka (2007) finds that foreign investors tend to acquire the most cost efficient banks to enter another country. Vander Vennet (1996) finds, in European banking, cross-border mergers and acquisitions of equally sized (foreign-owned or domestic-owned) banks may generate significant cost efficiency improvement. The study also suggests that cross-border mergers and acquisitions improve the efficiency levels of the acquiring banks, while domestic bank consolidation does not. Banks participate in mergers and acquisitions not only for scale gains, but also to attain specific niche markets, competing for profitable client portfolios.

Berger and Mester (1997) suggest that it is important to determine the efficiency effects of bank mergers and acquisitions within the context of the rapid growth of cross-border banking consolidations worldwide. Their results indicate that banks which have survived at least one merger over their sample period have higher profit efficiency, while on the other hand, efficiency for the acquired banks appears to be associated with higher cost efficiency.

Tripe (1999), however, provides no support for the premise that merged larger banks have the benefits of economies of scale in New Zealand's banking market. The economies of scale could be exhausted by the consolidation of large firms typically involved in international activities (Berger et al, 2000), for example, when bank assets are over US $10 billion (Berger & Mester, 1997).

The importance of bank size in foreign bank efficiency has also been discussed in a number of bank efficiency studies. The impact of bank size depends heavily on the foreign banks' activities, developed in the host market. In countries where foreign banks are small they tend to remain niche players, targeting only specific customers, and not adding to domestic financial development. In contrast, in countries with greater foreign banks' presence, they seem to engage in more competition in financial intermediation (Claessens & Van Horen, 2014).

In general, foreign banks with large parent banks may be able to exhibit scale efficiency in the host nation at a relatively lower cost (Sabi, 1988). Larger parent banks also allow wider penetration of markets and increase in revenue at relatively less cost, opting to operating with thinner margins by increasing volume to generate more profits and hence increase efficiency (Misra & Das, 2005). Small banks may possess some operational advantages due to relatively lower overhead costs that bring about higher efficiencies, while in contrast, costs (such as originating, servicing and monitoring costs on loans) for large banks might be higher than small banks. Tecles and Tabak (2010) found that large foreign and domestic banks in Brazil have outperformed their counterparts with smaller sized banks.

Isik and Hassan (2002) examine the impact of commercial banks' (foreign, and domestic private, and state-owned) size on bank performance in the Turkish banking system over the period 1988-1996, with results suggesting that both average cost and profit efficiency

fall systematically as bank size increases. Small banks may possess some operational advantages due to relatively lower overhead costs that bring about higher efficiencies. In contrast, costs (such as originating, servicing and monitoring costs on loans) for large banks might be higher than small banks. Curi et al (2012), in the study of foreign bank efficiency in Luxembourg, suggest that the relationship between size and bank efficiency is not non-monotonic, despite larger foreign banks being found to be more efficient.

Large foreign banks are likely to develop better means and opportunities for risk diversification, thus the structure of their asset portfolio in the host country can change significantly by size, shifting from less risky investment assets to riskier (more profitable) business and individual loans.

3.5.3 Bank Regulation

The banking industry is described as the most risky industry because banks are highly leveraged when compared to other firms, and the riskiness can negatively influence banks' performance. Capital and credit risks are the two common risk characteristics that have been investigated extensively in recent foreign bank efficiency studies (for example, Isik and Hassan.2002; Styrin, 2005; and Curi et al, 2012). These two indicators are generally incorporated into the cost and/or profit function for the underlying home and host banking industry to avoid miscalculating the level of bank inefficiency.

Bank financial equity constitutes an alternative source of funds to deposits, and therefore can significantly affect banks' costs and profits. The equity generally controls banks' managerial risk preference, and failure to account for risk preference can lead to managerial inefficiency. A well-capitalised bank might have less incentive for risk-taking in lending decisions and other diverse activities, hence possibly experience low profitability, thus profit efficiency (Fries and Taci, 2005). A higher equity ratio implies lower solvency risk, which can lead to growth in bank inefficiency.

Capital requirements can affect bank efficiency by influencing the quality and quantity of lending and/or the choice of bank strategies when allocating their asset portfolios and bank sources of funds (Pasiouras, 2008). Higher capital requirements for locally incorporated foreign subsidiaries can raise the cost of doing business at a given level of risk in a host country, and thus can be associated with lower bank efficiency. However, Curi et al (2012)

find that foreign banks in Luxemburg with higher equity ratios are more efficient, which indicates that well capitalized banks tend to perform better.

Berger & Mester (1997) further find that foreign banks with higher loan to asset ratios are associated with a higher alternative profit efficiency but a lower cost efficiency, which suggests that foreign banks could possibly gain lending power in the local market due to competitive advantages. However, when foreign banks increase lending to risky borrowers in the local market, they can incur monitoring costs to manage the risks, thus negatively impacting their cost efficiency.

Credit risk also plays a crucial role in foreign bank efficiency. Asset quality, as an indicator of bank credit risk, is generally measured by the total impaired bank assets relative to total lending or total bank assets. Impaired assets are typically loans which are at risk of not being fully (including interest on the loans) repaid to the bank. A bank needs to control the risk characteristics of bad loans to produce output in an efficient manner (Mester, 2003).

Banks with higher impaired asset ratios tend to have high costs and low profit (Berger & Mester 1997). Evidence from Havrylchyk (2005) on Poland, and Isik and Hassan (2002) on Turkey, shows that banks (domestic and foreign) with poor risk management are inefficient in their operation. However, Vu and Nham (2013) found that foreign banks in Vietnam exhibited lower levels of bad loans in their portfolios during the Asian crisis of the late 1990s, which partially contributed to the higher foreign banks' efficiency average, relative to domestic banks in Vietnam.

Banks also need to create loan loss provisions when they believe they are likely to lose money on loans. The loan loss provisions to total assets ratio is an indicator of a bank's asset quality. Risk-averse managers may be willing to incur additional costs (provisions) in making higher quality loans and monitoring loan performance, which could lead to the bank being more efficient and profitable. Since the loan loss provisions depend on the probability of loans' repayment, higher provisions indicate higher probability of non-performing asset ratios, hence, a lower ratio is desirable, as documented in the bank efficiency literature (Tripe, 2004).

3.5.4 Macroeconomic Conditions

The importance of specifying macroeconomic conditions in order to avoid bias in efficiency models has been recognized in some of the foreign bank efficiency literature (for example, Berger et al., 2000; Lozano-Vivas et al.,2001; Fries and Taci, 2005; Vu and Nham,2013).

Berger (2000) provides evidence that the nations with more developed and sophisticated financial systems (such as the US, and UK) are more likely to be able to export efficient financial practise and overcome the negative impact of the liability of foreignness. Strum and William (2008) find that foreign banks from more financially sophisticated countries (such as the UK, with higher GDP per capita) are more efficient operating in Australia. A higher GDP per capita generally leads to more savings and hence more deposits in both foreign and domestic banks, thus generating cheaper sources of funds compared with the international market (Vu and Nham, 2012; Sufian and Habibullah, 2012, Tahir and Haron, 2008).

Fries and Taci (2005) find a positive correlation between interest rates and bank efficiency, which suggests that rising interest rates increase interest costs for both foreign and domestic banks in the host country, and adversely affects their risk management and credit screening through higher risks and uncertainty. Tripe (2005b) explores the relationship between interest rates (the 90-day bill rate) and bank efficiency in New Zealand. The author's results, based on a constant return to scale model under the DEA approach, shows that the coefficient for the interest rate and the efficiency measurement are consistently negative, which suggests that the decrease in interest rates over the study period, 1996-2002, in New Zealand, might partially explain the improved banks' X-efficiency.

Inflation is an indicator of macroeconomic stability. Higher inflation is mostly associated with macroeconomic and financial instability, which may have a direct impact on bank performance. According to Perry (1992) the relationship between inflation rates and foreign banks' performance depends on whether the inflation is anticipated or unanticipated (Perry, 1992). Under the expected inflation hypothesis of Perry (1992), banks can timely adjust interest rates, which consequently results in revenues that increase faster than costs and generate more profitability for banks in the host nations. If banks fail

to anticipate inflation (unanticipated inflation), the impact on bank profits could be negative, because banks may be slow in adjusting their interest rates, thus resulting in a faster increase in bank costs than bank revenues. A higher inflation level in the host nation tends to lower the cost efficiency of banks (both foreign and domestic) that operate in that nation, while foreign banks are more efficient if the host country is under less inflationary pressure (Chen, 2009). As Vu and Nham (2013) found, banks operating during a high inflation period (1997-1998) in Vietnam were hampered by increasing costs, heightened uncertainty and distorted relative prices.

Studies of foreign bank efficiency in single nations show that local business environment factors have been generally ignored because both foreign and domestic banks operate under the same macroeconomic conditions. However, foreign and domestic banks serve different customers and individual banks may perform differently under the same macroeconomic conditions (Pasiouras & Kosmidou, 2007). Curi et al. (2013) investigated the impact of home and host country characteristics on foreign banks' efficiency in Luxembourg, and found that a difference in the level of GDP per capita in the home and host country does not appear to have a positive impact on foreign banks' efficiency in this international finance centre.

3.6 Conclusion.

The mainstream of foreign banks' efficiency studies are conducted in the US, Europe (including countries with developed and emerging economies), Australia, New Zealand and other transition and developing countries, such as Latin America, and Asian developing countries (for example, China, India, Thailand). Those studies have generally focused on the comparison of foreign bank efficiency relative to domestic banks. While, on average, foreign-owned banks in developed countries, such as the US and Australia, tend to perform with lower efficiency compared to domestic-owned banks, the opposite is true in transitional and developing countries or regions (such as in CEEs). Evidence from the New Zealand literature does not support the general evidence from developed countries, which suggests that foreign banks can be as efficient as domestic banks (Tripe, 2003, 2005a, 2005b).

The studies that investigate the determinants of foreign banks' efficiency, have extensively examined the home field advantage hypothesis and global field advantage hypothesis

developed by Berger et al., (2000). The empirical results from international foreign banks' efficiency studies reveal that foreign banks did not have a competitive advantage compared with domestic banks in any given countries. However, supporting evidence is found in studies of both developed and developing countries, that foreign banks from some nations, headquartered in specific nations with specific favourable market, regulatory, or supervisory conditions, operated more efficiently than foreign banks from other nations. These results are in line with the global limited advantage hypothesis documented in Berger et al.,'s study (2000).

In addition, the estimations of the impact of bank-specific characteristics on foreign banks efficiency have been extensively researched. Although there is no agreement regarding the choices of bank-specific variables, banks size, equity ratios, and asset quality are generally included in the efficiency analysis and significantly impact the level of foreign-owned banks' efficiency. Overall, it is not clear that bank size has a positive effect on foreign banks' efficiency in all cases and a highly concentrated banking market in the host nation can be a double-edged sword for foreign banks' efficiency levels. In addition, well capitalised foreign banks can be associated with lower cost and profit efficiency, while banks with a higher level of impaired assets are expected to have low efficiency levels.

Most of the studies investigating the factors influencing foreign banks' efficiency generally include an examination of the macroeconomic conditions in the host country or differences in economic conditions between the home and host country (cross-country studies). In general, income (GDP growth), interest rates, and inflation conditions in the host country impact foreign banks' efficiency to different extents, based on the foreign banks' efficiency scores. According to Williams (1998), bank-level characteristics have greater impact than country-level characteristics on foreign banks' efficiency .

Chapter 4

Data and Methodology

4.1 Introduction

This chapter describes the data and methodology employed in this study. Section 4.2 details the choice of the efficiency concept, frontier efficiency estimation techniques used in this study, and the inputs, outputs and explanatory variables used in the empirical models.

Section 4.3 provides the data sample, data sources and data heterogeneity issues and possible solutions. Finally, Section 4.4 presents the cost and alternative profit functions employed in this study and outlines the various inefficiency specifications in the cost and alternative profit function models used to investigate the determinants of foreign-owned banks' efficiency in New Zealand.

4.2 Methodology

The estimation method specified in Battese and Coelli (1995) was used to estimate the SFA model to measure the efficiency components of foreign-owned banks' efficiency relative to domestic banks in New Zealand.

4.2.1 Choice of Efficiency Concepts

A fundamental decision in measuring financial institution efficiency is which efficiency concept to use. According to Berger and Mester (1997), the most important economic efficiency concepts are cost efficiency (CE) and profit efficiency (PE), as these concepts have the best economic foundation for analysing the efficiency of financial institutions based on economic optimization in reaction to market prices and competition.

Cost efficiency deals with the bank's economic objective of cost minimization, while profit efficiency focuses on the goal of profit maximization, both of which require the same amount of managerial attention: to raise a marginal dollar of revenue or to reduce a marginal dollar of cost (Mester, 2003). Compared to cost efficiency, profit efficiency is a wider concept as it takes into consideration both cost and revenue.

A cost inefficient bank might still be profit efficient because customers pay more for higher quality financial services, hence the banks can earn extra revenue, enough to offset the higher expenses. Thus, if a study only measures cost efficiency, it may ignore this possibility and misrepresent the nature and extent of a bank's inefficiency (DeYoung and Nolle, 1996). Banks can improve cost efficiency by reducing the costs per unit of output for a given set of output quantities and input prices. On the other hand, improving profit efficiency requires putting together superior combinations of inputs and outputs.

Humphrey and Pulley (1997) and Berger and Mester (1997) define profit efficiency in two ways, as standard profit efficiency and alternative profit efficiency. Standard profit efficiency assumes the output market is perfectly competitive, and is defined as the ratio of predicted actual profits to the predicted maximum profits for a best-practice bank. It estimates how close a bank is to producing the maximum possible profit, given a particular level of input and output prices. On the other hand, alternative profit efficiency estimates how close a bank is to producing the maximum possible profit for a given level of input price and output quantities.

Berger and Mester (1997) argue that alternative profit efficiency is preferred over standard profit efficiency among bank efficiency studies for several reasons: (1) the quality of the financial products and services rendered differs substantially across banks, (2) markets are not perfectly competitive, so banks might have some market power when pricing their outputs, (3) outputs are not completely variable, so banks cannot achieve every output scale and product mix, and (4) output prices are not available, or are difficult to measure with accuracy (Isik and Hassan, 2002).

In the foreign bank efficiency literature, estimation of cost efficiency is the most common choice when an empirical study employs the frontier efficiency estimation method. However, profit efficiency has also been favoured in recent studies by Isik and Hassan (2002); Rossi et al.,(2005), Bonin, Hasan, and Wachtel (2005b), Kasman and Yildrim, (2006), Naaborg (2007), Aysan et al. (2011), Chan and Karim (2011) and Sufian (2011). In line with these studies, both cost efficiency and profit efficiency concepts are employed in the analysis.

4.2.2 Efficiency Estimated Method

Following Tripe's (2003, 2005a, 2005b) bank efficiency studies in New Zealand, the frontier efficiency method is used to analyse foreign-owned banks' efficiency in New Zealand. Frontier efficiency analysis is an objectively determined quantitative measure that removes the effects of market prices and other exogenous factors influenced by observed performance (Bauer et al., 1998).Diverging from Tripe's studies (which mainly used the non-parametric DEA method), an alternative parametric approach called the stochastic frontier analysis was then employed, with the aim of filling a gap in New Zealand's bank efficiency measurement literature.

4.2.2.1 Stochastic Frontier Analysis

The Stochastic Frontier Analysis and Data Envelopment Analysis (see Table B.1-B.7 in Appendix B) are the two major frontier analysis methods used in most literature estimating foreign bank efficiency. However, SFA estimates exhibit a steady increase in use for foreign bank efficiency measurement compared with DEA, at the international level (36 out of 65 studies reviewed employed SFA). Some studies, for example, Styrin (2005); Figueira et al. (2006) checked the robustness of their results by employing both the SFA and DEA methods, with results showing that efficiency scores do not differ substantially across techniques.

The SFA method is a well-established parametric technique, originally proposed independently by Aigner et al. (1977) and Meeusen and Van Den Broeck (1977) which has been extended by Ferrier and Lovell (1990) for bank efficiency measurement.

The SFA method requires a particular production functional form, usually a translog functional form, to estimate the bank's maximum output level based on a set of production inputs, and allows for random errors. The basic idea is the introduction of an additive error term consisting of two components: a non-negative asymmetric distribution (usually a truncated or half normal distribution) representing production inefficiencies, and random errors, including statistical noise, measurement error and random shocks, that are external to the firm's control (Battese & Corra, 1977).

According to Fiorentino, Karmann, and Koetter (2006), the behavioural assumptions in the SFA method, such as cost minimization and profit maximization, are appropriate for bank efficiency measurement. The assumptions allow for the estimated coefficients in the cost and production function to vary stochastically (be positive or negative) over time, to reflect the changes in organizations, technologies and environment.

The estimated coefficients in the SFA method are, however, sensitive to data outliers (Fries and Taci, 2005). Originally designed for cross-section data, Gong and Sickles (1992) and Sickles (2005) found that a stochastic frontier model using panel data could achieve relatively high ranking correlations between estimated and true inefficiency compared with cross-sectional models, as the panel data model not only incorporates additional information from the times series nature of the data, but also allows SFA for distributional assumptions by maximum likelihood estimation.

The DEA method is the main estimation method used in previous New Zealand bank efficiency studies.The main argument against the SFA method being the assumptions made about the distribution of efficiency[26]. These assumptions, however, permit statistical hypothesis tests of the most likely shape of the frontier and the distortion of inefficiency. Compared with non-parametric DEA, the SFA method therefore has the ability to capture distortion, such as errors in the data arising from luck, data problems and other issues, thus making misidentification of measurement errors, transitory differences and specification errors in inefficiency less likely (Bauer et al, 1998, Berger et al, 2000). In addition, the SFA method does not have the same difficulties as the DEA method in terms of outliers and noise in the data **(**Battese and Coelli, 1995).

Another advantage in using the SFA method is the possibility of ranking the efficiencies of the firms in the same order as their cost or profit function residuals, regardless of which specific distributional assumptions are imposed.

4.2.2.2 Battese and Coelli (1995)Model

To estimate the determinants of a firm's inefficiency, there are two options, either the standard two-step SFA approach of Aigner et al. (1977), Meeusen and Van den Broeck

[26] Other considerations of data samples and price data availability are discussed through the remainder of this chapter.

(1977), and Pitt and Lee (1981), or a one stage SFA approach such as that in Battese and Coelli (1995).

The two-step approach estimates firm-level efficiency using stochastic frontier functions, and then regresses the predicted firm's efficiency on the firm-specific variables, such as managerial experience, ownership characteristic, etc. in an attempt to identify some of the reasons for differences in the predicted efficiencies between firms in an industry (Pitt & Lee, 1981).

Wang and Schmidt (2002) point out that the standard two-step approach suffers from the assumption that the efficiency term is independently identical half-normally distributed in the first step, while in the second step the efficiency terms are assumed normally distributed and dependent on the explanatory variables. This contradicts the assumption of identically distributed efficiency effects in the stochastic frontier.

Based on Kumbhakar, Ghosh, and McGuckin (1991) and papers from Battese and Coelli (1992, 1993) studies, Battese and Coelli (1995) proposed a model with a single stage maximum likelihood procedure for technical inefficiency effects in a stochastic frontier production (used for profit efficiency estimation) and cost function (cost efficiency estimation) for cross section data and panel data (balance and unbalanced).

Battese and Coelli (1995) specifies a stochastic cost frontier with the following properties:

$$\ln C_{i,t} = C\left(y_{i,t}, w_{i,t}, q; \beta\right) + \mu_{i,t} + \nu_{i,t} \qquad (4.1)$$

Where $C_{i,t}$ is the total cost bank i faces at time t, $C\left(y_{i,t}, w_{i,t}, \beta\right)$ is the cost frontier, $y_{i,t}$ represents the logarithm of bank output, i, at time t, $w_{i,t}$ is a vector of logarithm of bank input prices, i, at time t, **q** stands for a set of control variables and β is a vector of parameters to be estimated. The term $\mu_{i,t}$ is a non-negative random variable, which accounts for cost inefficiency, assumed to be independently identically distributed (iid) with a truncated normal distribution. $v_{i,t}$ captures measurement error and random effects and is distributed as a standard normal variable. Both $u_{i,t}$ and $v_{i,t}$ are represented as follows:

$$u_{i,t} \sim N^{+}\left(m_{i,t}, \sigma_{\upsilon}^{2}\right) \text{and } \nu_{i,t} \sim \text{iid}N\left(O, \sigma_{v}^{2}\right) \qquad (4.2)$$

$$m_{i.t} = \delta_0 + \sum_{n} \delta_{n,i,t} Z_{n,i,t} \qquad (4.3)$$

Equation (4.3) is the inefficiency model, in which explanatory variables $Z_{n,i,t}$, determine the mean of the inefficiency (m) of bank i at time t.

Equations (4.1) and (4.3) are estimated in one step using a maximum likelihood estimator, then the cost efficiency values are calculated. The value indicates the percentage of observed costs that would have been sufficient to produce the observed output. If the bank is fully efficient, the cost efficiency score for the bank will be 1.

Clearly, the Battese and Coelli (1995) model allows for a set of exogenous factors (equation 4.3) in the measurement of inefficiency, which reflects that their model allows for data heterogeneity in the distribution of the inefficiency term (Huang & Liu, 1994; Kumbhakar, 1991). Thus, in this study, we employ Battese and Coelli (1995) models to estimate both cost and alternative profit efficiency in the New Zealand banking market. Details of the alternative profit function are discussed in the empirical model section.

4.2.3 Choice of Inputs and Outputs

In the Battese and Coelli (BC) model (equation 4.1), $C\left(y_{i,t}, w_{i,t}, \beta\right)$ is the cost function, $y_{i,t}$ represents the logarithm of bank output, i , at time t, and $w_{i,t}$ is a vector of the logarithm of bank input prices, i, at time t. In modelling the cost (and alternative profit) function, it is important to define the vectors of input prices and outputs.

The determinants of the efficiency frontier depend on the choice of inputs and outputs in the frontier functions and data availability (Havrylchyk, 2006). However, there is no agreement as to the explicit definition and measurement of the bank's input and outputs.

In practise, it is common to operationalise bank production according to the fundamental intermediation approach suggested by Sealey and Lindley (1977), that banks are price takers in input markets to produce outputs. More specifically, the funds raised and the expenses incurred in the intermediation process are treated as inputs, whereas the funds

loaned and incomes generated are regarded as outputs (Avkiran, 2006). In this study, we define three input prices for labour, funds, and physical capital, and two outputs' quantities[27], total bank loans and total other earning assets. The details of input price measurement and output quantities and data are described below:

Price of labour (PL) is the total personnel cost divided by the numbers of full-time equivalent employees reported in the individual bank's balance sheet. In this study, KPMG (2002-2012a) provides the numbers of full-time employees[28] for all the banks in New Zealand, however, some of the banks have no accounting information reported on the total personnel cost over the study period (Kookmin Bank, The Bank of Tokyo-Mitsubishi[29]) or none available for some of the years (for example, Kiwibank data was not available 2002-2007). Some banks reported the data annually or semi-annually which required an adjustment to quarterly data (Rabobank, Kiwibank 2008-2011).

Kiwibank, as one of the two main New Zealand owned banks, operates with more nationwide branches (utilising New Zealand Post retail outlets) than all other banks in New Zealand (Wilson, Rose, & Pinfold, 2009). The bank has competed with foreign-owned banks in the New Zealand banking market since 2002 when it was first established and is included in spite of data deficiencies[30] on personnel cost for the period 2002-2007. Rather than simply eliminating the missing data period available data from 2008 to 2011 was used, based on the following assumptions.

First, the actual ratio of total personnel cost to total operating cost per annum[31] was calculated for the period 2008-2011, which was 38% on average. Next, based on this figure

[27] Due to the choice of alterative profit efficiency concept used in this study, output quantity was chosen, not output price which is generally used in the standard profit function.
[28] Quarterly employee numbers are not available for all banks, thus the available annual employee numbers for the four quarters throughout the year are used.
[29] We eliminated the two banks because the banks only accounted for 0.7% of the total banking sector assets at December 31, 2011 (Reserve Bank of New Zealand, 2012a). This is not expected to impact the results of this study.
[30] Omitting the missing data period would give unbalanced panel data, which can still be estimated in the model, however, balanced panel data is preferred to reduce the possibility of biased results.
[31] Where data on personal expenses are not reported, the calculation of the price of labour can be calculated based on the assumption that the ratio of the personnel expenses to operational expenses is the same as the closest available year, see for example, Altunbaş, Gardener, Molyneux, and Moore (2001); Zhang and Matthews (2012). In this study, the figure for the closest year of 2008 is 27%, which is lower than the industry benchmark, based on common knowledge, thus the average ratio of personnel cost to total operational cost from 2008-2012, which is 38%, is used.

and the available operating cost and employee numbers, the personnel cost per employee for the missing data for the period 2002-2007 was estimated and ,believed to be robust[32].

Price of funds (PF): Tripe (2005b) comments that liabilities reported on individual bank's balance sheets in New Zealand, and the issue of lack of consistent information on sources of banks' funding, limit the usefulness of the borrowed fund data from the balance sheets, despite all banks separately identifying deposit categories. Thus, following Tripe's suggestion, all interest-bearing liabilities, excluding subordinated debt, are used as total borrowed funds to reflect the funds used in the intermediation process. The price of borrowed funds is approximated by dividing the bank's total interest expenses over the total interest-bearing liabilities, exclusive of subordinated debt.

Price of physical capital (PPC): The book value of premises and fixed assets is defined as the total physical capital. The total physical capital is divided by the total operating cost, exclusive of total personnel cost, to give the bank's price of physical capital.

Loans (LOAN): Loans is an output variable. In this study the total amount of all types of loans, advances and lease finance reported in the bank's balance sheet is used. Under New Zealand's disclosure regime, registered banks are not required to report their lending by the same sectors, thus, the lack of consistent information on lending sectors across the banks limits the use of classified loans as outputs. On the other hand, in order to ensure the number of outputs and inputs are proportionate to the sample size of the study all types of banks' total loans are calculated.

Other interest earning assets (OIEA) is another output quantity variable used in this study**,** which includes the bank's trading securities, all other interest earning assets, such as other investment securities, plus balances with related parties, as reported on the individual bank's balance sheet.

[32] The estimated personnel cost per annum per employee in Kiwibank for the period 2002-2007 was $63,418, in line with the actual average annual personnel cost, $65,877 for 2008-2011. Thus, the assumption on the missing personnel cost is believed to be robust. However, it is noted that the price of labour increased dramatically in 2010 and 2011.

A bank's trading securities could also be used as an output variable in this study, however, some foreign branch banks (such as HSBC, Citibank) have reported zero trading security values in some quarters during the study period. As the log of zero values is undefined, this issue could terminate the computational process in the log form BC model used in this study, hence we use other interest earning assets including securities to solve this issue.

4.2.4 Choice of Explanatory Variables

In the BC model (equation 4.1), the inclusion of appropriate explanatory (control) variables (Z) in the inefficiency model $m_{i.t} = \delta_0 + \sum_n \delta_{n,i,t} Z_{n,i,t}$ (equation 4.3) is to capture the systematic influences of these control variables on inefficiency distribution $\mu_{i,t}$.

Following the foreign bank efficiency studies by Naaborg (2007) and Lenlink et al (2008)[33] in the European banking market, the control variables are specified in three categories: (1) bank industry features, such as banks' ownership, similarities between home and host countries, organizational form of foreign banks, mergers and acquisitions, and market concentration; (2) bank specific characteristics, including the general common control variables, bank size, asset quality and equity ratios; and (3) macroeconomic conditions, such as GDP growth, interest rates and inflation rates.

4.2.4.1 Banking industry specific variables

Ownership variable is used to test the home field advantage hypothesis that foreign banks are less efficient than domestic banks due to their competitive disadvantage (Berger et al., 2000). Ownership is defined as a dummy variable (DO), with a value of 1 if the bank has at least 50% foreign ownership, otherwise 0. All foreign banks selected in this study have 100% foreign ownership over the study period 2002-2011.

Based on the DEA results from Tripe (2003, 2005a, 2005b), the home field advantage hypothesis is expected to be rejected, and show that major foreign-owned banks (big four)

[33] Naaborg (2007) and Lenlink et al., (2008) are cross countries studies, thus some of the control variables, such as equity ratio, asset quality and GDP per capita growth are controlled in the cost functions. However, unlike their studies, these variables are controlled in the inefficiency equations, and no impact on the results are expected since the application of the BC (1995) model estimates the cost function, alternative profit function and inefficiency equations in the one stage estimation.

in New Zealand can be as efficient as domestic banks (Kiwibank and TSB). Bollard[34] (2004) commented on the impact of foreign banks' entries in New Zealand that the entries are associated with diffusion of new technologies and better resource allocation, thus greater efficiency should be transferred (through competition and/or imitation) to the New Zealand banking sector.

Similarity is defined as a dummy variable in this study to test the global limited advantage hypothesis that some national characteristics allow banks from certain nations (Australia in this study) to overcome the diseconomies of operating away from their home nation. The variable with a value of 1 represents banks from Australia, 0 if from other countries. The higher level of similarity between New Zealand and Australia in terms of economy, language, laws and politics, is expected to have positive effects on the efficiency scores for foreign banks.

To and Tripe (2002) examined the impact of the difference in GDP growth between New Zealand and Australia on foreign banks' performance in New Zealand, but found no evidence to support any such impact. However, the similar culture, language, close geographical distance, regulation policies, and integration of markets between New Zealand and Australia are expected to contribute to the level of foreign banks' efficiency in New Zealand.

Organizational form: Organizational form is also a dummy variable, taking the value of 1 if the bank is an incorporated subsidiary and 0 if the bank operated as a foreign branch. It is noticeable that Westpac Banking Corporation (Australia) had conducted its operation in New Zealand as a branch bank until 14 February 2006, when the bank was incorporated into Westpac New Zealand Limited as a wholly-owned foreign subsidiary of the same parent bank. Westpac New Zealand was deemed a systemically important bank and was therefore required to incorporate its local retail business by RBNZ in 2006, while the corporate business remains with the branch bank.

[34] Dr.Alan Bollard was the Governor of the Reserve Bank of New Zealand from September 2002 to May 2012.

Mergers and acquisitions: ANZ's acquisition of the National Bank in October 2003 made the acquiring bank[35] the largest in New Zealand, with more branches, more ATMs and more staff supporting customers than any other. However, the two banks continued to operate separately for ten years, under their own brands, to retain their retail and small business customers. The rural market operated under the National Bank name, while other segments used the brand name that benefitted their business, before the bank rebranded to ANZ in 2012.

To test whether the ANZ acquisition had any impact on banks' efficiency during the study period, a dummy merger and acquisition (DM) variable was created to represent the variable before/after ANZ acquisition: 0 pre- acquisition[36], 1 post-acquisition. All other banks in the panel data are set to 0 to represent no acquisitions. The Liu and Tripe (2003) study empirically showed that, for mergers and acquisitions between 1989 and 1998 in New Zealand, the majority of the mergers led to an increase in bank efficiency. Thus, the acquisition is again expected to significantly impact banks' efficiency levels.

Market concentration (MKTC): Market concentration ratios have the ability to capture structural features of the banking market, explaining competitive performance in the banking industry as the result of changes in market structure caused by a bank into the market or its exit from it, or a merger (Bikker & Haaf, 2002). Following Sufian and Habibullah (2012) and Hasan and Marton (2003), Fries and Taci (2005) the market concentration ratio (MKTC) in this study is defined as the asset share of the four largest banks to total New Zealand banking assets.

Chan et al. (2007) examined the extent of competition in the New Zealand banking market, finding the industry to be competitive and financially stable. Within a highly concentrated banking market dominated by foreign-owned banks, competition between foreign and domestic banks in the New Zealand market are deemed to be strong. In a competitive banking market, the impact of market concentration on bank efficiency may depend on the individual bank's managerial behaviours mitigating the competitive pressure (such as

[35] After ANZ's acquisition in October 2003, the bank amended its registered name to ANZ National Bank. Further details have been provided in Section 2.4 in Chapter 2.

[36] The ANZ acquisition was announced in October 2003, however, the aggregated accounting information for the acquiring bank is available from the second quarter in 2004, thus values for the DM variable for the period (2002:Q1- 2004:Q1) are set to 0, with 1 from quarter 2 in 2004 to quarter 4 in 2011.

product differentiation) to pursue their cost minimization and profit maximization objectives (Bikker & Bos, 2005; Shamsuddin & Xiang, 2012).

4.2.4.2 Bank specific characteristic variables

Bank size is considered an important determinant of bank efficiency, with the natural logarithm of banks' total assets Ln (TA) used to control for bank size heterogeneity in the frontier efficiency estimation. It is related to economy of scale in that a larger sized foreign bank may reduce the cost of gathering and processing information, and has market power in pricing and competing with domestic banks (Berger, 2003). Larger foreign banks often have a greater share of low cost deposits due to their large branch networks, especially for foreign banks which have accessibility to international fund markets, thus the external influences on a bank's interest or funding cost should impact the bank's asset size (Fiechter et al., 2011).

The quality of bank capital risk management is measured by the ratio of equity capital to total assets with Equity ratio (EQR) used as a measure of the bank's capital strength. A foreign bank, incorporated overseas, is required by RBNZ to hold the same level of capital adequacy in New Zealand as domestic banks, although registered foreign branches are not so required. Overseas banks are, however, required to comply with their home countries' minimum international capital standards, and must include this information on New Zealand disclosure statements (Reserve Bank of New Zealand, 2014b).

It is rational to assume that banks with higher capital ratios are relatively safer in the event of a loss or liquidation. However, the conventional risk-return hypothesis implies a negative effect of equity to assets ratios on foreign bank efficiency. A well-capitalized bank (both foreign and domestic) can still be considered to be risky, which is likely to reduce the bank's incentive for cost efficiency.

Another significant risk characteristic for both foreign and domestic banks is the bank's asset quality (AQ), which is measured by the ratio of impaired assets to total gross assets (or gross loans) as the credit risk variable used in this study. Impaired assets are the amount of bank loans not fully repaid or interest on the loans which may not be fully paid by the borrowers, thus, information on impaired assets provides a useful indication of the quality

of a bank's assets. All registered banks in New Zealand are required to disclose the amount of impaired assets and the level of provisioning against impaired assets.

Among previous foreign banks' efficiency studies, the ratio of loan loss provision to total loans has also been used to control for loan quality in some studies (Sharma et al., 2013; Sufian, 2011). The estimated sign using this ratio can, however, be unclear since higher provisions may imply either solidity or higher operating costs associated with extensive risk management operations (Barry, Dacanay III, Lepetit, & Tarazi, 2008). A bank can also spend more of their resources on credit underwriting and loan monitoring to have less loan loss provision (Kwan, 2003).

4.2.4.3 Macroeconomic control variables

The differences in the level of foreign banks' efficiency can be reduced when macroeconomic variables are included in the parametric frontier efficiency estimation model (Dietsch & Lozano-Vivas, 2000). This implies that neglecting macroeconomic conditions may lead to a misspecification of the common frontier, and hence overestimate bank inefficiency.

There are three major macroeconomic conditions (country-level) control variables used in this study. These include the unemployment rate and foreign exchange rates to control for the price of labour and cost of funds.

Year to year growth of the real gross domestic products (GDP) in New Zealand, a commonly used macroeconomic indicator to measure the total economic activities within an economy, was also utilised**.** To and Tripe (2002) investigated the factors influencing the performance of foreign-owned banks in New Zealand, with their results indicating no impact of GDP growth rates on foreign banks' overall profitability.

Tripe (2003, 2005b) used interest rates (IR) as a control variable to study the cost of funds and bank efficiency in New Zealand from 1996 to 2003. The author suggests that the 90 day bill is a key interest rate in New Zealand financial markets as it is the most prevalent maturity for bank funding and as a pricing reference (Tripe, 2005a). Tripe's (2003, 2005a) studies showed that banks in New Zealand have become more efficient, on average, over the period 1996 to 2002. This appears to be partially a consequence of the fall in general

interest rates, as measured by the 90 day bill rate, which, over the period 2002-2011, changed within a range of 1.5% to 5.3%.

Following the foreign bank efficiency studies by Sufian and Habibullah (2012) and Vu and Nahm (2013), macroeconomic risk is also accounted for by controlling for the inflation rate (IFR) in the host country. The aforementioned studies reveal a positive relationship between inflation and bank efficiency.

New Zealand has inflation targeting in its monetary policy, under the Policy Targets Agreement (PTA) (Reserve Bank of New Zealand, 2012b) between the government and the Reserve Bank, to achieve price stability and avoid unnecessary instability in outputs, interest rates and the exchange rate over the long and medium term (Monetary Policy, RBNZ, www.rbnz, co.nz). The PTA defines price stability as an annual increase in the Consumer Price Index (CPI) between 1 and 3, on average, over the medium term. Since September 2000, New Zealand's CPI has averaged around 2.7%. In this study the relatively low inflation rate is expected to maintain the soundness and efficiency of the financial system in New Zealand.

As well as the three important macroeconomic variables above, other studies (Berger and Mester, 1997; Dietsch and Lozano-Vivas, 2000; Frei et al., 2000) have gone beyond the usual set of variables drawn from the bank's balance sheet and have been more informative. Using a broader set of variables to look deeper into how the host nation's macroeconomics can help explain efficiency differences between foreign-owned and domestic banks.

Consequently, we test if the foreign exchange rate (FX) has the effect of capturing foreign currency risks as an off-balance sheet item. The trade-weighted index (TWI) was used to examine if foreign exchange risks/exposures impact a foreign bank's efficiency in New Zealand. The TWI index is a weighted average of the New Zealand dollar against the currencies of New Zealand's major trading partners. RBNZ prefers this summary measure for capturing medium-term effects of exchange rate changes on the New Zealand economy and inflation (Reserve Bank of New Zealand, n.d.)

An increase in unemployment can create financial difficulties for customers which in turn reduces the bank's total loan volume (Gocer, 2013). A low unemployment rate can have a positive effect on the bank's interest margin and profitability, thus profit efficiency (Mahabadi & Yang, 2015). Following suggestions in Tecles & Tabak,'s (2010) study, the unemployment rate (UNEMP) is included to capture labour effects on foreign banks' efficiency in New Zealand. The rate is as reported by Statistics New Zealand, sourced from the House Labour Force Survey (Statistics New Zealand, 2015).

4.3 Data

This section describes the data, data sources and data heterogeneity issues and solutions.

4.3.1 Data

Table 4.1 Sample Banks: 2002-2011

Selected Banks	Country of Origin	Organizational Form	Market share*
Foreign-owned			
ANZ National Bank	Australia	Subsidiary	29.2
Bank of New Zealand	Australia	Subsidiary	18.2
ASB Bank limited	Australia	Subsidiary	16.6
Westpac	Australia	branch**	19.5
Rabobank Nederland	Netherlands	branch	2.7
HSBC	UK	branch	1.3
Deutsche Bank A G	Germany	branch	0.8
Citibank N.A	US	branch	0.5
Domestically owned			
TSB Bank Limited			1.3
Kiwibank Limited			3.7

Source: RBNZ
Notes:
*: Individual bank's market share is as a proportion of the total assets of the banking system, as at 31 December 2011
** Westpac was defined as foreign branch, although the retail business was separated to Westpac New Zealand Limited since 2006. The disclosures for the bank group provide aggregated data.

There were a total of 20 banks (see Table 2.1) registered with the RBNZ during the study period 2002-2011. However, as a result of data filtering, only 10 banks (see Table 4.1) which have continuously operated in New Zealand over the study period were selected,

which together hold more than 96% of the country's total banking assets[37]. Banks which either have insignificant market share, or were newly established (less than 3 years' of operation in the New Zealand banking market) were eliminated. Unfortunately, quarterly price data on personnel costs are not available during the study period and were also therefore omitted.

One of the reasons for the lack of SFA efficiency studios in New Zealand is the small number of banks (Tripe, 2003, 2005b). In this study, quarterly data, which includes a total of 400 observations (40 quarters x 10 banks), was used, which is sufficient for an SFA estimation.

Table 4.1 presents the 10 selected banks by ownership, country of origin, organizational form and market share. All banks have either 100% foreign or domestic ownership[38].

4.3.2 Data Source

All banks are required by the Reserve Bank of New Zealand to publish public disclosure statements quarterly. This enables the quarterly total cost (dependent variable in cost function), total profit before tax (dependent variable in alternative profit function), and quantities (not price) of inputs and outputs variables discussed in section 4.2.3 to be readily obtained. Bank-specific variables (bank size, equity and impaired assets) are obtained from the Income Statement and Balance Sheet disclosure included in the General Disclosure Statements for the 10 selected banks in New Zealand. The macroeconomic variables discussed in Section 4.2.4.2 are sourced from Statistics New Zealand, released and published on RBNZ's website.

Another important data source is the annual Financial Institutions Performance Surveys[39] (FIPS) conducted by KPMG New Zealand. The surveys provide annual analysis of the

[37] The result was based on the information from the Reserve Bank of New Zealand (2012a),Since these 10 banks represent the bulk of the New Zealand banking market, to some extent, the New Zealand banking market as a whole was measured, rather than only foreign-owned banks.
[38] See Chapter 2 New Zealand Banking System, for details of the ten major banks' profiles.
[39] The FIPS annual survey has been produced by KPMG New Zealand since 1989. The survey includes the New Zealand financial sector performance, individual banks' performance rankings, analysis of annual results and major retail banks' performance. The survey also provides the New Zealand banking industry overview, regulatory changes and challenges, and financial institution profiles (KPMG, 2011).

performance of New Zealand‘s registered banks, major finance companies and saving institutions from which annual accounting operating cost efficiency, staff numbers, banks profiles, foreign ownership and banking industry update data was sourced.

There are some issues regarding accounting information reported in the individual bank’s disclosure statements that deserve attention. The first issue arises from the RBNZ requirements differing between on-quarter and off-quarter disclosures. The on-quarters are made at the half year and annual balance dates, which disclose more extensive information, and are subject to full external audit at the end of the financial year and a limited scope audit review at the half year. Disclosure statements issued at the “off quarters” (the first quarter and the third quarter of the bank’s financial year) disclose relatively less information, and are not required to be audited (Brash, 1997). This is, however, not expected to have significant impact on the estimated results.

Another issue arising from the quarterly disclosures is the diversity of the balance sheet dates for financial statements. Each bank’s financial year ended in different quarters to be in line with the parent bank’s accounting policy and standard, which forces the adjustment of quarterly data for some banks (if their financial year does not fit the calendar year). This necessitated some adjustment to the data for some of the variables (total cost, total profit before tax, total personnel cost, operating cost, and personnel cost) sourced from the bank’s income statement. Tripe (2004) uses adjusted quarterly data for the DEA model on bank efficiency in the integrated banking market between Australia and New Zealand and believes that the diversity of balance sheet dates has not led to any significant distortion in his results.

Similarly, ANZ’s acquisition of the National Bank in December 2003 also raises a data issue for ANZ National (ANZ NZ) bank, the new company post- acquisition. During the study period 2002-2011, disclosure statements are available for the National Bank and ANZ bank until the first quarter of 2004, then the National Bank data was incorporated into ANZ NZ bank, despite the two banks continuing their operations under separate brands until 2012. Thus, the data for the acquiring bank, ANZ bank, was obtained from the bank’s disclosure before (and including) the first quarter of 2004, and the aggregated data for the remaining study period (2004:Q2 to 2012:Q4) from ANZ National Bank disclosures.

4.3.3 Data Heterogeneity

According to Greene (2004), data heterogeneity is often classified as observed and unobserved heterogeneity. Observed heterogeneity can be reflected in measured variables, given the variations caused by a firm's size, risk profile, regulatory and market characteristics (cross-country studies). However, these variables are unable to capture all the heterogeneities, as there is unobserved heterogeneity which is difficult to quantify. The problematic modelling issues in separating unobserved heterogeneity from estimated inefficiency items has not been addressed. Thus, in the SFA model, unobserved heterogeneity is assumed to remain constant over time.The main concern for researchers is issues arising from observable data heterogeneity, which is the likelihood of treating given variations as inefficient.

Table 4.2 Data Descriptive of Bank-level Variables

Variables	Mean	SD	Min	Max
Dependent Variable				
Total costs	406.53	485.45	10.00	2378.00
Total profits before tax	98.68	119.57	0.38	550.00
Inputs				
Total interest expenses	314.99	386.10	0.08	1969.00
Total funds	23801.43	26833.09	29.87	106391.00
Personnel expenses	42.85	52.99	0.77	273.00
Total Staff numbers	2300.00	2841.00	33.00	9534.00
Fixed assets	105.34	168.34	0.16	734.00
Operating costs	48.79	57.25	0.14	302.00
Outputs				
Total loans	21397.98	25908.28	6.99	99268.00
Other interest earning assets	3692.35	3514.00	4.43	17386.00
Bank Characteristics				
Total assets	27596.47	31875.82	177.14	132127.00
Total Impaired assets	222.25	423.17	0.00	2410.00
Equity	1933.04	2672.22	0.00	11270.00
Equity Ratios	0.06	0.04	0.00	0.38

Notes:
1) Other than staff numbers, variables are in millions of New Zealand dollars.
2) Total observations=400

Table 4.2 illustrates the considerable variation in the minimum and maximum values of bank-level inputs and outputs and other bank-level control variables used in this study.

Tripe (2005b) asserts that New Zealand banking is quiet heterogeneous, with bank loans for foreign subsidiaries, foreign branches and domestic banks varying substantially in size, while loan repayment schedules, risks, transparency of information, and type of collateral are also different across the banks. In terms of borrowed funds, banks with different ownership may pay different rates depending on their funding sources and their response to changes in market conditions (Bos & Kool, 2006). These differences are likely to affect the costs of bank loan origination and ongoing monitoring costs, amongst others, which should be taken into consideration when measuring foreign banks' efficiency.

One of the reasons why the Battese and Coelli (1995) model was chosen, is that it can account for both random noise and systemic differences between banks due to heterogeneity (Kumbhakar & Lovell, 2000), and allows a relative comparison of markedly different banks varying in ownership, organizational form, size, and risk portfolios: for example, foreign banks compared to domestic banks or foreign subsidiary banks verses foreign branches. However, to make the best effort to control data heterogeneity in the BC (1995) model inefficiency specifications, the 10 selected banks are divided into 3 groups according to ownership, types of business, and organizational form to define 3 common frontiers. This allows comparison of systemic differences between banks caused by different levels of data heterogeneity within these groups. Pooling the banks in different groups would implicitly assume efficiency differences across the banks are attributed to managerial decisions within the group, not technological differences.

Group A includes all 10 selected banks (8 foreign-owned banks and 2 domestic banks), which account for 96.3 % of total banking assets as at 31 December 2011 (Reserve Bank of New Zealand, 2012a)(Financial Stability Report, RBNZ, 2012). This group is used to examine the home field advantage hypothesis (Berger and Mester, 2000) and the group efficiency scores also give the reader an insight the level of efficiency in the overall New Zealand banking industry.

Group B is restricted to six major banks (Big Four banks, Kiwibank and TSB bank), which account for 88.2% of total banking assets in New Zealand (Reserve Bank of New Zealand, 2012a). The six banks are full service retail banks with the same and/or similar nature of0 business. The six banks are also subject to similar regulatory requirements and compete in the same market conditions, and are, therefore more homogeneous than those in group A.

Group B is also designed to examine the home field advantage hypothesis, but estimated on a dataset with less heterogeneity issues. Consequently, we expect the explanatory variables (Zs) have more power to interpret the factors influencing the differences in foreign banks' efficiency relative to domestic banks. The majority of the previous New Zealand studies estimated the efficiency on similar major banks using the DEA method. Group B banks are our preferred banks.

Group C consists of 8 foreign banks (3 locally incorporated subsidiaries and five foreign branch banks), which account for 88.50 % of total banking assets. This group, named the foreign banking group, is used to test the limited global advantage hypothesis and the impact of organizational form on the efficiency scores. Despite the ownership of the banks in this group being similar, the impact of the difference in organizational form make it less homogenous than group B.

Apart from estimating the level of efficiency by comparing foreign banks and domestic banks within each group, a major strength of the SFA method is its ability to rank the banks' efficiency scores. Of particular interest is the identification of best and worst efficient banks in each classified groups.

4.4 Empirical Models

The Battese and Coelli (1995) model chosen allows simultaneous estimations of the frontier cost and alternative profit function and inefficiency functions in a single, maximum likelihood procedure to avoid the problems of two-step estimation approaches.

4.4.1 Cost Function

The cost function specifies the minimum cost in producing the output vector, given the cost drivers such as price of inputs, managerial inefficiency, some economic factors, such as GDP growth, interest rates, and inflation rate in the host country, or just pure luck.

Table 4.3 summarises the definition of input prices, output quantities and explanatory variables (Zs in equation 4.3) and the two dependent variables total cost (TC) and total profit before tax (TP) used in the empirical models.

Table 4.3 Description of Variables

Notations	Variables	Definitions
Dependent Variables		
TC	Total Cost	Total interest cost plus non-interest cost
TP	Total profit	Total profit before tax
Input		
PL	Price of Labour	Total personnel cost/total number of employees
PF	Price of Funds	Total Interest expenses/Total deposits and other interest bearing liabilities
PPC	Price of physical capital	Operating cost-personnel cost/ total fixed assets
Output		
LOAN	Loans	Total loans and advances
OIEA	Other Interest Earning assets	Total other interest earning assets
Control variable		
T	Year	On the order of quarter 1 to 40 (2002-2011)
Industry-specific variables		
DO	Dummy ownership	1 if 100% foreign-owned 0 otherwise
DS	Dummy similarity	1 if Australian-owned,0 otherwise
DORG	Dummy organizational form	1 if subsidiary bank, 0 if foreign branch
DM	Dummy merger	1 if merged banks, 0 otherwise
MKTC	Market concentration	Ratio of the 4 largest banks' assets to the total of New Zealand banking assets
Bank-specific variable		
LNTA	Bank size	Log of total assets
EQR	Equity ratio	Total equity/total assets
AQ	Asset quality	Ratio of impaired assets to total assets
Macroeconomic conditions		
GDPG	GDP growth	Quarterly real year to year GDP growth rate
IR	Interest Rate	90 days bank bill yields wholesale rates
IFR	Inflation Rate	Real CPI inflation rate
FX	Foreign Exchange Rate	Real Trade-Weighted index (TWI5) on New Zealand dollar value.
UNEMP	Unemployment Rate	The year to year growth of the unemployment rate quarterly

In line with the BC (1995) model cost function (equation 4.2), following similar approaches as Naaborg (2007), Lensink et al (2008), Tecles and Tabak (2010) and Rossi et al (2005), the cost function in logs is specified below:

$$
\begin{aligned}
\ln\left(\frac{TC}{PL}\right)_{i,t} &= \beta_0 + \beta_1 \ln\left(\frac{PF}{PL}\right)_{i,t} + \beta_2 \ln\left(\frac{PPC}{PL}\right)_{i,t} + \beta_3 \ln(\text{LOAN})_{i,t} + \beta_4 \ln(\text{OIEA})_{i,t} \\
&+ \beta_5 \frac{1}{2}\left[\ln\left(\frac{PF}{PL}\right)_{i,t}\right]^2 + \beta_6 \left[\ln\left(\frac{PPC}{PL}\right)_{i,t}\right]^2 + \beta_7 \frac{1}{2}\ln\left[(\text{LOAN})_{i,t}\right]^2 + \beta_8 \frac{1}{2}\ln\left[(\text{OIEA})_{i,t}\right]^2 \\
&+ \beta_9 \ln\left(\frac{PF}{PL}\right)_{i,t} \ln\left(\frac{PPC}{PL}\right)_{i,t} + \beta_{10} \ln\left(\frac{PF}{PL}\right)_{i,t} \ln(\text{LOAN}_{it}) + \beta_{11} \ln\left(\frac{PF}{PL}\right)_{i,t} \ln(\text{OIEA})_{i,t} \\
&+ \beta_{12} \ln\left(\frac{PPC}{PL}\right)_{i,t} \ln(\text{LOAN})_{i,t} + \beta_{13} \ln\left(\frac{PPC}{PL}\right)_{i,t} \ln(\text{OIEA})_{i,t} + \beta_{14} \ln(\text{LOAN})_{i,t}(\text{OIEA})_{i,t} \\
&+ \beta_{15} \ln\left(\frac{PF}{PL}\right)_{i,t} T + \beta_{16} \ln\left(\frac{PPC}{PL}\right)_{i,t} T + \beta_{17} \ln(\text{LOAN})_{i,t} T + \beta_{18} \ln(\text{OIAE})_{i,t} T \\
&+ \beta_{19} T + \frac{1}{2}\beta_{20} T^2 + \mu_{i,t} + v_{i,t}
\end{aligned}
\tag{4.4}
$$

$$
\text{Where } \mu_{i,t} \sim N^{+}\left(m_{i,t}, \sigma_{\upsilon}^2\right) \text{ And } \nu_{i,t} \sim \text{iidN}\left(O, \sigma_{\nu}^2\right) \tag{4.5}
$$

$$
m_{i.t} = \delta_0 + \sum_{n} \delta_{n,i,t} z_{n,i,t} \tag{4.6}
$$

Where the dependent variable TC (total cost), in the cost function, is the sum of interest cost and operating cost. To avoid the problem of singularity in the disturbance covariance matrix of the equations, the dependent variable (TC), and the independent variables - price of funds (PF) and price of physical capital (PPC) - are normalized by price of labour (PL) before taking logarithms to impose linear input price homogeneity.

ln represents the natural logarithm, *i* denotes individual banks, t time horizon (quarters). The term $\mu_{i,t}$ captures cost inefficiency and is independently identically distributed with a truncated normal distribution. $v_{i,t}$ captures measurement errors and other random errors, and is distributed as a standard normal variable. Both $\mu_{i,t}$ and $v_{i,t}$ are time and bank specific.

Since the cost function (equation 4.4) is a second order approximation, on time-varying panel data, T and T^2 are introduced into the model specification to allow the model to

capture changes in technology, regulatory reforms and other external shocks over time[40]. These changes transform the banking environment as a whole and, since the observation period 2002-2011 covers the global financial crisis (2007-2009), the T variable is included to investigate the impact of global financial crises on banks' performance.

The cost efficiency measures take on values between 0 and 1, where 1 indicates a fully cost efficient bank. The value indicates the percentage of observed cost that would have been sufficient to produce the observed outputs if the bank was fully efficient. A cost efficiency score of 0.70 for a bank suggests that the bank would have incurred only 70% of its actual costs had it operated on the cost frontier.

4.4.2 Alternative Profit Function

Following Miller and Parkhe (2002), Isik and Hassan's (2002) studies, an alternative profit function relative to the term of standard profit function is used to measure how closely a bank approaches maximum profits, given its output levels rather than output prices in a standard profit function. The modified alternative profit function has identical independent and exogenous variables to the cost function (equation 4.4), but the dependent variable is the bank's total profit before tax (TP).

$$
\begin{aligned}
\ln\left(\frac{TP}{PL}\right)_{i,t} &= \theta_0 + \theta_1 \ln\left(\frac{PF}{PL}\right)_{i,t} + \theta_2 \ln\left(\frac{PPC}{PL}\right)_{i,t} + \theta_3 \ln(\mathrm{LOAN})_{i,t} + \theta_4 \ln(\mathrm{OIEA})_{i,t} \\
&+\theta_5 \frac{1}{2}\left[\ln\left(\frac{PF}{PL}\right)_{i,t}\right]^2 + \theta_6\left[\ln\left(\frac{PPC}{PL}\right)_{i,t}\right]^2 + \theta_7 \frac{1}{2}\ln\left[(\mathrm{LOAN})_{i,t}\right]^2 + \theta_8 \frac{1}{2}\ln\left[(\mathrm{OIEA})_{i,t}\right]^2 \\
&+\theta_9 \ln\left(\frac{PF}{PL}\right)_{i,t} \ln\left(\frac{PPC}{PL}\right)_{i,t} + \theta_{10} \ln\left(\frac{PF}{PL}\right)_{i,t} \ln(\mathrm{LOAN})_{i,t} + \theta_{11} \ln\left(\frac{PF}{PL}\right)_{i,t} \ln(\mathrm{OIEA})_{i,t} \\
&+\theta_{12} \ln\left(\frac{PPC}{PL}\right)_{i,t} \ln(\mathrm{LOAN})_{i,t} + \theta_{13} \ln\left(\frac{PPC}{PL}\right)_{i,t} \ln(\mathrm{OIEA})_{i,t} + \theta_{14} \ln(\mathrm{LOAN})_{i,t}(\mathrm{OIEA})_{i,t} \\
&+\theta_{15} \ln\left(\frac{PF}{PL}\right)_{i,t} T + \theta_{16} \ln\left(\frac{PPC}{PL}\right)_{i,t} T + \theta_{17} \ln(\mathrm{LOAN})_{i,t} T + \theta_{18} \ln(\mathrm{OIAE})_{i,t} T \\
&+\theta_{19} T + \frac{1}{2}\theta_{20} T^2 + \theta_{21} \ln(\mathrm{NPI})_{i,t} + \phi_{i,t} - \varphi_{i,t}
\end{aligned}
\tag{4.7}
$$

[40] Since a translog function is a second order approximation, a trend is included with a t and $\mathbf{t}^2$ term (Coelli, Rao, O'Donnell, & Battese, 1998).

Where $\phi_{i,t} \sim N^{+}\left(n_{i,t}, \pi_{\upsilon}^{2}\right)$ and $\varphi_{i,t} \sim \text{iid}N\left(O, \pi_{v}^{2}\right)$ (4.8)

$$n_{i.t} = \pi_0 + \sum_{n} \pi_{n,i,t} z_{n,i,t} \quad (4.9)$$

The alterative profit function is specified in terms of input prices and output quantities. Similar to the cost function (equation 4.4), the logarithm of the price of labour (PL) is subtracted from both sides of the alternative profit function without losing the generality, as given in equation (4.7):

Where Total profit (TP) before tax[41] is the dependent variable in the alternative profit function (4.7). There is a possibility of shifting profitable activities from foreign banks in New Zealand to their parent bank overseas, which could have an impact on foreign banks' net profitability, hence, the level of profit efficiencies for these foreign banks (To and Tripe, 2002).

Different from $\mu_{i,t} + v_{i,t}$, as the disturbance term in the cost function (equation 4.4), in the alternative profit function (equation 4.7), $\phi_{i,t} - \varphi_{i,t}$ represent the specified disturbance term. The term $\phi_{i,t}$ captures profit inefficiency and is independently identically distributed with a truncated normal distribution. $v_{i,t}$ captures the measurement error and random effects, and is distributed as a standard normal variable while $n_{it} = \pi_0 + \sum_{n} \pi_{n,i,t} z_{n,i,t}$ (equation 4.9) is the profit inefficiency equation. All Zs, control variables, in the equation can capture the systematic differences (i.e. profit inefficiency) due to the data heterogeneity.

Similar to the cost function (equation 4.4), T and T^2 are also used as control variables in the alternative profit function to allow the model to capture changes in technology,

[41] Return on equity has been used as a dependent variable in the alternative profit function, however, according to Tripe (2005b), in New Zealand, the book value of equity in accounting disclosure appears to be much less than market value, which could impact the level of banks' profit (Return on Equity).

regulatory reforms and other external shocks that can transform the banking environment as a whole.

There is an issue in the presence of negative profit for some banks, for example, Kiwibank has negative annual profits from 2002 to 2004, while Rabobank has negative quarterly profit after the adjustment from annual to quarterly data. In a translog specification, the log of negative numbers is not defined and different solutions exist in the literature. One solution is to eliminate such observations, which is not encouraged due to the small data sample. Another solution is to add the minimum profit (i.e. the maximum negative profit in the sample) plus 1 to each bank's profits before taking the log. Both of these approaches can bias the results (Bos, Heid, Koetter, Kolari, & Kool, 2005).

Following the suggestion by Bos et al. (2005), a negative profit indicator variable, NPI, was constructed as an additional right-hand side variable. For banks that exhibit positive profits, the NPI variable has a value of one, while for banks with negative profits, the negative profit variable on the left hand (TP) was replaced with value 1, and on the right hand the absolute value of negative profits was included as the NPI variable, but the value in the translog function was logged.

The primary advantage of the alternative profit function is that it allows for measurement of inefficiency on both output and input sides of the firm, providing a way of controlling for unmeasured quality differences in banking services. In other words, it enables us to examine the ability of foreign versus domestic banks or large banks versus small banks, to generate profits for the same levels of output and therefore reduce the bias that might be present in the standard profit function. The alternative profit function assumes banks have some market power to vary output prices, which it is believed, to some extent, exists in New Zealand's banking market.

The profit efficiency scores can be directly generated using the computer program Frontier 4.1. The measure of profit efficiency also ranges over the [0, 1] interval and equals one for the best-practice bank in the sample. The efficiency scores indicate the percentage of actual profits (before tax) relative to what the bank could have realised given its price of input and output mix. A 0.70 profit efficiency suggests that the bank would earn about 30% more profits than what it is making now if it were operating on the efficiency frontier.

4.4.3 Specifications of Stochastic Inefficiency Error terms

To obtain the inefficiency terms, an attempt to capture the impact of data heterogeneity in the cost inefficiency equations $m_{i.t} = \delta_0 + \sum_n \delta_{n,i,t} z_{n,i,t}$ (equation 4.6) and alternative profit inefficiency $n_{i.t} = \pi_0 + \sum_n \pi_{n,i,t} z_{n,i,t}$ (equation 4.9) was made.First, a model with bank-level characteristic variables (including bank industry and bank-specific characteristics (discussed in Section 4.2.4) was specified as the baseline model (1), with the assumption that all banks operate under the same macroeconomic conditions in New Zealand. The real value of the macroeconomic conditions variables (discussed in Section 4.2.4.3) were then added to model (1) to provide an inclusive model, called model (2).

Table 4.4 Variables in Inefficiency Equations by Bank Groups and Models

Groups	Model 1	Model 2
Group A : 10 sample banks		
ANZN	**Industry-Specific**	**Macroeconomic**
BNZ	Ownerhsip	GDP growth
Westpac	Merger	Interest rate
BNZ	Market Concentration	Inflation rate
HSBC	**Bank-specific**	Foreign exchange rate
Rabobank	Bank size	Unemployment rate
Deutsche Bank	Equity ratio	
Citibank	Asset quality	
Kiwibank		
TSB		
Group B: 6 Major Banks		
ANZN	**Industry-Specific**	**Macroeconomic**
BNZ	Ownerhsip	GDP growth
Westpac	Merger	Interest rate
BNZ	Market Concentration	Inflation rate
Kiwibank	**Bank-specific**	Foreign exchange rate
TSB	Bank size	Unemployment rate
	Equity ratio	
	Asset quality	
Group C: 8 Foreign Banks		
ANZN	**Industry-Specific**	**Macroeconomic**
BNZ	Similarity	GDP growth
Westpac	Organizational form	Interest rate
BNZ	Merger	Inflation rate
HSBC	Market Concentration	Foreign exchange rate
Rabobank	**Bank-specific**	Unemployment rate
Deutsche Bank	Bank size	
Citibank	Equity ratio	
	Asset quality	

4.4.3.1 Bank Industry and Bank Specific Inefficiency Model (Model 1)

The cost inefficiency equation (4.6) and alternative profit inefficiency equation (4.9) in the standard Battese and Coelli (1995) model discussed in Section 4.2 can be rewritten in equation (4.12) and (4.13), respectively.

$$m_{i,t} = \delta_0 + \delta_1 DO_{i,t} + \delta_2 DM_{i,t} + \delta_3 MKTC_{i,t} + \delta_4 LnTA_{i,t} + \delta_5 EQR_{i,t} + \delta_6 AQ_{i,t} \quad (4.12)$$

$$n_{i,t} = \pi_0 + \pi_1 DO_{i,t} + \pi_2 DM_{i,t} + \pi_3 MKTC_{i,t} + \pi_4 LnTA_{i,t} + \pi_5 EQR_{i,t} + \pi_6 AQ_{i,t} \quad (4.13)$$

Where $m_{i,t}$ and $n_{i,t}$ are the inefficiency distribution specifications extended, based on equations (4.6) and (4.9), for cost inefficiency and alternative inefficiency, respectively, where $Z_{n,i,t}$ represents the bank-specific explanatory variables (discussed in Section 4.2.4):

- DO: Dummy ownership
- DM: Dummy merger
- MKTC: Market concentration
- LNTA: Total assets
- AQ: Asset quality
- EQR: Equity ratio

The above two inefficiency measurement equations apply to both banks in group A and group B panel datasets, as the two groups of banks are designed to test the home field advantage hypothesis and the general form of the global advantage hypothesis.

To test the limited form of the global advantage hypothesis, and investigate the impact of organizational form on foreign banks' efficiency, the dummy ownership variable (DO) is removed, but the following two dummy variables (similarity and organizational form) are added into equation (4.12) and equation (4.13), which generate the cost inefficiency equation (4.14) and alternative profit inefficiency equation (4.15) to measure group C banks' panel data.

$$m_{i,t} = \delta_0 + \delta_1 DS_{i,t} + \delta_2 DORG_{i,t} + \delta_3 DM_{i,t} + \delta_4 MKTC_{i,t} + \delta_5 LnTA_{i,t} + \delta_6 EQR_{i,t} + \delta_7 AQ_{i,t} \quad (4.14)$$

$$n_{i,t} = \pi_0 + \pi_1 DS_{i.t} + \pi_2 DORG_{i,t} + \pi_3 DM_{i,t} + \pi_4 MKTC_{i,t} + \pi_5 LnTA_{i,t} + \pi_6 EQR_{i,t} + \pi_7 AQ_{i,t} \quad (4.15)$$

The cost inefficiency equation (4.14) and alternative profit inefficiency equation (4.15) when applied to group C banks, show the factor of banks' efficiency without and with macroeconomic variables, respectively. The main focus is to investigate how merger activities, similarity and organizational form influence foreign banks' efficiency.

4.4.3.2 Macroeconomic Conditions Model (Model 2)

To investigate the impact of the macroeconomic conditions on foreign banks' efficiency in group A and group B banks, five macroeconomic variables:

- GDPG: GDP growth
- IR: interest rate measured by 90 day bill rate
- IFR: CPI inflation rate
- FX: foreign exchange rate
- UNEMP: Unemployment rate

are added into equation (4.12) and (4.13) in model (1), to obtain the cost inefficiency equations (4.16) and alternative profit inefficiency equations (4.17), respectively for model (2).

$$m_{i,t} = \delta_0 + \delta_1 DO_{i,t} + \delta_2 DM_{i,t} + \delta_3 MKTC_{i,t} + \delta_4 \ln TA_{i,t} + \delta_5 EQR_{i,t} + \delta_6 AQ_{i,t} + \delta_7 GDPG_{i,t} + \delta_8 IR_{i,t} + \delta_9 IFR_{i,t} + \delta_{10} FX_{i,t} + \delta_{10} UNEMP_{i.t} \quad (4.16)$$

$$n_{i,t} = \pi_0 + \pi_1 DO_{i,t} + \pi_2 DM_{i,t} + \pi_3 MKTC_{i,t} + \pi_4 \ln TA_{i,t} + \pi_5 EQR_{i,t} + \pi_6 AQ_{i,t} + \pi_7 GDPG_{i,t} + \pi_8 IR_{i,t} + \pi_9 IFR_{i,t} + \pi_{10} FX_{i,t} + \pi_{10} UNEMP_{i,t} \quad (4.17)$$

For foreign banks in group C, the same set of macroeconomic variables are added into equation (4.14) and (4.15) in model (1), to generate the cost inefficiency equation (4.18) and profit inefficiency equation (4.19) for model (2), respectively:

$$m_{i,t} = \delta_0 + \delta_1 DS_{i,t} + \delta_2 DORG_{i,t} + \delta_3 DM_{i,t} + \delta_4 MKTC_{i,t} + \delta_5 LnTA_{i,t} + \delta_6 EQR_{i,t} + \delta_7 AQ_{i,t} + \delta_7 GDPG_{i,t} + \delta_8 IR_{i,t} + \delta_9 IFR_{i,t} + \delta_{10} FX_{i,t} + \delta_{10} UNEMP_{i,t} \quad (4.18)$$

$$n_{i,t} = \pi_0 + \pi_1 DS_{i,t} + \pi_2 DORG_{i,t} + \pi_3 DM_{i,t} + \pi_4 MKTC_{i,t} + \pi_5 LnTA_{i,t} + \pi_6 EQR_{i,t} + \pi_7 AQ_{i,t} + \pi_7 GDPG_{i,t} + \pi_8 IR_{i,t} + \pi_9 IFR_{i,t} + \pi_{10} FX_{i,t} + \pi_{10} UNEMP_{i,t} \quad (4.19)$$

All the inefficiency equations in both model (1) and (2) are estimated in the cost function (equation 4.4) and alternative profit function (equation 4.6) simultaneously, using maximum likelihood estimation as a one stage approach via the computer program Frontier 4.1 (Coelli, 1996)

4.5 Computer Program

The Frontier version 4.1 computer program developed by Coelli (1996) was chosen as it has been written to provide maximum-likelihood estimates of the parameters of a number of stochastic frontier production and cost functions, and function forms which have dependent variable in logged units. The program can accommodate balanced (and unbalanced) time-varying panel data and assume firm effects that are distributed as truncated normal random variables (Coelli et al.2005).

There are several reasons for the choice. First, Frontier 4.1 is a single purpose package specially designed for the estimation of technical efficiency (including cost and profit efficiency). Second, according to Battese and Coelli (1992, 1995), Frontier 4.1 model specifications are the primary program in Frontier 4.1, which enable the estimation of cost and alternative profit inefficiency equations designed in the log. Third, the estimates of individual bank's efficiency are produced as a direct output from the program, which enables the user to specify distributional assumptions for estimating the inefficiency term in a program control file.

Chapter 5
Empirical Results

5.1 Introduction

In this chapter, Section 5.2 provides the descriptive statistics of the data and Section 5.3 presents and assesses the maximum likelihood estimates (MLE) for cost, alternative profit functions and associated inefficiency functions. The chapter also reports the changes in operating cost efficiency (accounting) ratios (Section 5.4) for the sample banks over the study period 2002-2011.

Section 5.5 compares the mean cost and profit efficiency scores from different banking groups (group A, B and C) using two inefficiency models (with and without macroeconomic inefficiency effects). The study also ranks individual bank's mean cost and profit efficiency levels within each group and in both models, but focuses on the evaluation of the stability of efficiency for the six major banks' (four foreign and two domestic banks).

5.2 Descriptive Statistics

The data used in the study covers 40 quarters for the period between 2002 and 2011, obtained from individual banks' quarterly disclosure statements, annual reports, statistics from Reserve Bank of New Zealand's online resource and annual Financial Institutions Performance Surveys by KPMG (2002-2011b).

Table 5.1 presents the descriptive statistics of the 10 sample banks in group A (3 foreign incorporated subsidiaries, 2 domestic banks and 5 foreign branch banks); 6 major banks in group B (the big four foreign banks and 2 domestic banks) and 8 fully foreign banks (3 foreign subsidiaries and 5 branch banks) in group C. The number of observations are 400, 240 and 320, respectively. All groups contained a balanced panel dataset. The values reported in Table 5.1 are in millions of New Zealand dollars except for employee numbers and quality variables with prices or ratios.

Table 5.1 Descriptive Statistics of Industry-and Bank-specific Variables

Variables	Group A		Group B		Group C	
	Mean	SD	Mean	SD	Mean	SD
Dependent Variable						
Total costs (TC)	406.53	485.45	628.90	517.99	489.692	509.139
Total profits before tax(TP)	98.68	119.57	148.67	129.56	120.548	124.382
Inputs						
Total interest expenses	314.99	386.10	483.68	420.23	381.54	404.76
Total funds	23801.43	26833.09	36189.10	28481.10	28744.87	27839.25
Price of funds(PF)	0.01	0.00	0.01	0.00	0.01	0.01
Personnel expenses	42.85	52.99	68.35	55.25	51.82	55.69
Total staff numbers	2300.00	2841.00	3745.00	2869.00	2761.65	3001.00
Price of labour(PL)	0.15	1.65	0.02	0.01	0.18	1.85
Fixed assets	105.34	168.34	173.33	188.95	127.28	181.73
Operating costs	48.79	57.25	76.87	58.95	56.45	61.07
Price of physical capital(PPL)	1.92	3.86	0.74	0.76	2.16	4.27
Outputs						
Total loans(LOAN)	21397.98	25908.28	33872.40	26928.70	25929.54	27089.91
Other Interest earning assets(OIEA)	3692.35	3514.00	4275.14	3064.27	4366.45	3616.19
Explantory variable						
Total assets (TA)	27596.47	31875.82	42104.50	34053.50	33318.11	33198.83
Total Impaired assets	222.25	423.17	333.86	509.06	273.86	458.65
Asset quality(AQ)	0.01	0.01	0.01	0.01	0.01	0.01
Equity	1933.04	2672.22	3056.08	2945.32	2353.58	2835.29
Equity ratios(EQR)	0.06	0.04	0.71	0.03	0.05	0.04
Maket Concentraion(MKCT)	0.86	0.03	0.86	0.03	0.86	0.03

Notes:

1) Other than prices, ratios, staff numbers, all variables are in millions of New Zealand dollars.

2) Observations for group A=400
Observations for group B=240
Observations for group C=320

The table reports the means, and standard deviations (SD) of the variables[42]. The price of funds (PF), price of labour cost (PL), price of physical capital (PPC), asset quality (AQ) and capital equity ratios (EQR) across the 3 groups of banks exhibit low standard deviations (SD). Notably, almost no SD value was reported in all three groups of banks for the price of funds, which indicates the responses are fairly uniform on the input price

[42] The Coefficient of variation (CV) was computed (SD scaled by mean), and the results in group B banks exhibit the lowest CV ratios among the three groups of banks, which indicate more homogenous in group Banks compared with the other two groups of banks.

variables used in the cost function (equation 4.4), alternative profit function (equation 4.7), and bank performance ratios as explanatory variables in the inefficiency models (equation 4.12 to 4.19). The large SD on the two output quantity variables, total loans (LOAN) and other interest earning assets (OIEA), confirm considerable dispersion of the data amongst the sample banks in the different groups; however, this may simply indicate the natural heterogeneity of the variables.

Table 5.2 Descriptive Statistics of Macroeconomic Variables (2002-2011)

Variable(notation)	Mean	SD	Mini	Max
GDP growth (GDPG)	2.5	2.09	-2.6	6
Interest rate (IR)	0.057	0.021	0.027	0.089
Inflation rate (IFR)	2.802	0.999	1.5	5.3
Foreign exchange rate (FX)	67.311	7.673	38.53	77.73
Unemployment rate (y/y growth) (UNEMP)	4.894	17.689	-18.1	54.6

Table 5.2 reports the mean of quarterly macroeconomic variables over the period 2002-2011. The average growth rate of GDP is approximately 2.5%, interest rate, measured by the 90 day bank bill rate, has a mean rate of 5.7%, while the year to year growth in unemployment is 4.89%. The mean of inflation rates is fairly low (2.8%) over the study period. These low mean values indicate that the macroeconomic condition in New Zealand is considered stable over the study period of 2002-2011, despite the economy deteriorating sharply following the 2007 global financial crisis and domestic recession from 2008[43].

5.3 Parameter Estimates and Model Specification

This study employs the "one-step approach", based on Battese and Coelli 's (1995) model, for the panel data groups A, B and C, to control for data heterogeneity. The two-step approach is used to solve the model's econometric problems (see Chapter 4). The parameter estimates and efficiency scores (discussed in the next section) are obtained from the defined cost and alternative profit functions (equation 4.4 and 4.7, respectively), and

[43] New Zealand has felt relatively moderate impact from the global financial crisis, compared with other nations in the OECD. In 2009 the economy picked up and economic activity continued to improve, driven mainly by the rebuilding of Canterbury after the Christchurch earthquake and recovery in domestic demand (New Zealand Government, 2014).

the associated inefficiency functions (equations 4.12, 4.14, 4.16, 4.18 and 4.13, 4.15, 4.17, 4.19, respectively) using the software Frontier 4.1 method of maximum likelihood (Collie, 2007).

The parameter estimates, reported in Tables C.1 and C.2 (see in Appendix C), are classified under three categories: first, the frontier estimates in cost and alternative profit function (equations 4.4 and 4.7, respectively), second, the coefficients of the explanatory variables in inefficiency models (equations 4.12 to 4.19), and finally the values of the model indicators, such as Likelihood ratios (LR) and gamma values. Results are compared across the three groups of banks and two models and subsequently, tested to achieve the preferred specification.

5.3.1 Maximum Likelihood Estimates

The advantage of the maximum likelihood estimation process in Frontier 4.1 for panel data is that repeated observations of the same firm make it possible to estimate the firm's level of efficiency more precisely (Coelli et al., 2005)

The results of the maximum likelihood estimates in Table C.1 and C.2 produce two important observations. First, the cost and alternative profit function in this study (equations 4.4 and 4.7) are second order[44] linear models (logarithm of the likelihood functions), which involve cross-products (interaction terms) and squares of the independent variables prohibiting the isolation of direct effects (Mendenhall & Sincich, 2012). Interpretation the values of the maximum likelihood estimators: β s in the cost function (equation 4.4), and, θs in the alternative profit function (equation 4.7), are, consequently, not straightforward. Following the comments from several previous foreign bank efficiency studies (Thi, Anh, & Vencappa, 2008), the estimates of the interaction terms by themselves have little informational value.

It is, however, apparent that the value of the **t** statistics are significant in both frontier functions and inefficiency equations. In Table C.1 (in Appendix C), 145 of 185

[44] Since most relationships in the real world are curvilinear to some extent, a second-order model would be appropriate (Mendenhall & Sincich, 2012).

coefficients (81 %) are statistically significant at the 5% and 1% level in the cost function (equation 4.4), and cost inefficiency functions (equations 4.12, 4.14, 4.16 and 4.18). Similarly, Table C.2 (in Appendix C) shows 70% (134 out of 191) of the alternative profit function (equation 4.7), and profit inefficiency terms' functions (equations 4.13, 4.15,4.17 and 4.19) are significant at the 5% level or better.

5.3.2 **Model Specification**

The indicators in Table C.1 and C.2 for equation 4.4 and 4.7 and corresponding inefficiency equations (4.12-4.19), are summarised to assess the fitness of the models and specifications.

The gamma values for the frontier function are reported under the "model indicators" category in Table C.1 and Table C.2, ranging from 0.79 (in group B model 2) to 0.997 (in group C model 2) in the cost function, while 0.99 overall for the alternative profit function. This value indicates the proportion of variation in the composite error terms is due to inefficiency components. The gamma values in the alternative profit function are, overall, close to one (in Table C.2 and equation 4.7) and are statistically significant at 1%, indicating that the profit inefficiency effects are likely to be highly significant in the analysis of the value of banks' outputs (Battese and Coelli, 1995)

Another major test used in assessing goodness of fit in logistic regression is log likelihood ratio (LR). In this study, it is used with one-sided error to assess the fitness of the cost and alternative profit functions (equations 4.4 and 4.7), and associated inefficiency equations, to determine the existence of a frontier and the inefficiency effects. The statistics for each defined banking group and the two models are automatically generated from the Frontier 4.1 computer program (Coelli, 1996), and presented under "model indicators" category in Table C.1 and C.2.

The values of the log LR ratios range from the lowest of 78.78 (in group B model 1) to the highest of 226.16 (in group C model 2) across the groups of banks in the two models[45]. The values exceed the critical level of 30.81 and 32.08[46] respectively in cost function and

[45] The log LR can be positive for modified log likelihood function, with large LR ratios caused by the small standard derivation in scaling price data on inputs used in cost and alternative profit equation 4.4 and 4.7.

[46] Standard statistical practise is to compare the results at the 95 percent probability (i.e. at 5 percent of significance), with three restrictions (representing the "degree of freedom" in the model) that the

alternative profit function at 5% significance, which indicates the existence of cost and profit inefficiency effects in the frontier models; in addition, the presence of the inefficiency effect is not spurious, and the explanatory variables in the cost and profit inefficiency equations are stochastic, related to deviations from the estimated common cost and alternative profit frontiers.

The higher overall LR ratios in model (2) in all groups of banks reveal that the macroeconomic variables included in the cost inefficiency equations provide a better statistical fit than model (1). In addition, it is likely that the joint effects with macroeconomic explanatory variables (model 2) on the inefficiencies of production are significant, although the individual effects of one or more of the variables may not be statistically significant. Notably, the relatively lower LR ratios in group B banks in both models might be partially due to the smaller number of observations[47] (n=240) compared with group A (n=400), and C (n=320) banks.

The sign and magnitude of the T variable and ½ T squared variables is presented under the first category in the cost and alternative profit function in Tables C.1 and C.2, which together determine the characteristic of the functions that can be increasing or decreasing over the study period. Therefore, the overall statistically significant negative in Table C.1 (positive in Table C.2) coefficients of variable T (1/2 squared T variables are overall positive) indicate an overall decreasing (increasing) time effect on the cost (alternative profit) function. The results on T variables in this study also support the advantage of the panel-data frontier estimation technique that enables us to distinguish inefficiency from observable explanatory variables and time specific effects (Kumbhakar, 1991).

In terms of the appropriateness of the sample size in this study, this is a relatively small sample size with a large t (40 quarters) and small n (10 banks). However, according to Mendenhall and Sincich (2012), for multiple regression models, the number of data points

relationship in the model is valid. However, it does not apply to the test with Chi-squared distribution (Coelli et al, 2005). We obtained the chi-squared critical value of degree of freedom=20 in cost function (equation 4.4) and degree of freedom=21 in equation 4.7 at 5% significance from (Kodde & Palm, 1986), Table 1: Upper and Lower bounds for the critical value for jointly testing equality and inequality restrictions.

[47] However, caution is required as the matters regarding the properties of log LR statistics are not straightforward if the sample size is small (Coelli et al., 2005, p. 225).

(40 quarters as data points in this study) must exceed the number of parameters (22 in cost frontier equation 4.4 and 23 in alternative profit function equation 4.7) in the model to ensure that there are sufficient data to estimate the parameters in the second-order model. Therefore, that the dataset sample used in this study meets the requirement of sample size, with 400 observations in group A, 240 in group B and 320 in group C banks.

5.4 Operating Cost Efficiency Ratio

The practical approach to benchmark the level of a bank's operating cost efficiency is to analyse the ratio of its operating expenses to operating income. In practise, lowering the ratio remains an important focus in banks' cost management. The ratio has also been generally used by bank management to assess its cost level and structure in contrast to best practise banks in the industry (Hess & Francis, 2004). This measure has intuitive appeal, compared with sophisticated parametric or non-parametric frontier efficiency techniques such as DEA or SFA, and can be used to cross check the frontier efficiency results.

Table C.2 (in Appendix C) provides the operating efficiency ratios for the 10 sample banks in this study. The mean results show, on average, a small, continuing operating efficiency improvement overall for the period 2002-2011.The overall reduction in the ratios reflects these banks have continually driven to control costs and implement efficient programmes.

Table 5.3 Operating Efficiency Ratios

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Mean
ANZN	48.70	50.15	45.75	47.85	44.82	41.54	43.43	44.39	47.49	48.20	46.23
BNZ	45.82	44.86	52.30	48.88	44.12	40.55	40.38	47.03	48.72	39.92	45.26
ASB	51.26	47.86	47.65	44.81	42.60	40.08	44.24	41.80	44.07	42.94	44.73
Westpac	42.41	41.50	40.52	40.25	39.48	39.39	40.37	38.52	38.34	39.29	40.01
TSB	45.17	46.46	44.42	44.06	41.53	40.55	40.09	39.91	36.19	39.54	41.79
Kiwibank	169.71	122.96	97.92	88.36	82.06	78.71	73.57	57.44	67.56	64.04	90.24
Rabobank	62.39	53.41	53.38	58.01	49.99	44.13	50.04	24.02	29.84	37.14	46.24
HSBC	46.51	65.96	72..39	66.19	62.36	53.58	53.20	41.40	37.81	43.71	54.31
Citibank	33.83	45.61	49.09	46.31	59.80	50.63	28.90	36.71	44.80	47.36	44.30
Deutsche	8.68	7.25	7.00	11.28	60.00	89.66	31.67	22.89	90.48	53.41	44.30
Mean	55.45	52.60	51.04	49.60	52.68	51.89	44.59	39.41	48.53	45.56	

Source: KPMG (2002-2012)

Note: (1) From 2004, the ratios are obtained for ANZ National bank based on the consolidated data of the merged ANZ National Bank. (2) Ratios for Westpac (2006-2011) do not include Westpac New Zealand Limited

The efficiency ratios for the big four foreign banks (ANZN, BNZ, ASB and Westpac) range from 40.01% to 46.23%. The efficiency ratio of ANZN, BNZ and Westpac bank remained relatively flat over the study period while ASB continuously exhibits decreasing ratios (indicates increasing operating efficiency) from 51.26% in 2002 to 42.94% in 2011. Rabobank Bank's efficiency ratios also increased significantly over the period with exceptional increase from 53.38 in 2004 to 58.01 in 2005 possibly affected by the increased marketing cost for promoting a new brand (Raboplus) in this year (KMPG, 2006). However, Deutsche Bank shows significant decreases in the operating efficiency ratios: 8.68% in 2002 and 90.48% in 2010. The high ratio in 2007 may partially due to the bank's unwound structure financial deal in 2005 which lowered the trading income on derivatives (KPMG, 2008).

Recently, the big four foreign banks in New Zealand appear to be embracing the use of social media to transform communication and ease the payment system thus reducing their operational costs. ASB bank has made the greatest inroads in the Social Media World, while domestic banks such as TSB and Kiwibank appear to have less ability to develop and compete in this new business culture.

For the two domestic banks, TSB has a mean ratio of 41.79%, which is lower than ANZN, BNZ and ASB bank (46.23%, 45.26%, 44.73%, respectively), but slightly higher than Westpac (40.01%). Kiwibank a newly established bank, exhibited high ratios (low efficiency) in the early years but improved over time, 64% by 2011, although still not quite comparable with other major banks. The higher ratio was largely a result of Kiwibank's continuing expansion. Given the size of the Kiwibank branch network, personnel expenses represent a significant expense for the bank with employee numbers increasing to 1029 in 2011 (KPMG, 2011)

Although the operating cost to operating income ratio is well accepted by finance practitioners as an operating efficiency indicator, it does have theoretical and practical limitations (see Chapter 3). It might also neglect to control for product mix or input prices (Berger, et al, 1993). A blind pursuit of accounting based efficiency might reduce a bank's cost efficiency by cutting back on those expenditures necessary for the banks' operation (DeYoung, 1998).

5.5 Estimations of Efficiency

In this section, following the dimensions of the defined models and specifications in Chapter 4, cost and alternative profit efficiency scores generated under each common frontier (banking group), that exclude (model 1) but include (model 2) macroeconomic conditions are presented and compared. The stability in cost and profit efficiency for the major banks (group B) in model (2) over the 40-quarters Q1: 2002-Q4:2011 are also illustrated. Group B banks were chosen as the preferred group as it is a relatively homogenous group, while model (2) is the preferred model as it accounts for industry-specific and bank-specific characteristics, and macroeconomic conditions as potential inefficiency effects.

5.5.1 Banking Industry Efficiency

Analysing the mean cost and alternative profit efficiency scores for each banking group provides an insight into the efficiency for the predominately foreign-owned New Zealand banking industry[48].

Table 5.4: Mean CE, APE by Groups and Models

	Model (1)		Model (2)	
Groups (number of banks)	**CE**	**APE**	**CE**	**APE**
Group A: full sample banks (10)	0.824	0.536	0.833	0.547
Group B: Major banks (6).	0.959	0.720	0.963	0.719
Group C: Full sample foreign banks(8)	0.848	0.622	0.852	0.596

Notes: (1) CE: Cost Efficiency (2) APE: Alternative profit efficiency

(2) Mean efficiency of groups are simply the arithmetic averages of the the individual efficiency

[48] Industry efficiency can be viewed as the average of the efficiencies of all the firms in the industry (Coelli et al., 2005, p. 255). Due to price data unavailability and other considerations, it is not possible to include all the banks in the banking industry over the study period, however, the sample banks in each group account for over 80% of the total assets of the New Zealand banking industry as discussed in Chapter 3. Thus, the mean efficiency scores in each group are viewed as bank efficiency performance in New Zealand over the study period 2002-2011.

A summary of the mean cost efficiency and alternative profit efficiency scores for group A, B and C banks in models (1) and (2) is presented in Table 5.4.

The estimated mean cost efficiencies are 0.824, 0.959, and 0.848 in model (1) for the full sample banks (group A), major banks (group B) and full sample foreign banks (group C), respectively. This suggests that, banks, on average, need 17.6%, 4.1 % and 15.2% more resources to produce the same outputs as the best-practice bank under the common frontier.

Turning to the mean alternative profit efficiency (APE) scores in Table 5.4, the data shows that the APE scores range from 0.536 to 0.720 across the three groups of banks in the two models. This suggests that, on average, the banks could have realised between approximately half or a quarter more profit, compared with actual profit, if the banks had chosen optimal input and output mixes, which is higher than that in alternative profit efficiency studies of U.S banks. For example, Berger and Mester (1993) found that the US banking industry appeared to lose about half of its potential variable profits to inefficiency, while 0.33 to 0.67 were reported in Berger and Mester's (1997) study.

There are two noteworthy results in Table 5.4. First, there are large differences in mean CE and APE across the three groups of banks and in both models, which may strengthen the need to estimate common frontiers under each banking group due to the data heterogeneity. The highest CE of 0.963 and PE of 0.719 in both models for group B banks, for instance, suggest that higher efficiency levels are associated with a more homogenous dataset. Vedula and Tripe (2004b), in their DEA study, report that major banks achieved X-efficiency ranging from 0.86 to 0.96 for the period 2000 to 2002.

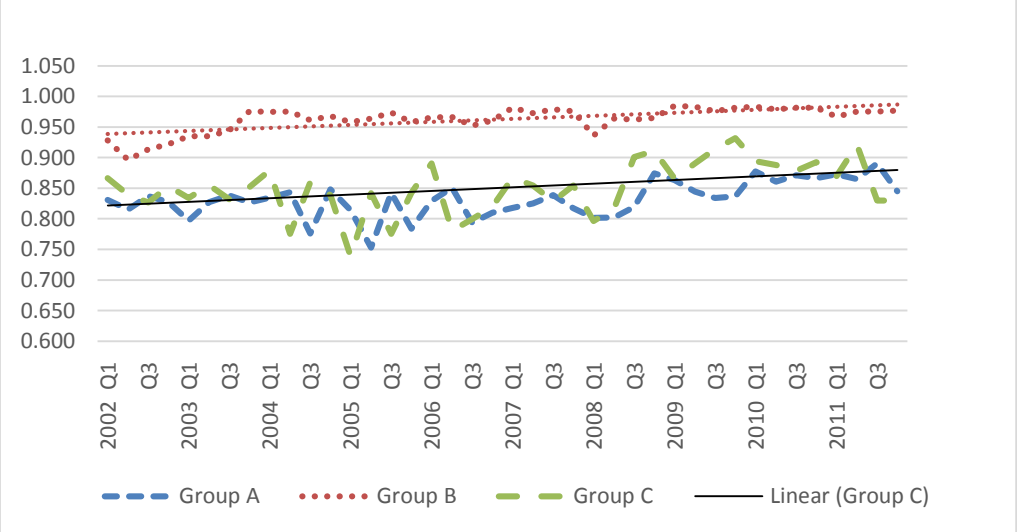
Second, the mean cost efficiency substantially outweighs the alternative profit efficiency in all groups and in both model (1) and (2), which supports the findings in Rossi et al's (2005) study on banks in 9 CEE countries (1995-2002) and Yildirim and Philippatos's (2007) in 12 CEE countries (1993-2000), where foreign banks were found to be more cost efficient but less profit efficient relative to banks with other types of ownership. The overall lower profit efficiency level indicates that banks' management in New Zealand might have pursued growth in order to maximise managers' interests rather than shareholders' utility, which could reduce the banks' profits. Williams (1998), De Young

and Nolle (1996) and Mghaieth and El Mehdi (2014) also reported similar results in their studies.

The mean CE and APE for banks in all the groups in model (2) differ marginally from the results in model (1), with the largest difference only 0.026 (in group C banks). This information alone does not necessarily suggest that the macroeconomic factors have no impact on banks' cost efficiencies, as the overall higher LR-test statistics in model (2) across all three banking groups support the importance of considering macroeconomic variables in this study.

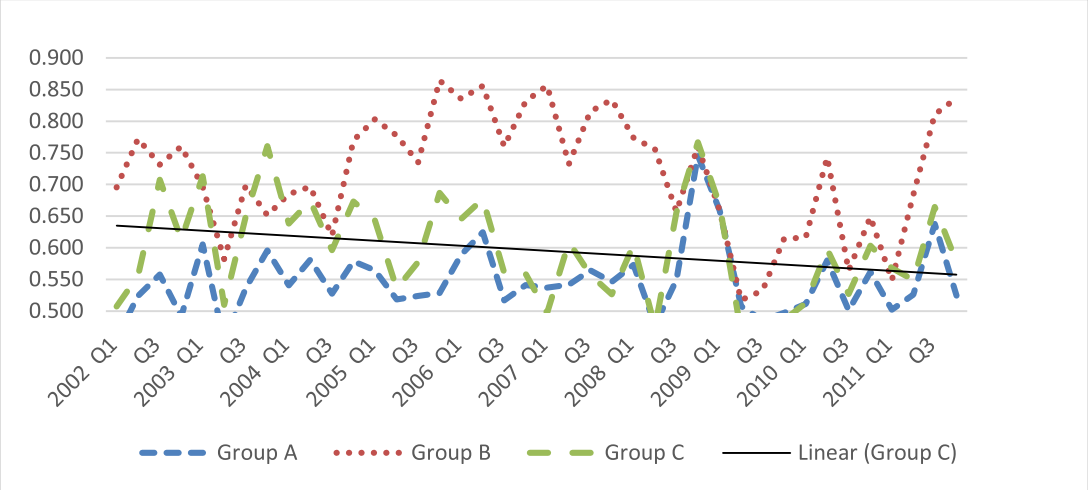
Figure 5.1 shows a higher level of cost efficiency overall for the six major banks (group B) compared with other two group of banks in model (2), and a slight increase in cost efficiency over the study period, which is in line with the improvement in the mean accounting measurement operating efficiency shown in Table 5.3.

Figure 5.1 Comparison of Mean CE by Bank Groups in Model (2) (2002-2011)



The level of mean APE across all groups (Figure 5.2) shows more variation compared with that of mean CE, slightly decreasing overall through the 40 quarters, except for the sharp fall shown 2009/ 2010, possibly due to the deterioration caused by the GFC from 2007 to 2009.

Figure 5.2 Trends of Mean APE by Bank Groups (2002-2011)



5.5.2 Comparison of Bank's Cost Efficiency

In Table 5.5, it is apparent that the mean CE scores for the four systemically important banks (ANZN, BNZ, ASB and Westpac) change minimally across groups and models. However, the mean cost efficiency scores for two domestic banks (Kiwibank and TSB) in group B improved markedly.

The mean cost efficiency for individual banks in each group in both models, and ranks[49] are reported in Table 5.5. The mean CE for 8 foreign banks and 2 domestic banks pooled in group A was calculated based on the results in Table 5.5 finding the average mean CE for foreign banks in group A is 0.876 in model (1), and 0.889 in model (2), compared with 0.620, 0.607 in model (1) and (2), respectively, for domestic banks. In the preferred group (B) banks, this was 0.980 and 0.972 for foreign banks, but 0.917 and 0.944 for domestic banks in model (1) and model (2), respectively. These results suggest that foreign banks in New Zealand yield a slightly higher level of cost efficiency on average than domestic

[49] According to (Berger et al., 2009) , when researchers represent their efficiency results, the levels of cost and profit efficiency of banks are more accurate than ranks because the levels account for the measured distance from the best-practice frontier. However, efficiency ranks can be more comparable across time. Neither the levels nor the ranks are clearly superior ex ante, thus both are shown in this study.

banks over the study period 2002 to 2011, although in the retail banking market (group B), with fewer differences in cost efficiency among the six major banks.

Table 5.5 Mean CE by Banks, Groups and models

	Model (1)		Model (2)	
Group A: Full Sample Banks	**CE**	**Rank**	**CE**	**Rank**
ANZN	0.938	4	0.949	2
BNZ	0.934	5	0.942	4
ASB	0.957	1	0.958	1
Westpac	0.944	2	0.948	3
Rabobank	0.876	6	0.883	6
HSBC	0.939	3	0.933	5
Citibank	0.814	7	0.821	7
Deutsche	0.604	9	0.677	8
TSB	0.653	8	0.638	9
Kiwibank	0.586	10	0.577	10
Group Mean Efficiency	0.824		0.833	
Group B: Six Major Banks.				
ANZN	0.967	4	0.957	5
BNZ	0.983	2	0.976	2
ASB	0.986	1	0.982	1
Westpac	0.982	3	0.975	3
TSB	0.922	5	0.958	4
Kiwibank	0.911	6	0.929	6
Group Mean Efficiency	0.959		0.963	
Group C: Full Sample Foreign Banks				
ANZN	0.965	3	0.945	4
BNZ	0.967	2	0.956	3
ASB	0.977	1	0.968	1
Westpac	0.960	4	0.960	2
Rabobank	0.770	6	0.774	6
HSBC	0.846	5	0.880	5
Citibank	0.695	7	0.716	7
Deutsche	0.608	8	0.615	8
Group Mean Efficiency	0.848		0.852	

There are marginal differences in the mean CE scores for individual banks across groups between models (1) and (2). Kiwibank exhibits the lowest efficiency scores compared with other banks in both group A and B in both models This may indicate new bank entry into a competitive banking market, and macroeconomic conditions such as interest and inflation rates may have more impact on this bank's efficiency than the well-established banks.

The ranking in Table 5.5 is based on the average cost efficiency scores over 40 quarters for the banks in each group and two models. There are slight changes in the ranking order for some of the banks, such as ANZN, BNZ, and TSB banks, although the ranking orders show less variability in group B compared with that in other groups in both models. This suggests the impact of data heterogeneity in groups A and C might have resulted in an overestimation of inefficiency estimations.

ASB Bank is ranked as the most cost efficient bank across all groups in both models over the study period, for example, with the highest efficiency scores of 0.957, 0.986 and 0.977 in groups A, B and C, respectively, in model (1). This indicates that ASB bank only need improve 4.3%, 1.4% and 2.3% under the common frontier in each group and to be on the optimal cost efficient frontier in each bank group. Tripe's (2004b) study reported that ASB bank exhibited continuous improvements in technical efficiency over the three year period from 2000 to 2002. Interestingly, ANZ National Bank ranked with different orders across the groups and models.

A review of the results for group B in model (2) in Table 5.5 shows there is marginal difference in cost efficiencies among the major banks. ASB bank is the most cost efficient bank with the highest 0.982 efficiency score, closely followed by BNZ bank (0.976) and Westpac bank (0.975). Notably, TSB can be as same cost efficient (0.958) as ANZ National bank (0.957) while Kiwibank (0.929) is the least cost efficient bank.

Not surprisingly, Kiwibank, a newly established bank, is the least cost efficient bank among all the sample banks in this study, reflecting that a bank's age might be related to efficiency since bank production might involve higher learning costs in the short term (Berger and Mester, 1997).

TSB, another domestic bank, also shows a relatively lower cost efficiency score compared with other foreign banks, including both incorporated and foreign branch banks, which could indicate that foreign banks are more effective in controlling cost compared with domestic banks in New Zealand.

Among the small foreign branches in Groups A and C, HSBC bank is the most cost efficient foreign branch bank while Duetsche Bank is the least efficient (excludes Westpac bank as a large foreign branch.) Different from other small foreign branch banks, HSBC

bank has recently seen a rapidly growing presence in the commercial sector in addition to the traditional corporate sector as it aims to provide quality multi-products, and multi-channel services in New Zealand, leveraging off the strengths and resources of the group internationally. Duetsche Bank's ranking as the least cost efficient foreign branch bank might be attributed to the impact of the unwound structured finance deal in 2005 which lowered its trading income on derivatives during the GFC period (KPMG, 2006, 2007).

5.5.3 Comparison of Bank's Profit Efficiency

Berger & Mester (1997) suggest that cost and alternative profit efficiency are not directly comparable because they are reported in terms of different denominators. Profit efficiency incorporates both cost and revenue efficiencies and their interactions (Akhavein, Berger, & Humphrey, 1997).

The mean APE scores are presented in Table 5.6 for all the sample banks across the three groups. Compared with the ranking orders for cost efficiency, the following changes are identified: (i) ASB Bank, as the most cost efficient bank in all groups, become the least profit efficient bank in both group A and group B (ii) ANZ National Bank, the least cost efficient bank among the major banks, is, however, the most profit efficient bank but ranked as second most efficient bank in group C, while (iii) Kiwibank, the least cost efficient bank , moved up the ranks to be a more profit efficient bank than the four small foreign branch banks. TSB Bank also shows greater profit efficiency than foreign branch banks and ASB bank in groups A and B over both models.

Based on the mean APE for individual banks (both foreign and domestic banks) in group A and B in Table 5.6, the average APE for pooled foreign banks (including foreign subsidiaries and foreign branches) was calculated, and compared to that of the domestic banks in the same group. The table shows conflicting results between groups A and B. Foreign banks in group A have mean APE scores of 0.432 in models (1) and 0.439 in model (2), compared to domestic banks' means of 0.553 and 0.575 in model (1) and (2), respectively. However, in the preferred group (B), foreign banks exhibit higher mean PEs (0.756 in model 1, and 0.751 in model 2), compared to 0.648 in model (1) and 0.656 in model (2) for the domestic banks. Thus, the models can confirm that major foreign banks are more profit efficient than domestic banks in New Zealand.

Table 5.6 Mean APE by Banks, Groups and Models

	Model (1)		Model (2)	
Group A: Full Sample Banks	**APE**	**Rank**	**APE**	**Rank**
ANZN	0.791	1	0.787	1
BNZ	0.743	2	0.747	2
ASB	0.619	5	0.635	5
Westpac	0.715	3	0.727	4
Rabobank	0.377	7	0.390	8
HSBC	0.368	8	0.388	9
Citibank	0.217	10	0.225	10
Deutsche	0.423	9	0.419	6
TSB	0.714	4	0.736	3
Kiwibank	0.391	6	0.415	7
Group mean efficiency	0.536		0.547	
Group B: Six Major Banks.				
ANZN	0.794	1	0.793	1
BNZ	0.752	2	0.745	4
ASB	0.726	5	0.712	5
Westpac	0.751	3	0.755	2
TSB	0.732	4	0.746	3
Kiwibank	0.565	6	0.567	6
Group mean efficiency	0.720		0.719	
Group C: Full sample Foreign Banks				
ANZN	0.775	2	0.785	1
BNZ	0.737	3	0.758	2
ASB	0.769	1	0.740	3
Westpac	0.705	4	0.700	4
Rabobank	0.572	5	0.483	5
HSBC	0.487	6	0.458	6
Citibank	0.478	7	0.389	8
Deutsche	0.451	8	0.458	7
Group mean efficiency	0.622		0.596	

It is apparent that Tables 5.5 and 5.6 show that there are adverse changes in the ranking orders of CE and APE for ASB and ANZ National banks. Isik and Hanssan's (2002) study of banks in Turkey found that the coefficient correlations (0.19) between banks' cost and profit efficiency were low, suggesting that cost inefficient banks can become more profit efficient at the same time in a concentrated banking market such as Turkey. It appears to be true in the New Zealand context too.

The efficiency literature reaches no agreement on the correlation between cost and profit efficiency. Banks generally focus on different efficiency management measures regarding their efforts to generate profits by increasing revenues versus efforts to eliminate slack on the cost side. However, some of the low correlations between cost and profit efficiency might be the result of a failure to account for heterogeneity (Bos et al., 2005).

5.5.4 Evolution of Cost Efficiency over Time

In this section, the focus is the stability of cost efficiency for individual banks in model (2). Figure 5.3 provides the mean efficiency scores for each group over the 40 quarters from 2002 to 2011. It appears that the Big Four banks exhibited less fluctuation over time, and also retained a static, higher cost efficiency level overall across the three groups, compared with two domestic banks and foreign branches in model (2),

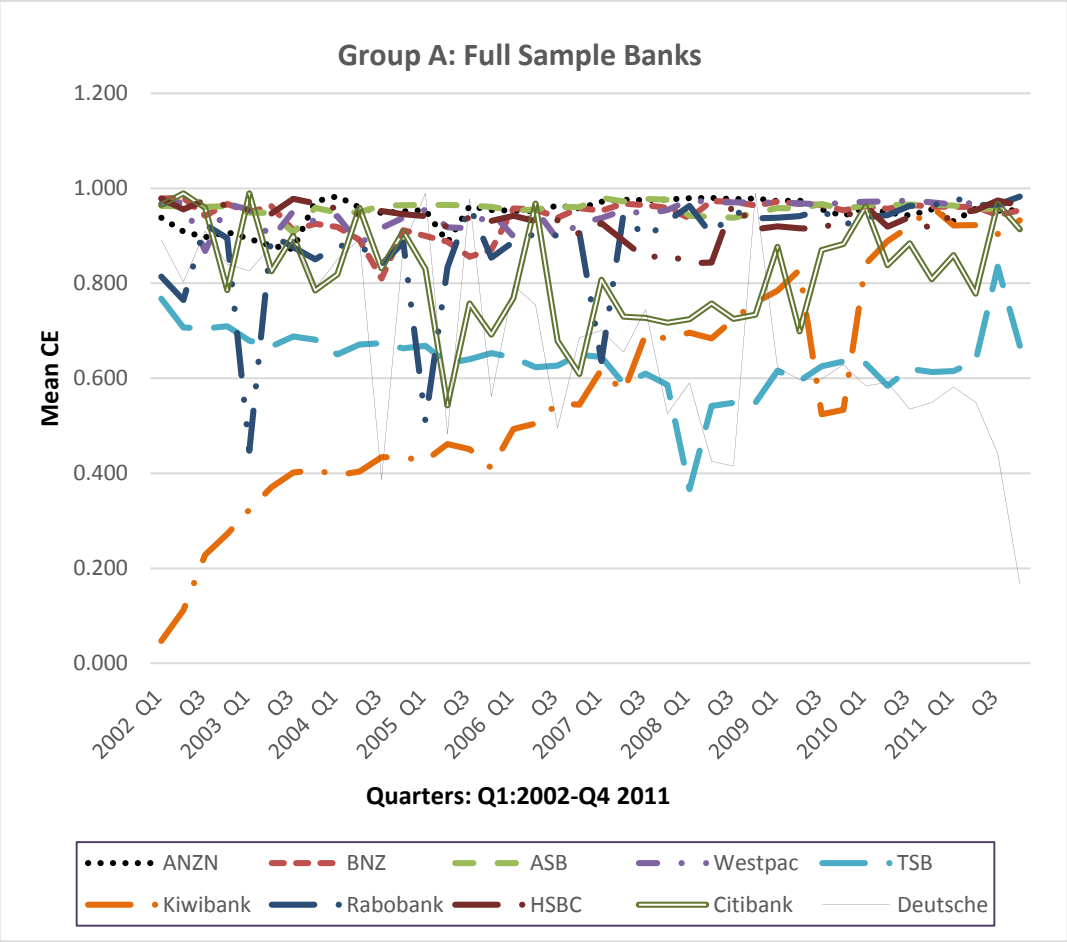
Kiwibank has achieved the greatest cost efficiency improvement[50], mainly due to low fees and growth in services[51], while Deutsche Bank and Citibank experienced lower efficiency among the foreign banks over the same period. The fluctuations in group A and C banks in model (2) might possibly be due to the data adjustment for quarterly data on the banks' balance sheets or other accounting related issues with regard to the difference in organizational form.

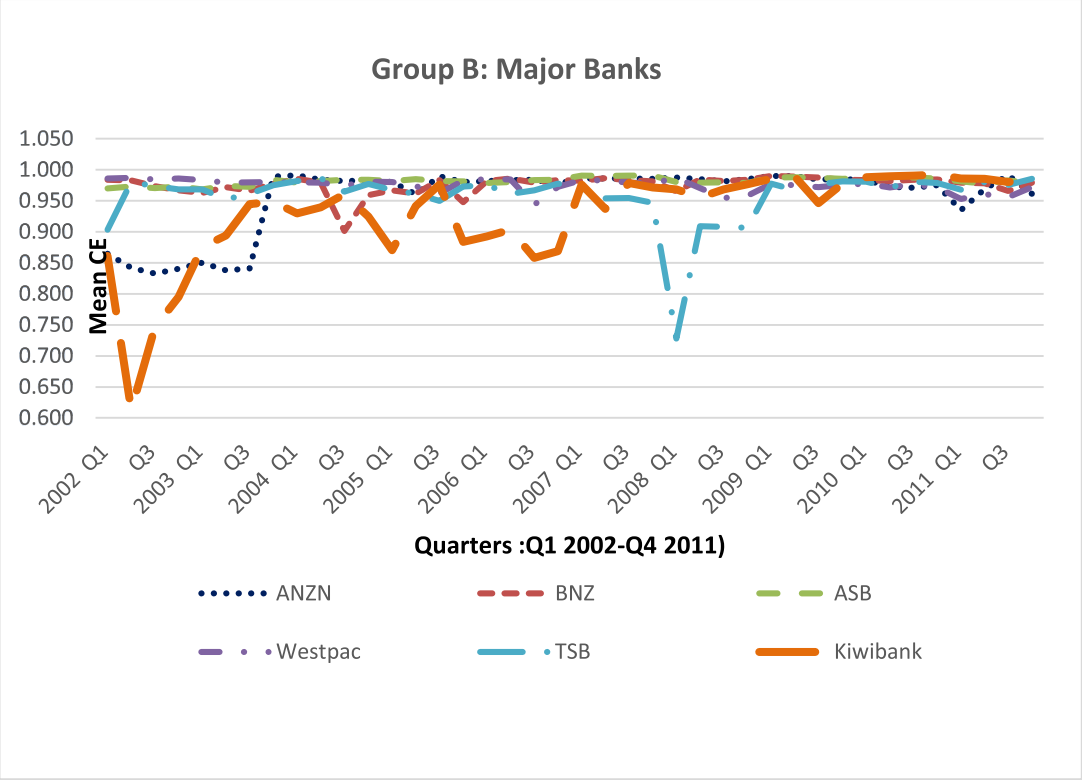
The results in Tripe's (2005b) study, based on the Malmquist index approach, also showed that ASB bank had achieved the greatest improvement in pure technical efficiency while TSB bank had the least, with a significant decline for ANZ bank over the period from 2000 to 2002.

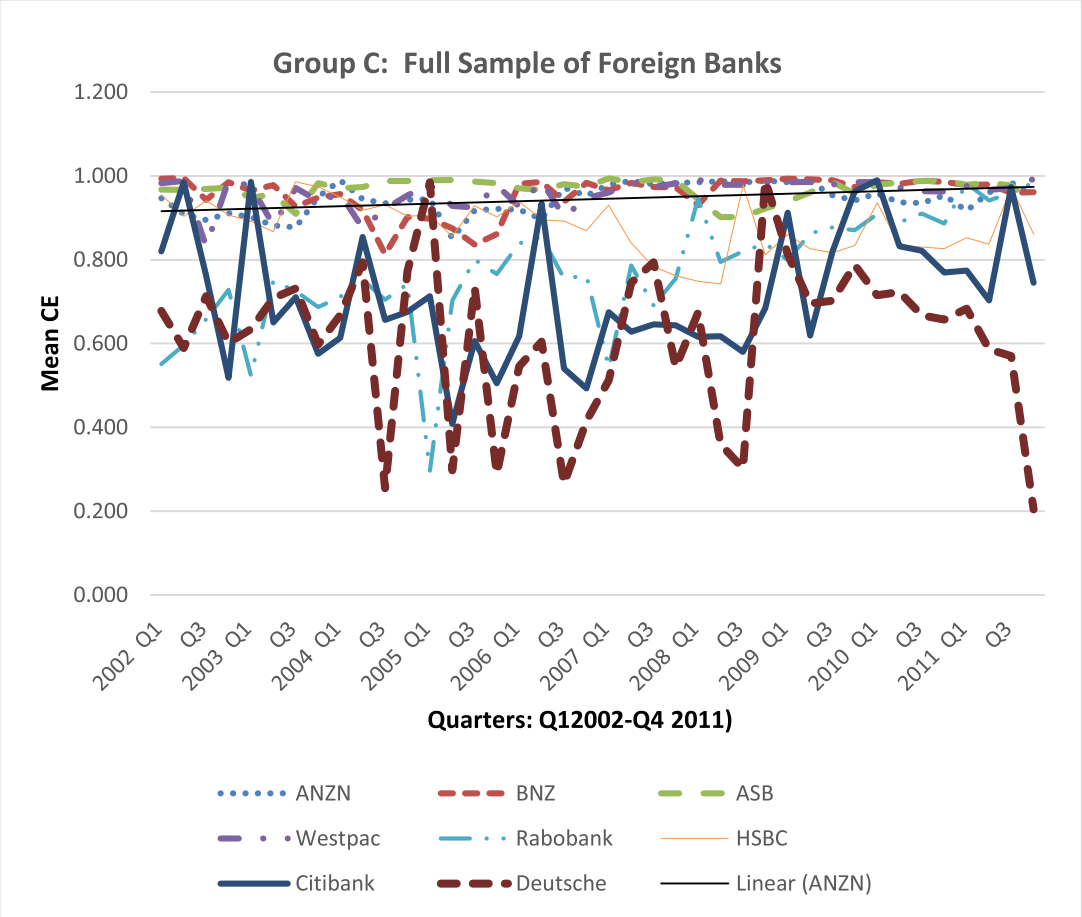
The quarterly mean cost efficiency scores and ranks over the 40 quarters for the six major banks (group B) in model (2) are presented in Table 5.7. The results for group B banks in model (1), group A and C banks in both models (1) and (2) are presented Table D.1-D.5 in Appendix D.

[50] However, one should be aware of the assumptions on price of labour for Kiwibank which could potentially have contributed to the overestimated inefficiency for the bank from 2002 to 2007.

Figure 5.3 Evolution of CE by Groups in Model (2) (2002-2011)




Group B: Major Banks
1.050
1.000
0.950
0.900
0.850
0.800
0.750
0.700
0.650
0.600
Mean CE
2002 Q1
Q3
2003 Q1
Q3
2004 Q1
Q3
2005 Q1
Q3
2006 Q1
Q3
2007 Q1
Q3
2008 Q1
Q3
2009 Q1
Q3
2010 Q1
Q3
2011 Q1
Q3
Quarters :Q1 2002-Q4 2011)
ANZN
BNZ
ASB
Westpac
TSB
Kiwibank


Group C: Full Sample of Foreign Banks
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Mean CE
2002 Q1
Q3
2003 Q1
Q3
2004 Q1
Q3
2005 Q1
Q3
2006 Q1
Q3
2007 Q1
Q3
2008 Q1
Q3
2009 Q1
Q3
2010 Q1
Q3
2011 Q1
Q3
Quarters: Q12002-Q4 2011)
ANZN
BNZ
ASB
Westpac
Rabobank
HSBC
Citibank
Deutsche
Linear (ANZN)

The most obvious observations are the lower CE efficiency scores for ANZ (prior to the ANZ acquisition in 2003) and the earlier period for Kiwibank, established in 2002. The operation of ANZ Bank and National Bank with two separated brands from 2003 to 2013 resulted in an increase in some costs related to merger and acquisition activities, such as the increase in personnel cost in the early merger period. Some of the employees were filling roles associated with integration or roles created to bring back ANZ New Zealand's retail banking system from Australia.

Figure F.1 (in Appendix F) illustrates the changes in cost efficiency for major banks in group B in model (2) based on the results in Table 5.7. It is evident that there are slight increase in CE levels for ANZN, Kiwibank, while ASB, BNZ and TSB show stable levels of CE throughout the study period. Surprisingly, there is a dramatic decrease in mean CE for Westpac Bank, which may partially be explained by the significant increase in impaired assets for the bank and risk management cost during the GFC period (KPMG, 2010b).

Kiwibank experienced great improvements in cost efficiency, despite the bank being, overall, the least cost efficient bank over the study period. Since 2007, Kiwibank has continued to grow in line with other major banks efficiency levels.

Table 5.7 Quarterly Mean CE in Model (2): Major Banks (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Mean
1	0.865	0.984	0.970	0.986	0.903	0.861	0.928
2	0.842	0.983	0.973	0.987	0.980	0.613	0.896
3	0.833	0.973	0.971	0.984	0.974	0.746	0.913
4	0.841	0.967	0.973	0.986	0.969	0.795	0.922
5	0.850	0.963	0.968	0.983	0.969	0.876	0.935
6	0.838	0.972	0.974	0.979	0.952	0.894	0.935
7	0.841	0.966	0.972	0.980	0.961	0.945	0.944
8	0.989	0.978	0.984	0.980	0.975	0.948	0.976
9	0.991	0.986	0.979	0.980	0.982	0.930	0.975
10	0.984	0.979	0.982	0.980	0.986	0.940	0.975
11	0.982	0.901	0.984	0.975	0.965	0.961	0.961
12	0.983	0.959	0.984	0.981	0.977	0.925	0.968
13	0.980	0.967	0.982	0.980	0.968	0.870	0.958
14	0.961	0.962	0.985	0.974	0.961	0.942	0.964
15	0.990	0.984	0.982	0.962	0.950	0.976	0.974
16	0.980	0.948	0.981	0.982	0.973	0.884	0.958
17	0.982	0.982	0.979	0.985	0.975	0.892	0.966
18	0.983	0.986	0.980	0.984	0.961	0.903	0.966
19	0.984	0.979	0.983	0.944	0.967	0.858	0.953
10	0.978	0.983	0.984	0.973	0.978	0.869	0.961
21	0.986	0.982	0.991	0.983	0.970	0.976	0.981
22	0.986	0.987	0.990	0.983	0.954	0.937	0.973
23	0.986	0.983	0.991	0.979	0.955	0.979	0.979
24	0.985	0.981	0.991	0.978	0.947	0.971	0.976
25	0.988	0.965	0.980	0.987	0.728	0.968	0.936
26	0.985	0.985	0.980	0.971	0.909	0.955	0.964
27	0.981	0.982	0.980	0.955	0.908	0.968	0.962
28	0.985	0.984	0.979	0.958	0.907	0.977	0.965
29	0.990	0.990	0.988	0.977	0.978	0.985	0.985
30	0.990	0.989	0.988	0.975	0.968	0.989	0.983
31	0.984	0.987	0.987	0.972	0.977	0.947	0.976
32	0.985	0.984	0.986	0.976	0.981	0.978	0.982
33	0.983	0.984	0.987	0.978	0.981	0.988	0.983
34	0.972	0.982	0.988	0.971	0.971	0.990	0.979
35	0.971	0.984	0.987	0.976	0.981	0.991	0.982
36	0.975	0.984	0.986	0.971	0.979	0.992	0.981
37	0.935	0.980	0.982	0.953	0.968	0.986	0.967
38	0.969	0.978	0.978	0.961	0.980	0.986	0.975
39	0.991	0.966	0.983	0.956	0.976	0.980	0.975
40	0.961	0.979	0.978	0.972	0.986	0.983	0.977
Mean	0.957	0.976	0.982	0.975	0.958	0.929	0.963
Rank	5	2	1	3	4	6	

Note: T: 40 quarters (Q1:2002-Q4:2011)

5.5.5 **Evolution of Alternative Profit Efficiency of Major Banks Over Time**

This section reports the evolution of mean profit efficiency across the 3 groups of banks in model 2 throughout the 40 quarters from 2002 to 2011 (see Figure 5.4).

Apparently, there is more frequent volatility of PE levels in the groups of banks compared with the changes in mean CE (see Figure 5.4) over the same period. Particularly in groups A and C, due to more data heterogeneity compared with group B. The possible reason for this considerable volatility could be that the quarterly data on the income statements tend be more volatile than the balance sheet data, thus movement in some variables obtained from the income statement, in particular profit before tax, can be influenced by one-off income or expense items that occur in a single quarter.

Note that the estimates of alternative profit efficiency are based on the dependent variables profit before tax and loan loss provision and extraordinary item costs, which are much larger than net income. (DeYoung & Nolle, 1996) used the same measurement to estimate the profit efficiency model that controls for risk and non-interest income and also controls for residuals truncated within asset size, and concluded that foreign-owned banks' cost and profit inefficiency were significantly different from their domestic counterparts'. They found domestic banks to be more efficient than foreign-owned banks as foreign-owned banks sacrificed profitability during the late 1980s and early 1990s to enable them to increase their market share. During that time period, foreign-owned banks grew their operation by originating or purchasing loans or by acquiring other banks which add more cost into their market growth, as a consequence, affect the banks' profit efficiency.

Figure 5.4 Comparison of APE by Groups in Model (2) (2002-2011)

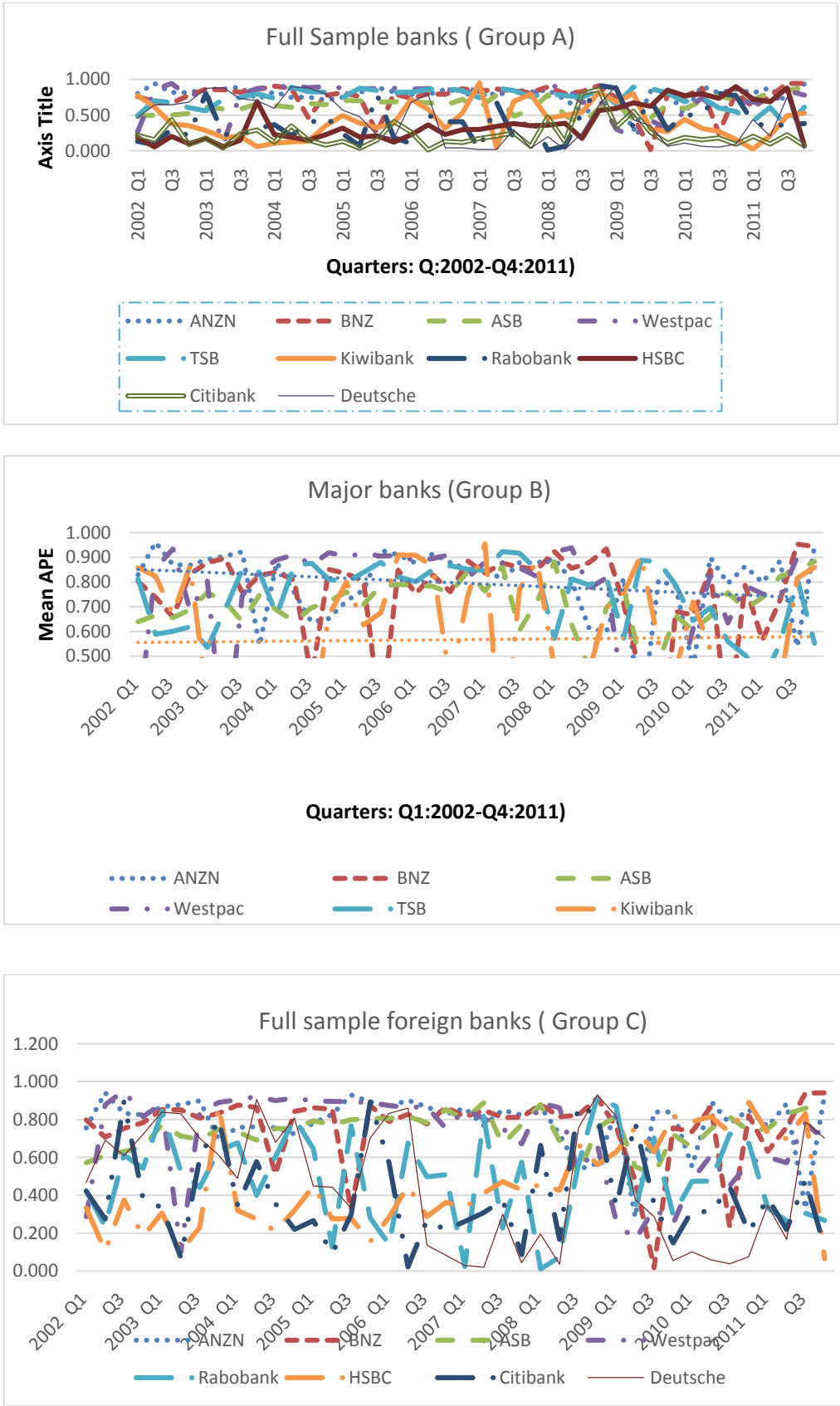


Table 5.8 Quarterly Mean APE in Model (2): Major Banks (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Mean
1	0.829	0.802	0.639	0.232	0.812	0.857	0.695
2	0.961	0.738	0.665	0.854	0.589	0.825	0.772
3	0.871	0.658	0.655	0.934	0.600	0.668	0.731
4	0.868	0.832	0.689	0.686	0.619	0.866	0.760
5	0.891	0.878	0.758	0.803	0.535	0.313	0.696
6	0.905	0.896	0.721	0.080	0.687	0.203	0.582
7	0.923	0.758	0.640	0.743	0.850	0.279	0.699
8	0.543	0.826	0.748	0.845	0.839	0.107	0.652
9	0.880	0.841	0.687	0.890	0.666	0.144	0.685
10	0.758	0.807	0.640	0.911	0.868	0.194	0.696
11	0.638	0.411	0.696	0.869	0.876	0.222	0.619
12	0.652	0.851	0.722	0.919	0.811	0.664	0.770
13	0.723	0.833	0.760	0.904	0.799	0.800	0.803
14	0.768	0.804	0.710	0.915	0.839	0.626	0.777
15	0.928	0.236	0.785	0.905	0.880	0.675	0.735
16	0.910	0.848	0.790	0.908	0.821	0.910	0.865
17	0.877	0.753	0.787	0.886	0.801	0.908	0.836
18	0.914	0.828	0.783	0.895	0.850	0.862	0.856
19	0.879	0.761	0.755	0.911	0.867	0.387	0.760
10	0.844	0.886	0.843	0.817	0.853	0.746	0.831
21	0.856	0.836	0.762	0.881	0.846	0.955	0.856
22	0.808	0.876	0.864	0.878	0.923	0.046	0.732
23	0.879	0.861	0.606	0.856	0.917	0.772	0.815
24	0.877	0.851	0.721	0.823	0.847	0.885	0.834
25	0.895	0.923	0.882	0.922	0.572	0.448	0.774
26	0.805	0.856	0.627	0.938	0.812	0.496	0.756
27	0.612	0.879	0.449	0.773	0.788	0.440	0.657
28	0.598	0.934	0.696	0.818	0.818	0.695	0.760
29	0.817	0.713	0.775	0.321	0.572	0.757	0.659
30	0.233	0.411	0.464	0.201	0.888	0.909	0.517
31	0.807	0.015	0.480	0.456	0.882	0.555	0.532
32	0.781	0.681	0.662	0.331	0.786	0.441	0.614
33	0.454	0.666	0.605	0.611	0.644	0.720	0.616
34	0.900	0.849	0.662	0.824	0.696	0.526	0.743
35	0.795	0.214	0.758	0.634	0.559	0.424	0.564
36	0.864	0.787	0.692	0.785	0.503	0.261	0.649
37	0.798	0.564	0.737	0.753	0.403	0.037	0.549
38	0.885	0.727	0.822	0.743	0.549	0.378	0.684
39	0.538	0.953	0.847	0.899	0.811	0.816	0.811
40	0.945	0.944	0.883	0.834	0.552	0.860	0.836
Mean	0.793	0.745	0.712	0.755	0.746	0.567	0.719
Rank	1	4	5	2	3	6	

Note: T: quarters (Q1:2002-Q4:2011)

The quarterly efficiency scores from this study's preferred group B banks in model (2) are presented in Table 5.8, with the mean efficiency for each quarter and rank information for each banks. The quarterly mean APE for group B banks in model (1), group A and C banks in both models (1) and (2) are presented Table E.1-E.5 in Appendix E.

The changes in the source of bank funding due to the financial crisis from 2007 until early 2010, has likely impacted on the banks' costs, thus negatively affecting the banks' profits. Furthermore, deposits became more expensive (the deposit rate was 7.5% per annum in 2007) when competition (deposit war) was intensive in the retail banking market during the GFC (KPMG, 2010b).

Figure F.2 (in Appendix F) shows the changes in mean APE for the six major banks in group (B) in model (2), based on the results in Table 5.8. The changes are shown separately for each major bank to have a better understanding and comparison of the stability of the banks' cost efficiency over the study period.

An overall slight decrease in the mean APE for ANZ National Bank, BNZ, Westpac, and TSB Bank are shown in Figure 5.6, while the trend line for ASB and Kiwibank appears flat. It appears in Figure 5.5 and 5.6 that the mean PE for Kiwibank moves closer to the level of other major banks' performance from 2007, as the bank has continued competing intensively with the large foreign banks in residential mortgage price-setting and for retail deposits (KPMG, 2011).

In addition, it is evident that all major banks have experienced a sharp decrease from the third quarter of 2008, which may indicate that their efficiency performance might have been largely shaped by the responses of businesses and individuals toward the GFC from 2007 until the third quarter of 2010. The total profit before tax for all the major banks in New Zealand took a hit in the wake of the GFC, with profits declining by about 10% on average across 2007-2009 (see Table 3.2, (KPMG, 2010a).

5.6 Conclusion

The efficiency results in this study support the New Zealand banking system exhibiting both high cost efficiency and profit efficiency level, with cost efficiency outweighing profit efficiency, which indicates that banks in New Zealand are more efficient in the generation of profits rather than in control of costs.

The efficiency results generated under the common frontier by the preferred panel dataset (group B banks) and model (2), accounting for macroeconomic condition effects, suggest that the Big Four foreign banks exhibit, overall, higher levels of cost and profit efficiency compared to the two major domestic competitors over the study period 2002 to 2011.

These findings are not consistent with the results in foreign bank efficiency literature in other developed countries, where foreign banks are less efficient than domestic banks. Hermes and Lensink (2003) show that the effect of foreign ownership participation in more developed markets is not as strong as that in transition countries because the potential for learning from foreign banks is not so great. This appears not to be the case in New Zealand, where foreign banks have dominated the banking market for so long.

Although the rank results for individual banks are not identical across the three banking groups and in the two models, ASB bank is ranked as the most cost efficient bank across all groups and in both models over the study period, but, conversely, the least profit efficient bank compared with other large foreign banks. The ANZ National Bank exhibits the highest profit efficiency relative to other large foreign banks across all 3 groups in both models.

Kiwibank, a start-up domestic bank, shows the greatest improvement in both cost and profit efficiency over the period, similar to the changes shown in accounting operating efficiency ratios. TSB as a regional domestic bank was found to be more cost efficient than some of the foreign banks, such as ASB bank, and more profit efficient than ANZ National Bank.

The efficiency results presented in this chapter are used for further investigation in the next chapter into what determines the differences in foreign-owned banks' efficiency in New Zealand.

Chapter 6

Determinants of Foreign Banks' Efficiency

6.1 Introduction

This chapter discusses the estimated results for the bank efficiency determinants by analysing the coefficients of three sets of explanatory variables obtained from the cost (equation 4.4) and alternative profit function (equation 4.7) and associated inefficiency[52] equations (4.11-4.19). Each of the explanatory variables will be discussed in Sections 6.2, 6.3 and 6.4 for industry-specific, bank-specific and macroeconomic determinants, respectively.

6.2 Industry-Specific Determinants

Table 6.1 shows that 80% (32 of 40) of the coefficients of the bank industry-specific variables in cost and profit inefficiency equations are statistically significant at the of 5% level or better, which confirms the selection of bank industry-specific variables (ownership, origins of foreign banks, organizational form, merger and acquisition and market concentration) are appropriate for the cost and profit inefficiency equations.

6.2.1 Ownership

The ownership variable (DO) is a dummy variable to test the home field advantage hypothesis (Berger et al, 2000) that foreign banks are less efficient than domestic banks in the host nation. Table 6.1 reports the sign and t statistics of the coefficients for DO in both cost and profit inefficiency equations in models (1) and (2), and under both group A (full sample banks) and B (major banks).

With regard to the impact of foreign ownership on banks' cost inefficiency, Table 6.1 shows that DO is negative and statistically significant at 1% and 10% levels of significance

[52] The discussion of the results focusses on inefficiency correlates. For example, a negative sign indicates a negative impact of the variable on the bank's inefficiency, and therefore a positive effect on the bank's efficiency.

in group A banks in both models, and group B banks in model (2), respectively, however, insignificant and positive in group B banks in model (1).

Table 6.1 Coefficients of Industry-specific Variables in Inefficiency Equations

	Group A		Group B		Group C	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Cost Inefficiency	**Eq.4.12**	**Eq. 4.14**	**Eq. 4.12**	**Eq. 4.14**	**Eq. 4.16**	**Eq.4.18**
DO	-0.293 [a]	-0.387[a]	0.150	-0.215[c]		
	(-4.159)	(-5.366)	(0.557)	(-1.723)		
DS					-1.263 [a]	-1.697[a]
					(-10.176)	(-10.266)
DORG					-0.479 [a]	0.035
					(-7.445)	(0.279)
DM	0.360 [b]	0.362 [b]	0.480 [c]	0.541 [a]	0.303 [a]	0.724 [a]
	(2.519)	(2.137)	(1.651)	(4.738)	(3.971)	(2.576)
MKCT	-0.643	-1.310	3.702	-1.053	2.066 [a]	4.852 [a]
	(-0.578)	(-1.101)	(0.953)	(-1.375)	(4.301)	(5.760)
Profit inefficiency	**Eq. 4.13**	**Eq. 4.15**	**Eq. 4.13**	**Eq. 4.15**	**Eq. 4.17**	**Eq.4.19**
DO	2.532[a]	3.109[a]	-3.962[a]	-3.444[a]		
	(6.158)	(7.967)	(-5.5870)	(-3.396)		
DS					-1.964	-2.308 [a]
					(-0.242)	(-2.986)
DORG					9.399 [c]	-2.421 [a]
					(1.675)	(-3.186)
DM	-7.588 [a]	-7.697 [a]	-6.379 [a]	-5.829[a]	-2.975 [a]	-5.468 [b]
	(-3.823)	(-5.732)	(-19.627)	(-6.368)	(-4.152)	(-2.129)
MKCT	4.395 [a]	4.842 [a]	-13.957 [a]	-27.833 [a]	2.039 [a]	0.334
	(3.695)	(3.761)	(-4.801)	(-4.446)	(4.930)	(0.329)
Observations	400.00	400.00	240.00	240.00	320.00	320.00

Notes: a=1 % Level of statistical Significance, **b=** 5 % Level of Statistical significance, **c=**10% level of Statistical Significance; *t*-test in parentheses

Variables Notations:

DQ: Dummy Ownership
DS: Dummy Similarity
DORG: Dummy Organizational form
DM: Dummy Merger and Acquisition
MKCT: Market concentration

Table 6.1 shows mixed coefficient results for the DO variable in the profit inefficiency equations, with DO appearing to have negative and significant impact on group B banks under both models. This result rejects the home field advantage hypothesis, and indicates that foreign ownership in the banking industry might have contributed to the high profit

efficiency for foreign banks relative to domestic banks in New Zealand over the study period. The significant positive coefficients of DO in profit inefficiency equations (4.13 and 4.15) for group A banks may reflect the effect of relatively higher data heterogeneity caused by foreign branch banks[53] in the group, rather than the difference in profit inefficiency between foreign banks and domestic banks.

The negative coefficients of the DO variable in both cost and profit inefficiency equations in model (2) for preferred group B (major banks), reject the home field advantage hypothesis, which suggests that foreign banks (the Big Four foreign banks in group B) are more cost efficient compared with the domestic banks (two domestic banks in group B) in New Zealand. The finding is consistent with prior findings in Hasan and Martin (2003), Grigorian and Manole (2002), Fries and Taci, 2005, Berger et al, 2009, Fang et al. (2011) and Curi et al. (2012). However, our result differs from the general findings in developed countries that foreign banks are less efficient than domestic banks (Berger et al, 2000)

Overall, the results support the positive effect of foreign ownership on cost and profit efficiency for banks in New Zealand, although it appears that the foreign ownership effect has more impact on profit than cost inefficiency (in terms of the t-statistics). This supports Bollard (2004), who states that foreign banks' entries to the New Zealand market are associated with diffusion of new technologies, better resource allocation and thus greater efficiency, which should be transferred (through competition and/or imitation) to the overall banking sector.

6.2.2 **Bank Origins**

Following the procedures in Berger et al., (2000), the origin of foreign banks was distinguished to test the limited form of the global advantage hypothesis. Each bank's parent country was used as the measure of similarity between home and host country, with each foreign bank is assigned a similarity dummy (DS) variable of 1 (origin from Australia) or and 0 (otherwise) to investigate its impact on the cost and profit efficiency. This estimation only examined group C as this includes all 8 sample foreign banks.

[53] Small foreign branch banks are generally small banks operating in the host country under the defensive expansion hypothesis with different output mixes and specialised services (William, 2002).

The negative and statistically significant DS coefficients in the banks' cost and profit inefficiency equations were both at the level of 1% (except for the insignificant and negative in profit inefficiency equation 4.17, see in Table 6.1). This result strongly supports the limited global advantage hypothesis that banks from some nations (Australia in this context) are more efficient than banks from other nations (HSBC, the UK, Citibank, the US, Netherland Bank, Netherland, Deutsche Bank, Germany) in New Zealand's banking sector. Sturm and Williams (2009) found supporting evidence in Australia that foreign banks from the UK were more efficient than banks from the US due to the economic similarity between the UK and Australia.

Miller and Parkhe (2002), Lensink et al (2008), Naaborg (2007), Vu and Nahm (2013), and Curi et al (2012) provide evidence that the liability of foreignness can be reduced substantially when home and host nations with great similarities share a common language and culture and similar regulatory/supervisory environments and financial systems. Australian-owned banks operating in New Zealand with a similar operating environment to their parent banks[54] face fewer challenges and lower costs than banks from other nations, thus are more efficient.

When banks expand their banking activities over geographic distances in different markets, despite the recent improvements in information processing and telecommunications, which can, to some extent, lessen the agency cost (Berger et. al., 2004), banks can still experience special difficulties and incur additional costs due to the environments' dissimilarity between the home and host country.

Lensink et al (2008) measured similarity of home-host country institutional frameworks on a sample of 2095 banks in 105 countries, and reported that differences in the institutional environments, such as law, political stability, and government effectiveness, between home and host countries exhibited a positive impact on the foreign banks' cost

[54] It is noticeable that the parent banks of the Big Four Australian-owned foreign banks in New Zealand do not dominate the Australian banking market in terms of size. The banking system in Australia is dominated by the Big Four largest domestic banks. This dominance acts as an effective barrier for foreign banks wishing to operate in the Australian market.

efficiency levels. The authors also found that the smaller the institutional distance between the host and the home country, the lower the foreign banks' inefficiency.

When a foreign bank has settled in a country for enough time, they can compete on the same level as the local enterprises. In this regard, Zaheer and Mosakowski (1997) suggest that it takes more than 15 years for foreign firms to overcome disadvantages due to the liabilities of foreignness. To and Tripe (2002) conclude that foreign banks, through a long presence in New Zealand or acquisition of local banks, could have knowledge of and experience in the local market and gain general managerial expertise which could contribute positively to foreign banks' performance in the host market (income revenue and operating efficiency).

In an integrated financial market, foreign banks are likely to face fewer difficulties hence experience better performance. Andrieş and Căpraru (2012) investigated the impact of European integration on the cost efficiency of 27 EU bank markets over the period 2003-2009, and confirmed that the European integration had a positive impact on cost efficiency before the GFC period. Weill (2009) analysed the impact of financial integration on the EU market in 10 EU countries between 1994 and 2005, also providing evidence of improvement in banks' cost efficiency in the market.

The Tran-Tasman integrated market might have contributed to the high overall level of cost and profit efficiency of Australian-owned banks in New Zealand. Tripe (2004) comments that such banks in New Zealand are not only Australian-owned, but also, to various degrees, integrated with the operations of their parent banks in Australia. For example, in order to maximise profits during unexpected financial events, the Big Four banks derive significant funding from their parent banks in Australia in operating areas such as technological progress, senior management systems and liquidity management.

6.2.3 Organizational Form

The dummy organizational form variable (DORG) is examined only in group C, which includes all foreign banks, to examine the relationship between the organizational form and foreign banks' cost and profit inefficiency.

Table 6.1 shows mixed results regarding the impact of DORG, with the coefficient on cost inefficiency in model (1) negative and statistically significant at the 1% level, but statistically insignificant and positive in model (2). In contrast, the DORG coefficient in the profit inefficiency equation is positive at a 10% significance level in model (1) while negative and significant in model (2) at the 1% significance level. The mixed results could be affected by the data heterogeneity caused by small foreign branch banks, and also by Westpac Bank being a foreign branch[55] of a completely different size and operational type.

The significant negative DORG coefficients in both cost and profit inefficiency equations (4.16 model 1 and 4.19 model 2, respectively), suggest that foreign subsidiaries are more cost and profit efficient than foreign branch banks, which is not consistent with the finding of Curi et al. (2012), where foreign branch banks are more efficient than foreign subsidiaries in Luxembourg. The result suggests that a foreign branch with simple organizational structure and entry strategy operating in Luxembourg might have more competitive efficiency advantages than foreign subsidiaries. However, the authors further confirm that organizational form does not play as important a role in determining banks' efficiency as similarity between home and host countries,

The diversification of the other major foreign branches' activities poses a challenge when testing the organizational form hypothesis. For instance, Rabobank Nederland bank specialises in certain segments of the NZ market, such as agriculture, and has a large market share in farming business compared with the major banks. Despite the efficiency scores for Rabobank, in all groups and models, being lower than the Big Four foreign banks, they are higher than the other two foreign branch banks, Deutsche and Citibank, but lower than HSBC Bank.

Deutsche Bank exhibits more fluctuation in cost and profit efficiency levels throughout the study period, which may be affected more by their overseas parent bank's worldwide market strategies rather than an organisational form inefficiency effect. Parent banks can

[55] Although the retail business of Westpac Banking Corporation New Zealand Division are locally incorporated to Westpac New Zealand Limited since 2006, aggregated data was, however, used for the two banks, for the purpose of comparison in this study. The bank was considered as a foreign branch (DORG with 0 value) over the full study period.

choose to shrink their overseas operation when they have home country problems, which could affect the foreign branch's performance in the host nation (Peek & Rosengren, 2000)

6.2.4 **ANZ Acquisition of National Bank**

The impact of the ANZ's acquisition of National Bank in 2003 is measured by a dummy merger and acquisition variable DM, 1 for merged banks and 0 otherwise (prior and post the acquisition in 2003). DM is examined across group A, B and C banks in both models.

The ANZ acquisition of National Bank has made gains, not only in scale, but also in specific niche markets, competing for profitable clients' portfolios (KPMG, 2004). Different from cross-border banking mergers, the merger of ANZ and NBNZ in New Zealand had no distortion of culture differences, political or regulatory obstacles.

Table 6.1 shows that DM coefficients are statistically significant at the 1% level across all three groups in both models, and positive in the cost inefficiency equations, but negative in the profit inefficiency equations. This suggests that the ANZ's acquisition of National Bank might not have achieved cost efficiency, but has, however, improved the merged banks' profit efficiency. Akhavein et al (1997) found that bank mergers in the US in the 1980s had improved profit efficiency but no cost efficiency associated with the merger. The Greek evidence by Athanasoglou and Brissimis (2004) also confirmed that the majority of individual banks' mergers (8) in the 1990s led to improved profit efficiency rather than improved cost efficiency (only 3 out of 8 mergers had improved cost efficiency). Berger et al. (2000, p. 35) further suggest that large banks' consolidations may possibly result in no gains or perhaps even losses in cost scale efficiency.

Regarding the negative impact of the merger and acquisition on alternative profit efficiency, Akhavein, Swamy, Taubman, and Singamsetti (1997) suggest that a merger might improve profit efficiency by improving profit scale, scope or X-efficiency. They examined the efficiency and price effects of banks' mergers in the U.S in the 1980s by applying a frontier profit function and concluded that merged banks experienced a significant, 16% on average, increase in profit efficiency scores relative to other banks in their studies. However, the authors also note that the improvement in banks' profit efficiency does not necessarily indicate a merger and acquisition related improvement, other possible reasons could be the effect of the number of observations available and the economic banking environment, such as changes in the interest rates.

In the New Zealand banking literature, there are no prior studies examining the impact of mergers on both banks' cost and profit efficiencies. Tripe (2003) used the DEA method to investigate the impact of 6 mergers on banks' efficiency in New Zealand between 1989 and 1998. The majority of the mergers over the study period had increased X-efficiency, not, however, due to economies of scale or scope but instead, possibly the effect of reduced costs due to the rationalization of branch networks, head offices and infrastructure for the merged banks. Tripe (2005b) found a downturn movement in X-efficiency for National bank (the acquired bank by ANZ) in 2003, reflecting additional operating costs, at least partially caused by accounting adjustments due to the ANZ acquisition in 2003.

In general, merger and acquisition activities possibly generate tradeoffs between cost and profit in the early stage of a merger, trimming overlaps in branch networks and redundancy are common. Westpac's acquisition of Trust Bank New Zealand in 1996 is an example, with WestpacTrust suffering higher operating costs for a significant interim period although cost reductions were eventually achieved. The amount of premium paid by the acquirer (Westpac) might also have impacted the bank's efficiency level.

6.2.5 Market Concentration:

Market concentration (MKCT) in this study is measured in terms of the ratio between the assets of the largest four foreign banks and the total assets of the banking industry. The descriptive statistic (in Table 5.1) shows a mean ratio of 86%, with quarterly ratios ranging from 0.89 to 0.81 over the study period.

When examining the impact of market concentration on bank efficiency in the New Zealand banking market, the possibility that inefficiency might mistakenly reflect difference in market power (indirectly, the endogeneity of prices) rather than true inefficiency needs to be considered.

The estimated coefficients of MKCT on bank inefficiency presented in Table 6.1 are inconclusive. Its impact is negative but not significant in cost inefficiency equations for group A and B banks. A recent study by Xiang et al. (2015) shows that the bank concentration ratio in Australian banking market has no influence on banks' technical and cost efficiency.Pasiouras, Tanna, and Zopounidis (2009) finding that banks in more concentrated markets are able to extract higher interest margins through offering lower deposit rates and higher loan rates, thus improving both cost and profit efficiency. Contrary

to the expectation, the coefficients of MKCT are statistically significant and positive for group C banks in both models at the 1% level, suggesting that banks in more concentrated markets exhibit poorer efficiency.

The coefficients of MKCT are statistically significantly and negative in the profit inefficiency equations for group B banks in both models, while positive for group A and C banks (in model 1) at the 1% level. The negative coefficients for group B in the two models are in line with the findings in Xiang et al. (2015) supporting that the high degree of local market concentration might allow large banks to exploit economies of scale and scope. If markets are so competitive that banks differentiate their products then quality can be rewarded with higher revenues that offset the cost, thus alternative profit efficiency [56](Berger and Mester, 1997).

Chan et al, (2007) examined the competitive conditions in the New Zealand banking industry using the Panzar-Rosse (1987) model, concluding that, during the period 1996-2005, New Zealand's market operated under monopolistic competition conditions, in other words, each bank in the monopolistically competitive market has some degree of market power over the prices of the products and services that it provides.

6.3 Bank-specific Determinants

Miller and Pakrhe (2002) pointed out that foreign banks need to have bank-specific advantages such as product differentiation, managerial skills, and accessibility to international financial markets or parent banks' support, to operate successfully in the host country. In this study, the impact of bank size, Ln(TA), equity ratio (EQR) and asset quality (AQ) on foreign banks' cost and profit efficiency were explored.

[56] Profit efficiency essentially improves cost efficiency by offsetting the extra cost of producing higher quality with higher revenues. Consequently, if the effects of market power in pricing bank outputs are more important, alternative profit inefficiency might be larger than cost inefficiency (Berger and Mester,1997)

Table 6.2 Coefficients of Bank-specific Variables in Inefficiency Equations

	Group A		Group B		Group C	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Cost Inefficiency	**Eq. 4.12**	**Eq. 4.14**	**Eq. 4.12**	**Eq. 4.14**	**Eq. 4.16**	**Eq.4.18**
Ln(TA)	-0.626 [a]	-0.596 [a]	-0.157 [b]	-0.062 [b]	-0.159 [a]	-0.224 [a]
	(-9.678)	(-10.350)	(-2.072)	(-2.240)	(-4.572)	(-6.972)
EQR	2.225 [a]	1.408 [b]	0.528	0.622 [c]	2.675 [a]	3.683 [a]
	(3.758)	(2.309)	(0.962)	(1.760)	(7.290)	(9.067)
AQ	-47.721 [a]	-39.139 [a]	15.487	3.845 [b]	-5.448 [a]	-8.787 [a]
	(-3.808)	(-4.160)	(1.120)	(2.437)	(-10.266)	(-6.151)
Profit Inefficiency	**Eq. 4.13**	**Eq. 4.15**	**Eq. 4.13**	**Eq. 4.15**	**Eq. 4.17**	**Eq.4.19**
Ln(TA)	-1.711 [a]	-1.835 [a]	0.544 [a]	-0.465	-13.797	-0.725 [b]
	(-9.486)	(-10.852)	(3.633)	(-1.428)	(-1.328)	(-2.216)
EQR	-10.286 [a]	-6.230 [a]	-5.571 [a]	-22.614 [a]	0.827 [a]	-3.028 [b]
	(-2.874)	(-2.566)	(-3.645)	(-5.755)	(3.755)	(-2.195)
AQ	1.327	2.476 [b]	3.098 [b]	15.306 [a]	-0.038 [a]	0.751
	(1.274)	(2.135)	(2.521)	(4.683)	(-3.279)	(0.638)

Notes: a=1 % Level of statistical Significance, b=5 % Level of Statistical significance, c=10% level of Statistical Significance; t-test in parentheses

Variables notations

Ln(TA): Bank Size

EQR: Equity ratio

AQ: Impaired assets ratio

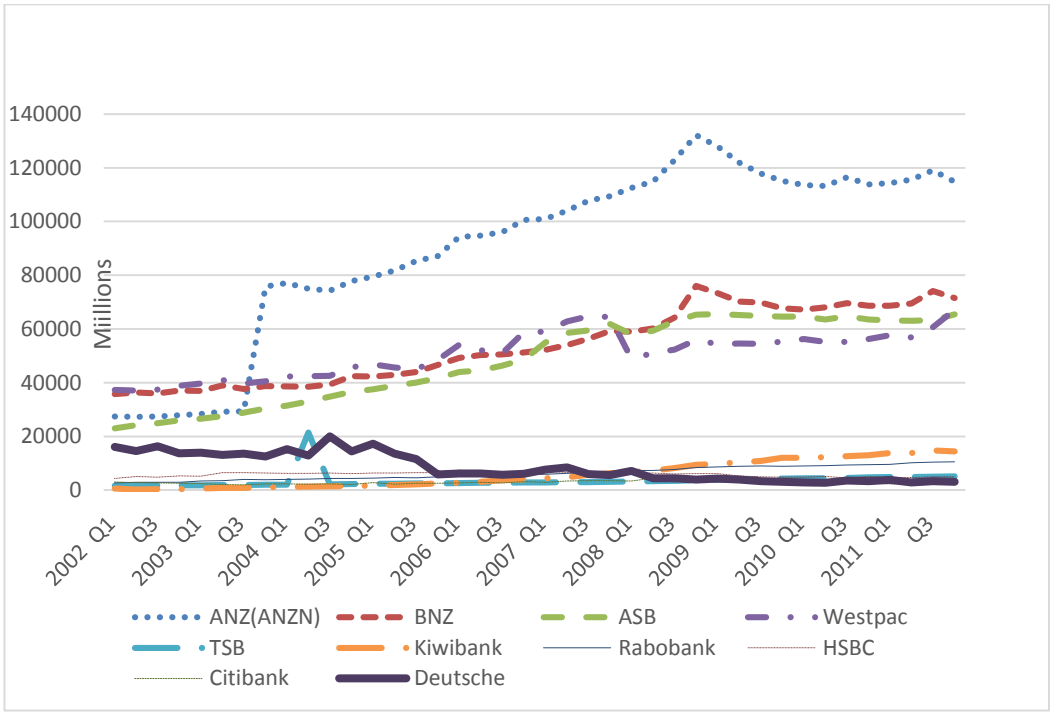
Table 6.2 shows the estimated results of the relationship between the three variables and cost and profit inefficiency.

6.3.1 **Bank Size**

In this study, bank size is measured by Ln(TA) (the natural logarithm of a bank's total assets) in the inefficiency equations (4.12-4.19), and used as a proxy to allow for nonmonotonicity and nonlinearities in the relationship between bank size and bank inefficiency (Berger and Mester, 1997). It also controls for the effect caused by loan portfolio and diversification associated with bank size (Yildirim and Philippatos, 2007).

Figure 6.1 shows the comparison of size (quarterly total assets) of each sample bank from 2002 to 2011. It is evident that there are significant differences in bank size between the Big Four foreign banks and smaller domestic and foreign branch banks. The sudden increase of ANZ National Bank's total assets was based on the consolidated total asset growth for ANZ and the National Bank from the fourth quarter in 2003.

Figure 6.1 Total Assets: Full sample Banks (quarterly 2002-2011)



Source: individual banks' quarterly disclosure statements (2002-2011)

The Ln (TA) variable is significant and negative in both cost and profit inefficiency equations, which suggests that large foreign banks are more efficient than small domestic and foreign branch banks in New Zealand. However, the results differ from the findings in the Liu and Tripe (2003) and Tripe (2005b) DEA studies. Liu and Tripe (2003) found that the Big Four foreign banks (ANZ, NBNZ, ASB and WestpacTrust) were less X-efficient than small banks (TSB and Countrywide) from 1989 to 1998, while Tripe (2005a), in his unpublished PhD thesis, also found that scale efficiency was not important in a panel data approach[57]. The author's study shows TSB bank, as the smallest bank in the data sample, was the most efficient bank (with 0.9802 X-efficiency score) which suggests that scale benefits were not important in New Zealand over the study period 1996 to 2003.

The negative impact of bank size on efficiency indicates that scale biases might favour larger foreign banks in New Zealand more than small foreign branches and domestic

[57] Tripe's (2005b) thesis investigates the changes in New Zealand bank efficiency by reconciling two sets of results from the panel data approach and Malmquist index, which measures productivity more than efficiency (IRD, 2006).

banks. Supporting evidence can be found in Berger et al.,(1993) in the US banking market, and Thi et al. (2008) who investigated the factors that impact foreign banks in the Czech Republic, Hungary and Poland.

Competition in the New Zealand retail banking sector has become intensive driving all market participants to innovate their products, services and distribution channels and differentiation (KPMG, 2006). Technological changes since the 1990s in New Zealand's banking industry might have impacted more on small banks', such as TSB bank, performance, which may partially explain why TSB is less cost efficient than the majority of the foreign banks. Technological progress could increase economies of scale over time and allow larger organizations to be managed more proficiently relative to small institutions (Berger, Dick, Goldberg, & White, 2007).

The overall, significant, negative impact of bank size on bank cost and profit inefficiency indicate that the relaxation of asset restrictions for foreign banks in the New Zealand banking system, allows both foreign and domestic banks to grow and venture into different bank practises to accrue economies of scale.

6.3.2 Bank Equity Levels

Equity ratio (EQR) is used in this study to measure the effect of capital risks for both foreign and domestic banks on cost and profit inefficiency. If the equity ratio is ignored, bank efficiency would be mismeasured (Berger and Mester, 1997).

The result in Table 6.2 shows a uniform positive relationship between EQR and bank cost inefficiency for the three groups of banks in models 1 and 2, but less significant in our preferred group (B) banks in both models. Vu and Turnell (2011) analysed the cost and profit efficiencies of Australian banks over the period 1997-2009, also found positive impact of capitalisation on both cost and profit inefficiency. Their results suggest that banks with a higher level of capital are less efficient, whereas banks with low level of capitalization seemed to be more cost and profit efficient. Pessarossi and Weill (2013) in China also found that foreign banks with a lower level of capital ratio appear to be more efficient, and that efficiency decreases as the capital ratio increases. Other studies (Altunbas, Carbo, Gardener, & Molyneux, 2007; Berger & Di Patti, 2006), discussing the difficulties of assessing the role of prudential regulations on capital adequacy in the US

and European markets, found that banks having capital in excess of the regulatory required amount might have a negative effect on bank efficiency levels.

According to Pasiouras, Tanna, et al. (2009), there are two possible reasons for the positive relationship between equity ratio and bank cost inefficiency. First, the more skilful managers can use inputs efficiently while operating with higher leverage; second, banks with lower capital levels may increase their risk-taking, such as investing in more risky but potentially more profitable activities to become more cost efficient (but maybe only in the short term).

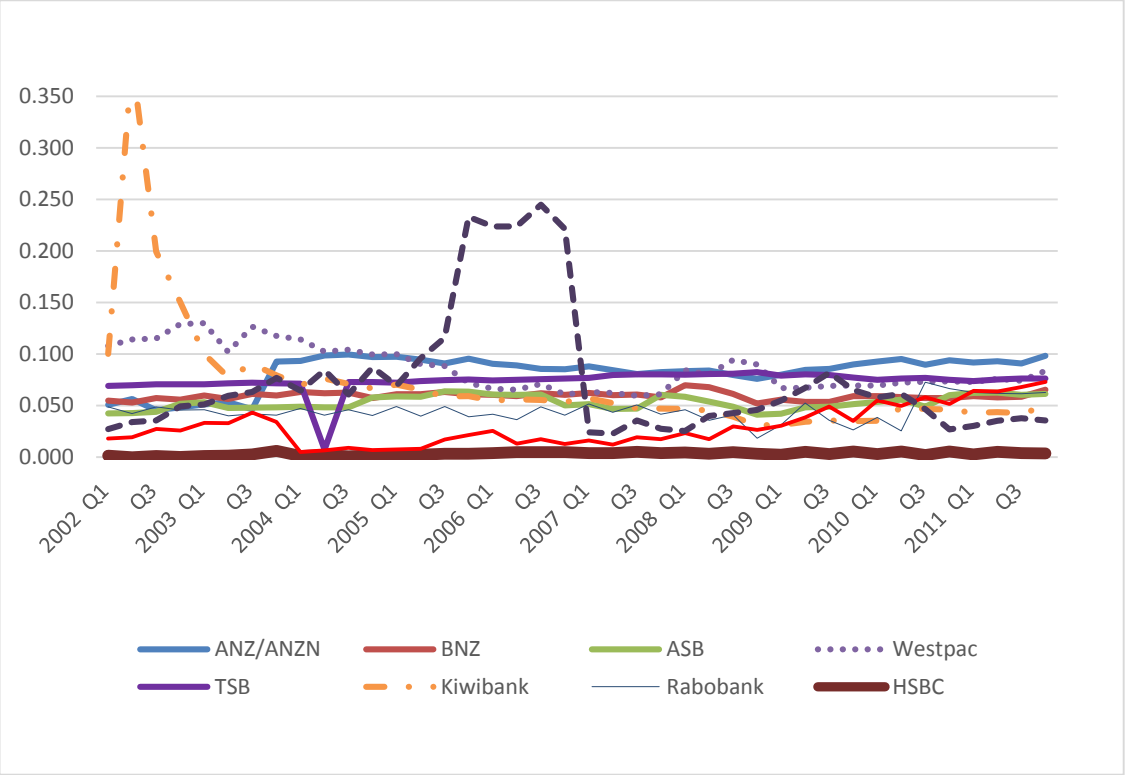
The statistically significant and negative coefficients of EQR at the 1% level in profit inefficiency equations (see Table 6.2) imply that banks in New Zealand with adequate financial capital can increase their profit efficiency. Such evidence can be found in Pasiouras, Tanna, et al. (2009); Pasiouras (2008) and Chortareas, Garza-Garcia, and Girardone (2011) in EU market. Berger and Patti (2006), using the distribution-free approach for the US banking industry over the period 1990-1995, found that smaller banks benefit more from sufficient capital ratios, thus bank size may affect the link between capital and efficiency.

New Zealand's banking industry has a conservative regulatory capital regime (under both Basel I and Basel II frameworks). In 1984, the first regulation on capital adequacy requirement was implemented for all domestic banks and all incorporated banks (foreign and domestic), with defined capital requirements and precise methods of calculation. From July 1, 2005, New Zealand introduced new thin capitalisation rules[58] for foreign-owned banks with the objective of effectively measuring the income associated with bank activities in New Zealand. This rule could deny foreign owned banks interest deductions if the bank does not have sufficient capital in New Zealand to support their business and their offshore investments made through New Zealand. As a result, there was a substantial inflow of capital into New Zealand by foreign-owned banks at the time. However, excess

[58] The new thin capitalisation rules were introduced in response to government concerns that tax paid in New Zealand by foreign-owned banking groups appeared insufficient relative to their accounting profits. The rules compare the equity of the New Zealand banking business with a legislatively prescribed level of equity based on 4% of the bank's New Zealand risk-weighted exposures. If there is a deficiency in the New Zealand equity compared with the required equity, interest is denied on the shortfall.

capital may not be attributable to bank efficiency, but is a "spare" corporate resource which earns only the risk-free rate of return (KPMG, 2006).

Figure 6.2 Equity Ratios: Full Sample Banks (Quarterly 2002-2011)



Source: Individual banks' disclosure statement (2002-2011)

Figure 6.2 illustrates the comparison of equity ratios for each of the sample banks, based on quarterly equity ratios (Table G.1 see Appendix G) over the period of 2002 to 2011. There are several interesting observations[59] in Table G.1 that deserve attention. First, the significantly higher level of equity ratios for Kiwibank in the early years (2002-2004) is a reflection of higher capital requirements for newly established business in general, which likely affected Kiwibank's efficiency performance for that period. Second, Westpac

[59] The significant change in equity level of Deutsche Bank between 2005 and 2007 also caught attention. Its parent bank relocated its capital globally due to the global market conditions during 2005, which resulted in a significant reduction in the bank's structured lending in New Zealand, consequently affecting the bank's equity level (KPMG, 2007). This is not necessarily a reflection of EQR on the bank's cost and profit inefficiency effect.

exhibited the highest equity ratios overall before decreasing from 2006[60], which might have contributed to the decrease in its profit efficiency (see Figure F.2 in Appendix F). Third, ASB bank shows much lower mean equity ratios (5.3%) than the majority of the banks (7% mean ratio for six major banks, 5.8% for all sample banks), which might partially explain its highest cost efficiency among all banks.

6.3.3 Bank Asset quality

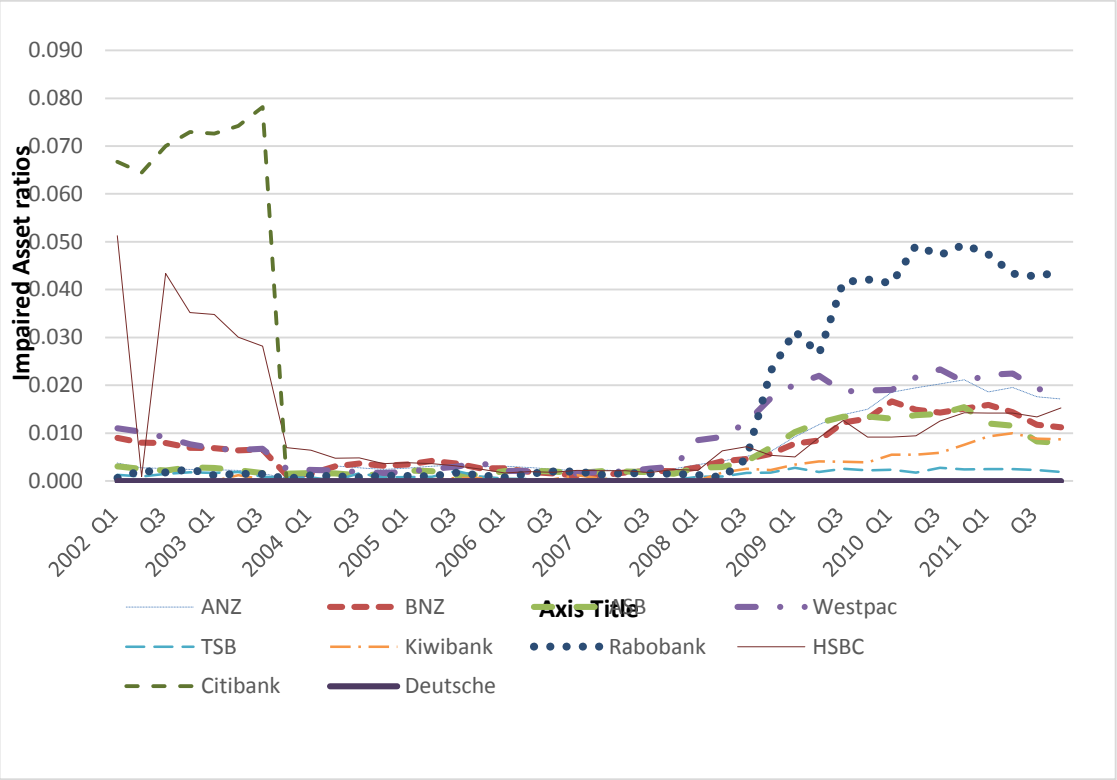
Asset quality (AQ) is measured by the ratio of impaired assets to total bank assets in this study. Banks with higher ratios of impaired assets tend to have high costs and lower profits due to poor risk management, which reflects lower cost and profit inefficiency (Berger and DeYoung, 1997), hence a positive impact of impaired asset ratios on both cost and profit inefficiency should be seen.

As expected, the results in Table 6.2 shows the coefficients of AQ are positive in the cost inefficiency equations in group B banks in both models, despite not being significant in model (1).These findings are consistent with the majority of the findings such as Berger and DeYoung (1997), Karim, Chan, and Hassan (2010) and Tsai and Huang (1999) that banks with higher, non-performing, problem loan ratios (lower asset quality) behaved cost inefficiently at managing banks' operations, and were poor at managing their loan portfolios. Interestingly, the coefficients of AQ in group A and C banks in both models are statistically significant and negative at the 1% level (see Table 6.2), an unexpected result. Rossi et al. (2005) found no evidence to support a positive relationship between bank efficiency and non-performing loans, although there is a possibility that bad loans can trigger inefficiency.

Table 6.2 shows the estimated coefficients of AQ in the profit inefficiency equations are positive and statistically significant at the 1% level in group A and B (both models) and C under model (2), which may indicate that both domestic and foreign banks in New Zealand might have used more resources than usual in their credit evaluation and loans monitoring process over the study period 2002-2011. This could have affected the banks' profit efficiency.

[60] The data for Westpac in this study is consolidated data for the bank under both organizational forms (as branch and locally incorporated subsidiary).

Figure 6.3 Impaired Assets Ratios: Full Sample Banks (Quarterly 2002-2011)



Source: individual banks' quarterly disclosure statements (2002-2011)

With regards to the quarterly impaired assets ratios (Table H.1 in Appendix H) for individual banks from 2002-2011, the Big Four foreign banks exhibit lower impaired asset ratios compared with small foreign branch banks, which could possibly explain the overall lower profit efficiency of foreign branch banks. The two domestic banks (TSB and Kiwibank) exhibit the lowest impaired asset ratios (Table H.1 see Appendix H), which may partially and positively contribute to the efficiency performance of TSB (better than one of the large foreign banks in cost and profit efficiency) and the improvement of Kiwibank's efficiency over time.

Tripe (2005b) does not incorporate problem loans in his study due to insignificant debt expenses occurred during the study period from 1996-2003. This study considers the ratio of impaired assets, as, highlighted in Berger and DeYoung (1997), efficient banks are better at managing their credit risk. The omission of asset quality as an extraneous variable in estimating bank efficiency might lead to a bias or erroneous results (Mester, 1996).

A high ratio of impaired assets would have a detrimental effect since banks with more non-performing loans are required to exert additional managerial effort and additional expenses[61] in monitoring the problem loans, analysing and negotiating solutions, sizing, maintaining and eventually disposing of collateral if default occurs, and other personnel cost such as diversion of senior management involved in the process (Karim et al., 2010).

6.4 Macroeconomic Determinants

Table 6.3 Coefficients of Macroeconomic Variables in Inefficiency Equations

Bank groups		**Group A**	**Group B**	**Group C**
Cost Inefficiency		**Eq.4.14**	**Eq. 4.14**	**Eq. 4.18**
Variable	**Variable Description**	**Coefficients**	**Coefficients**	**Coefficients**
GDPG	GDP growth	0.000	0.000	0.000
		(-0.398)	(-0.232)	(0.033)
IR	Interest rate	3.428 [a]	6.710 [a]	0.787
		(3.280)	(4.156)	(0.630)
IFR	Inflation rate	0.046	0.027 [b]	-0.048 [a]
		(1.600)	(2.000)	(-2.850)
FX	Foreign exchange rate	0.009 [b]	0.004 [b]	-0.005 [b]
		(2.210)	(2.479)	(-2.108)
UNEMP	Unemployment growth rate	0.005 [a]	0.007 [a]	-0.003 [a]
		(2.917)	(4.328)	(-3.529)
Profit Inefficiency		**Eq. 4.17**	**Eq. 4.17**	**Eq. 4.19**
GDPG	GDP growth	-0.013	0.012	-0.022
		(-1.168)	(1.366)	(-1.292)
IR	Interest rate	2.012 [c]	-40.836 [a]	4.997 [c]
		(1.725)	(-4.979)	(1.683)
IFR	Inflation rate	-0.246 [b]	-1.165 [a]	-0.322 [b]
		(-2.179)	(-6.997)	(-2.405)
FX	Foreign exchange rate	0.046 [b]	-0.094 [a]	0.084 [a]
		(2.277)	(-2.680)	(3.318)
UNEMP	Unemployment rate	0.001	0.043 [a]	0.018 [b]
		(0.150)	(4.789)	(2.482)

Notes: a=1 % Level of statistical Significance, b=5 % Level of Statistical significance, c=10% level of Statistical Significance; t-test in parentheses

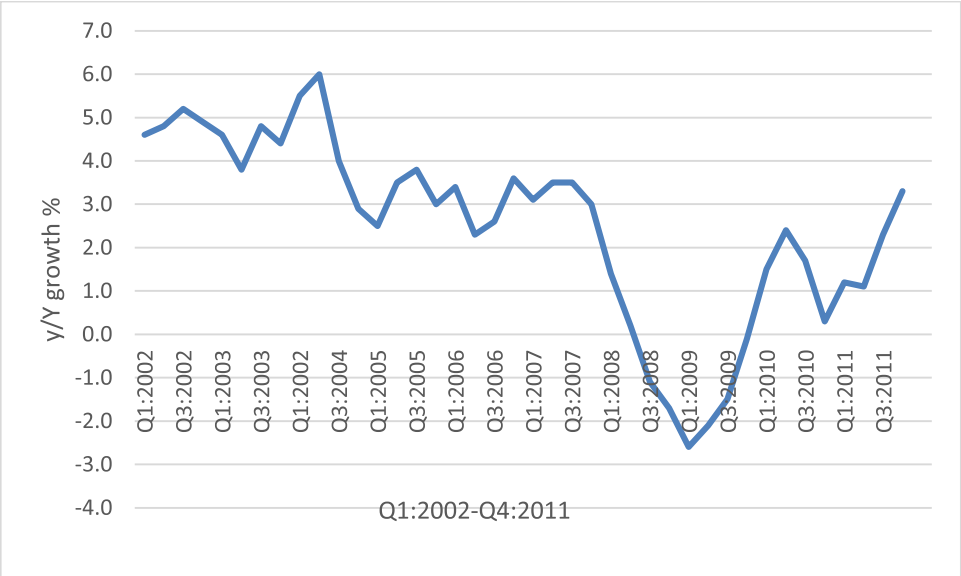
[61] The amount of salary and wages for highly specialised tasks like risk management, investment banking or agribusiness banking or financial engineering (such as online banking activities) requires experts, thus likely causes more expense for some of the banks which have low impaired asset ratios.

Decomposing the effects of macroeconomic inefficiency[62] in Table 6.3, except for the insignificant effect of GDP growth per capita (GDPG) on both cost and profit inefficiency, the coefficients of four other macroeconomic variables - interest rate (IR), inflation rate (IF), foreign exchange rate (FX), and unemployment rate growth (UNEMP) are statistically significant for both bank cost and alternative profit inefficiency at the 5% and 1% level.

6.4.1 GDP Growth

The GDPG is a measure of the host country's economic development. Figure 6.4 shows a slight decreasing trend in economic growth over the study period, partially reflecting the significant adverse effect of the recent global and the associated domestic recessions on New Zealand's economic growth. The average growth rate of GDP is approximately 2.5% (see descriptive statistic in Table 5.2).

Figure 6.4 GDP Growth (quarterly year to year): Q1:2002-Q4:2011



Source: Reserve Bank New Zealand

The results in Table 6.3 show, overall, insignificant and inconclusive coefficients of GDPG with banks' cost and profit inefficiency, inconsistent with the findings of Sufian and Habibullah (2012).The results suggest that the host nation's economic development

[62] Model (2) tests the macroeconomic conditions in bank's cost (equations 4.17 and 4.18) and profit inefficiency equations (4.15 and 4.19), and include group A B and C banks in model (2) only.

may not be an important attribute in improving foreign bank's cost and profit efficiency in the context of New Zealand.

The insignificant and negative coefficients of GDPG in cost inefficiency in preferred group B banks concur with the findings of Fries and Taci (2005) and Hauner (2005) that overall slow growth of economic development is not significantly related to cost inefficiency.

Conversely, the positive GDPG coefficients in profit inefficiency equations for group B banks are unexpected since healthy economic conditions (high GDP growth) generally provide a favourable environment for banks to achieve higher profit efficiency (Maudos et al., 2002; Vu and Nahm, 2013).

Yildirim and Philippatos (2007) estimated the cost and profit efficiency in 12 CEE countries, and also found the GDP control variable positively linked to cost efficiency while negatively linked to profit efficiency.

6.4.2 **Interest Rate**

Interest rate (IR), was measured by the 90-day bank bill rate, following Tripe (2003, 2005a, 2005b), who found it provided the best single explanation (in terms of R square and F statistic) of the technical efficiency scores for some of the major banks such as ANZ, ASB and TSB.

The results show a statistically significant and positive relationship between IR and banks' cost inefficiency in group B banks and model 2 at the 1% level. This indicates that the 90 day bank bill rates have strong explanatory power in the major banks' cost inefficiency, which suggests that banks in the periods with higher interest rate environment generally reflect uncertainty in the macroeconomic environment, thus may exhibit higher cost inefficiency.

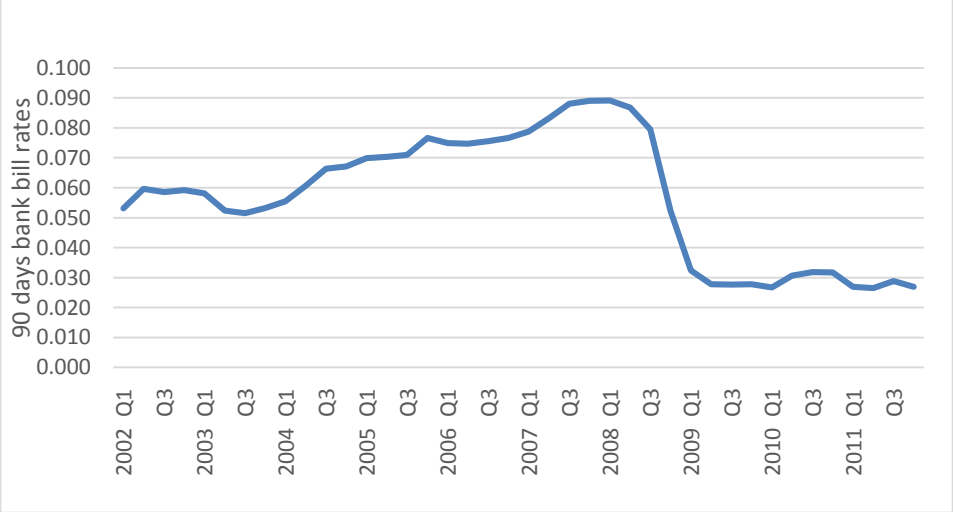
The coefficient for the 90 day bank bill rate (IR) with profit inefficiency (see Table 6.3) is insignificant and positive in group A and C banks in both models. It is, however, statistically significant and negative at the 1% level in preferred group (B) banks and

model (2), which supports the argument that interest rates might be associated with higher levels of profit[63] efficiency for major banks, and vice versa.

Figure 6.5 shows the changes in the 90 day bank bill rates during the study period. The figure shows the rate increased significantly from 4.98% in the first quarter of 2002 to 9.02% in the first quarter of 2008, then dropped rapidly through the year, and remained at a stable level, around 3%, from 2009 until the end of the study period, 2011. The flat interest rate environment since 2009 has led to increased interest margins for major banks(KPMG, 2011) , which may explain, in part, the increased mean profit efficiency for foreign banks from 2009-2011 (see Figure 6.5).

Tripe (2003) uses the DEA method and logit regression to explore the relationship between banks' 90 day bank bill rate and banks' scale efficiency over the period 1996 to 2002. The author found in his constant return to scale model, the coefficients for interest rate consistently affect bank's efficiency negatively, which suggests that the improvement of the bank efficiency over the period 1996-2002 appears to be a consequence of the fall in the general level of interest rates.

Figure 6.5: 90-days Bank Bill Rates (Quarterly 2002-2011)



Source: Reserve Bank of New Zealand: Statistic

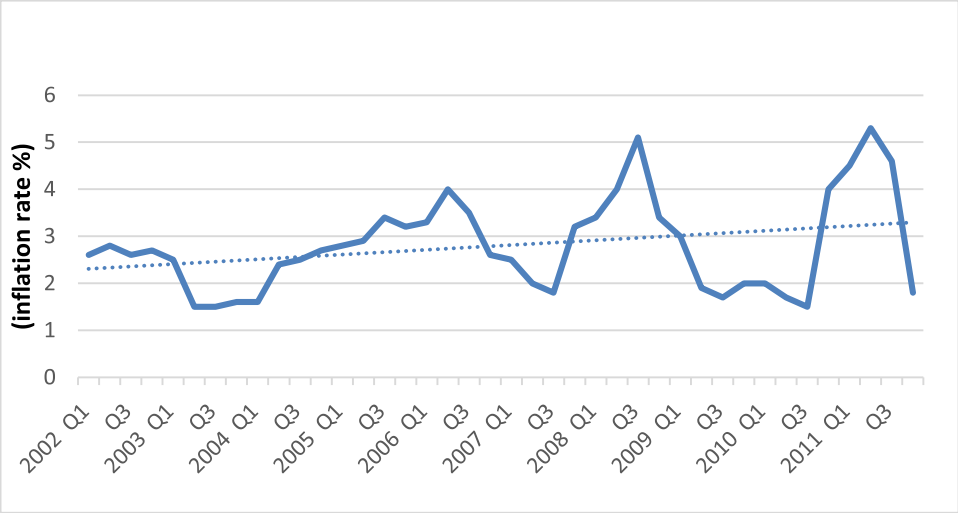
[63] Drummond, Maechler, and Marcelino (2007) found that, in an era of low interest rates in Italy, banks' interest income declined, however other income rose, which suggests that a lower interest rate environment could be associated with higher profit.

According to Wong (2012),during the GFC period, banks in New Zealand experienced a significant shift in funding, thus simply observing the 90-day bank bill rate might not be an appropriate proxy for banking funding costs.

6.4.3 Inflation rate

Previous studies in New Zealand bank efficiency literature have not included the inflation rate, due to the unchanged inflation level over their study periods (Tripe, 2005b). This study includes the inflation rate since it fluctuates during the study period 2002-2011 (see Figure 6.6).

Figure 6.6: Inflation Rates: Quarterly 2002-2011



Source: Reserve Bank of New Zealand: Statistic

As illustrated in Figure 6.6, the inflation rate in New Zealand increased over the study period, but remained relatively low with an average of 2.8%[64], especially compared with averages of 12% in the 1970s, and 11% in the 1980s as reported by the Reserve Bank of New Zealand (2015b). Since September 2002, under the Policy Targets Agreement (PTA), New Zealand has kept its inflation within a range of 1-3 per cent on average over the medium-term. The relatively lower inflation environment has likely contributed to the overall high cost and profit efficiency for New Zealand banking industry during the study period (Reserve Bank of New Zealand, 2012b).

[64] 2.8% is the mean of IFR variable over the study period 2002-2011 in New Zealand, which is presented in the Descriptive Statistic of Macroeconomic Variable in Table 5.2

Table 6.3 shows statistically significant and positive coefficients of inflation rate and cost inefficiency in our preferred group B banks in both models, which suggest that banks operating during periods of relatively higher inflation are less cost efficient, which is supported by the cross-country evidence by Pasiouras, Delis, and Papanikolaou (2009) and Kasman and Yildirim (2006).

With regard to the impact of the inflation rate on profit inefficiency, all the signs are negative at 1% significance level, which suggests that the higher inflation rates negatively impact profit inefficiency. However, this finding contradicts the Vu and Nahm (2013) study in Vietnam which shows that the annual inflation rate (a low average of 4.3%[65] in Vietnam) is negative and statistically significant with bank profit efficiency. This suggests that high inflation is associated with lower levels of bank profit efficiency in the Vietnam banking sector.

According to Boyd and Champ (2006), theoretically, inflation might negatively affect economic growth through the banking sector by reducing the overall amount of available credit to businesses. However, high inflation beneath some thresholds, might actually lead to increase in real economic activities but only in the periods where inflation and nominal interest rates are both low. This may partially explain the adverse impact of relatively low inflation rates on banks cost inefficiency in this study.

Inflation can affect the real value of banks costs and revenues either positively or negatively depending on whether it is anticipated or unanticipated (Perry, 1992). If banks can fully anticipate the inflation rate, they can appropriately adjust interest rates faster than their costs to allow them to acquire higher economic profits.

6.4.4 Two additional macroeconomic variables

Two important macroeconomic factors, the foreign exchange rate and the unemployment rate were included, in addition to GDP growth, interest rate and inflation rate, to test a broad set of the macroeconomic variables.

Foreign Exchange Rate

[65] Boyd and Champ (2006) suggest that moderate inflation rates might be 5-10 percent in the U.S context.

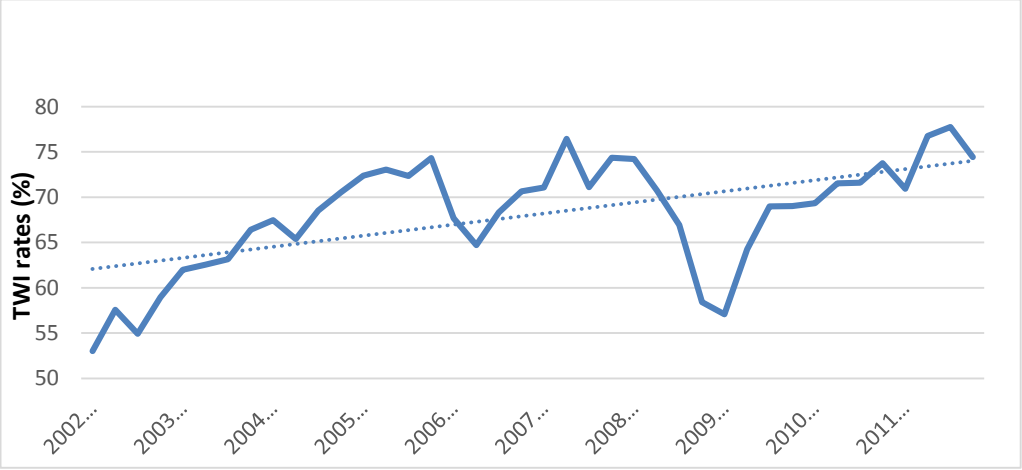
Fluctuations in foreign exchange rates over time are a useful element in assessing or interpreting macroeconomic developments (Steenkamp, 2014). Mendes and Abreu (2003) found that exchange rate instability increases risk in cross-border bank activities and losses could have occurred in foreign exchange transactions.

A foreign exchange rate (FX) variable is included here and measured by the TWI (Trade-weighted index)[66]to examine the possible influence of FX on banks' efficiency in New Zealand. The index measure of foreign exchange rate can capture the medium-term effect of exchange rates on the New Zealand economy and inflation (Reserve Bank of New Zealand, n.d.)

Figure 6.7 illustrates the changing trend in the quarterly TWI index, ranging from 53 in 2002 to 77.73 in 2011.The increasing FX rate from 2002 indicates New Zealand's currency strengthened, which reflects a strong domestic economy, risk in export commodity prices and associated increasing interest rates, until a sharp fall in the NZD in 2007-2009, against some of the currencies in the TWI, due to deterioration caused by the GFC.

Figure 6.7: New Zealand Dollars Exchange Rates-TWI (Index: 1979=100)

(2002-2011)



Source: Reserve Bank of New Zealand

Notes: The Trade-Weighted Exchange Rate Index is the nominal New Zealand-dollar exchange rate weighted 50/50 by New Zealand's trade with its major trading partners (US, Australia, Japan, the UK, and the Euro) and the nominal GDPs (in US dollars) of those countries. On 30 June 1979, the basket equalled 100 (Index: 1979=100) (Reserve Bank of New Zealand, statistic).

[66] A "Trade-weighted index"(TWI) is one way of constructing an effective exchange rate index, based simply on trading partners' share of New Zealand's foreign trade(Steenkamp, 2014).

The FX coefficients (in Table 6.3) in the cost inefficiency equation for group (B) banks in model (2) are significant and positive at the 5% level, but significant and negative in the profit inefficiency equations at the 1% level. This seems to confirm the necessity of selecting foreign exchange rate as a macroeconomic condition to test for the inefficiency effect. It also appears that the fluctuation of foreign exchange rate has impacted more on profit efficiency than cost efficiency (in terms of the t statistics).

The fluctuations in foreign exchange may be caused by a number of factors such as interest rates, inflation rates, terms of trade and public debt (Otuori, 2013), consequently, the relation between foreign exchange rate and bank efficiency can be complex and is beyond the scope of this study.

Poghosyan and Poghosyan (2010) study cost efficiency in 11 CEE countries, introducing foreign exchange rate, with GDP growth and inflation rate, to control for the macroeconomic environment in their cost inefficiency specifications. The authors found positive and significant effects of foreign exchange rate depreciation on loan rates, which suggests that currency stability has important implications for the lending decisions of banks in CEE countries.

Unemployment Rate

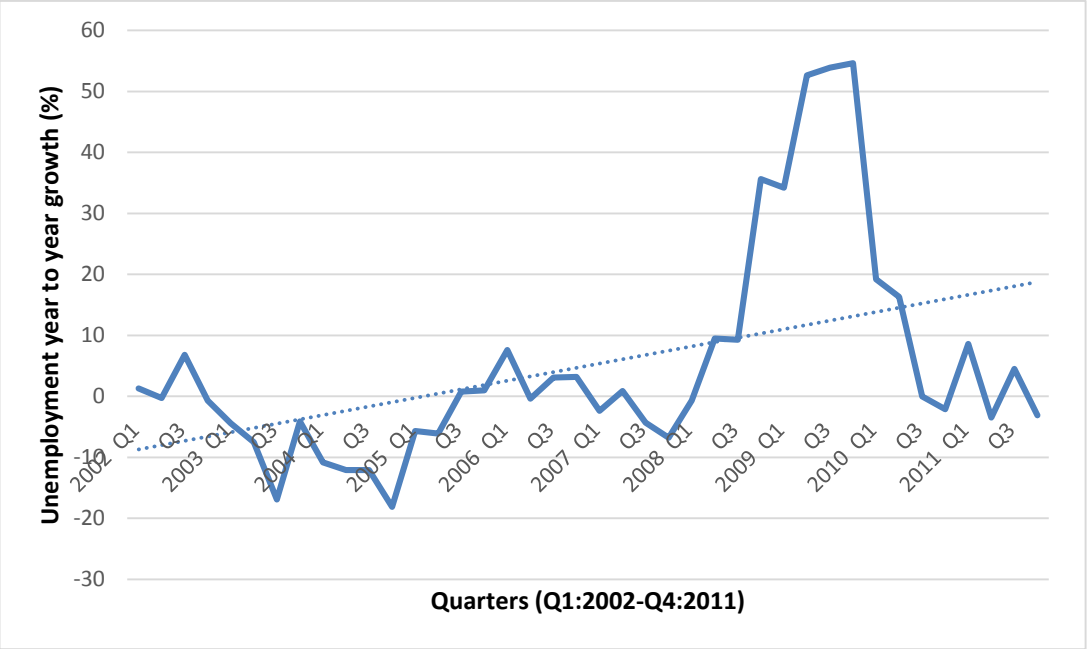
Unemployment rate is also not a usual macroeconomic variable used in bank efficiency measurement literature. However, as a main macroeconomic indicator, it reflects the overall health of an economy or business cycle, important to other macroeconomic conditions such as the inflation level, and the growth of wages, thus, impacting banking savings, demand for credit volume and quality.

The sign and significance of the unemployment rate (UNEMP) variable in Table 6.3 shows a significant positive relation of unemployment growth rate on both bank cost and alternative profit inefficiency[67]. The results are consistent with the Fitzpatrick and McQuinn (2008) study that found an increase in the unemployment rate in Ireland, the

[67] Except for the negative correlation of unemployment rate growth with cost inefficiency in foreign banks group C in model 1.

UK, Canada and Australia, could increase the level of both foreign and domestic commercial bank inefficiency.

Figure 6.8: Unemployment Y/Y Growth Rate (2002-2011)



Source: Reserve Bank of New Zealand: Statistic

Figure 6.8 illustrates an overall increase in the unemployment growth rate over the 40-quarter period of 2002-2012, in particular, during the GFC and domestic recession, since late 2008, leading to a level not seen for over a decade. According to , the unemployment rate in New Zealand reached a peak of 10.6% in 1992, fell to 6.3%, rose to 7.7% in 1998 then declined steadily before rising again to 6.9% in 2010 and decreasing in 2011. The progressive increase in unemployment rate growth from 2008 to 2011 (in Figure 6.9) reveals that it could be a key change in the New Zealand economy and a key factor in terms of the performance of financial institutions (with foreign and domestic ownership) in New Zealand (KPMG, 2009).

An increase in the unemployment rate might produce a demand for new bank loans, which may cause a contraction of the reimbursing capacity of households, triggering an increase in the loan default rate (Moinescu, 2008). At the height of unemployment growth, around 2010 in New Zealand (see Figure 6.8), interest rates were at record lows, and the dollar was stable. Both foreign and domestic banks struggled to grow their loan books and many banks had flat or low returns due to bad debts through customers being unable to repay

their loans (KPMG, 2011) Business and consumer confidence only picked up in New Zealand, in the first quarter of 2011 when economic recovery was imminent and unemployment dropped significantly from its peak in 2010 (KPMG, 2011). These changes are similar to the changing pattern in profit efficiency[68] for major foreign banks during the GFC period (see Figure F.2 in Appendix F).

6.5 Conclusion

Taking into account the findings in the homogenous panel data sample group (B) banks, and inclusive inefficiency model (2), which contradict the usual findings in developed countries, the home field advantage hypothesis (Berger et al., 2000) is rejected, confirming that foreign ownership is significant and positively impacts the overall level of cost and profit efficiency for major foreign banks in New Zealand over the study period 2002-2011.

In addition, the global limited advantage hypothesis (Berger et al., 2000) is also supported in this study, indicating that the efficient Australian-owned banks have experienced specific, favourable market, regulatory, or supervisory conditions in New Zealand, and thus can operate more efficiently than domestic institutions and foreign banks from other nations.

The empirical results reveal that higher concentration in banking could have increased some of the foreign banks' power in their profit efficiency rather than cost efficiency. The ANZ's acquisition of National Bank did not change the market concentration, however, it improved the bank's cost efficiency.

With regard to the impact of general bank-specific characteristics on a bank's cost and profit efficiency, the results suggest that a higher level of cost and profit efficiency are associated with bank size in the context of New Zealand. Larger foreign banks are more cost and profit efficient than domestic or regionally active banks such as TSB, as these banks may be exposed to more competition and are more successful in adopting new

[68] The changing pattern in cost efficiency of the major four foreign banks in Figure F.1 (see in Appendix F) is not similar to that in unemployment growth during the GFC period in Figure 6.9. This may suggest an efficiency gain for foreign banks from the Reserve Bank New Zealand Retail (and wholesale) Guarantee Scheme, and the financial support from the parent banks.

technologies and products compared with smaller foreign and domestic banks. Interestingly, less-capitalised foreign banks, such as ASB bank, exhibited higher profit efficiency than other banks. The results of the study also reveal that banks in New Zealand over the study period 2002-2011 have relatively low impaired asset ratios, thus the banking industry behaved both cost and profit efficiently.

The estimated coefficients of the macroeconomic variables in cost and profit inefficiency equations indicate that the variation in banks' cost and profit inefficiency is empirically explained by interest and inflation rates, which confirm the general belief that a fall in interest rate, and a relatively low-inflation economy provides a favourable environment for foreign banks' efficiency performance. The two additional macroeconomic variables, foreign exchange rate and unemployment growth rate, could also have considerable influence in determining the level of foreign banks' cost and profit efficiency.

Chapter 7
Conclusion

7.1 Introduction

The banking sector in New Zealand differs from many other countries as the percentage of the combined assets held in large foreign-owned banks has been close to 90 percent of the total banking sector assets for over a decade. More importantly, larger banks in New Zealand are foreign-owned, and by one nation, Australia. In such a highly concentrated banking sector, dominated by foreign ownership, efficiency concerns regarding the performance of financial institutions should be promoted to assist in the assessment of the stability of New Zealand's financial system, the effectiveness of financial sector regulatory practises and the impact of foreign-owned banks' performance on financial and economic development in New Zealand, in particular, following the recent global financial crisis.

The Reserve Bank of New Zealand has a specific concern with the performance of individual banks in the financial system, given the legislative requirement to promote a sound and efficient financial system. The efficiency criteria relate to the financial institution's ability to perform its functions in a cost-effective way, while helping to achieve the maximum profits. If individual financial institutions perform their functions inefficiently, it could potentially affect the efficiency and stability of New Zealand's financial system, and disrupt economic activities in New Zealand.

Previous bank efficiency studies in New Zealand literature by Tripe (2002, 2003, 2004, 2005a, 2005b) and Adjei-Frimpong et al. (2014) are dominated by one single methodology, which is the non-parametric frontier approach of Data Envelopment Analysis (DEA). The findings by those studies suggest that banks' efficiency in New Zealand has shown overall improvement. However, the DEA method rules out the possibility of the frontier being shifted by random noises, which clearly is a limitation. The method also generally ignores prices, and thus makes comparison difficult between banks that use different kinds of input and/or produce different kinds of output, which should be controlled for when evaluating the banks' efficiency performance (Berger and Mester, 1997).

The objective of this study is to use an alternative efficiency measurement methodology, namely, the Stochastic Frontier Analysis (SFA), to extend the existing bank efficiency studies for New Zealand for the period of 2002-2011. The focus is on investigating the factors determining cost and profit efficiency for foreign banks in New Zealand. Non-parametric techniques, such as DEA, generally focus on technological optimisation rather than economic optimisation. The SFA approach, however, corresponds well with economic (cost and profit) efficiency and allows the study to obtain banks' efficiency scores accounting for random errors, data heterogeneity and possible explanatory variables. There are 10 banks including 8 foreign banks and 2 domestic banks included in this study.

This chapter summarizes and discusses the findings of the empirical results presented in the previous chapter. Section 7.2 condenses the three research questions, and their associated methodology and empirical results, then the policy implications are discussed in Section 7.3, followed by limitations of the study in Section 7.4. Some directions for future research are proposed in Section 7.5.

7.2 Major Findings of the Research Questions

To achieve the objective of this study, 65 recent bank efficiency studies, based on the foreign ownership impact on banks' efficiency across countries or in single nations, were reviewed. Driven by the gaps and inconsistencies in methodology and discussions on efficiency determinants, three research questions emerged: (1): is the Stochastic Frontier Analysis (SFA) approach an appropriate efficiency estimation technique in the New Zealand context? (2): Does foreign-owned and domestic-owned bank efficiency differ in New Zealand? (3): What determines the differences in foreign-owned banks' efficiency in New Zealand? The main findings of each question are summarised below.

7.2.1 Appropriateness of SFA Approach

The first research question was mainly driven by the limitations of non-parametric frontier method DEA and the DEA-like methods (such as the Malmquist index and other derivatives) employed in the existing literature, especially for New Zealand banks, and the knowledge gap due to the lack of alternative bank efficiency measurements in New Zealand efficiency measurement literature.

Due to data availability, ten banks (eight foreign banks, two domestic banks) were selected which continuously operated in New Zealand from 2002 to 2011. To address the data heterogeneity caused by ownership, bank size, organisational form, these were classified into three bank groups, the full sample of banks in group A, major banks which compete mainly in the retail market in group B and all selected foreign banks in group C. With the group datasets, the application of the Battese and Coelli (1995) model permits the identification of effects of technological change and of time-varying efficiency (Battese and Coelli, 1995).

An intermediation approach is employed as the theoretical framework in this study using the input and output variables. Efficiencies for both foreign and domestic banks are modelled in the SFA cost and alternative profit functions as multi-product firms that produce two outputs (loans and other earning assets) with three input prices (price of labour, funds and physical assets).

Frontier efficiency studies by SFA should account for heterogeneity across sample banks, especially when efficiency measures are employed for policy purposes. The SFA approach to handling the data heterogeneity issues was taken from the Battese and Coelli (1995) model, as a means of exploring the cost and profit inefficiency of individual sample banks. The "one-step approach" of this model is a panel data stochastic frontier and a time dependent inefficiency model, simultaneously estimating cost and alternative profit frontiers (equation 4.4 and 4.7) and modelling the cost and profit inefficiency equations (4.11-4.19) in Frontier 4.1 (Coelli, 1996). These methods enabled parameter estimates and efficiency scores for individual banks to be obtained.

The SFA method and Battese and Coelli (1995) model inefficiency specifications also account for non-stochastic and stochastic environmental variables in the inefficiency equations. In this study, two models were designed to estimate the impact of a set of industry-specific and bank-level specific characteristics and macroeconomic conditions. The estimates' parameters in cost and profit frontier functions and the coefficients in cost and alternative profit inefficiency specifications are, overall, statistically significant at the 10% level or more, confirming that the SFA approach and the Battese and Coelli (1995) model specifications suffice to capture the inefficiency effects in this study, further supported by the high value of gamma and LR-tests. Moreover, the higher LR ratios of the

comprehensive model (2) with the consideration of all explanatory variables, support the author's belief that results obtained from the models including the macroeconomic variables in the cost and profit inefficiency equations, for the core group of six major banks (ANZN, BNZ, Westpac, BNZ, TSB, and Kiwibank) in the model are preferred.

The operating cost to income ratios obtained for each sample bank suggest that large foreign banks show a marginal improvement in operating cost efficiency over the study period, consistent with the evaluation of cost efficiency over time by the SFA approach. For example, ASB continuously exhibits decreasing operating cost efficiency ratios from 51.3% in 2002 to 42.9% in 2011, while SFA results show ASB was ranked as the most cost efficient across all three groups of banks. The results closely follow the Bauer et al. (1998, p. 109) findings that the parametric-based SFA approach is generally consistent with the standard performance measured but the DEA-based efficiencies might be much less so.

7.2.2 Foreign-owned vs Domestic-owned Banks' Efficiency in New Zealand

The SFA results in this study suggest that foreign banks in New Zealand on average exhibit higher cost efficiency and profit efficiency than domestic banks over the study period 2002-2011. The result does not reinforce the general findings of past studies of foreign banks' efficiency in developed countries, where foreign banks were less efficient than domestic banks.

Previous DEA studies on the major banks' efficiency performance in New Zealand showed an overall improvement between 1996 and 2002 (Tripe, 2003, 2005a, 2005b), while the SFA findings in this study indicate no remarkably increased cost efficiency, while profit efficiency has slightly decreased over the study period.

In line with the literature, the differences in cost efficiency are significantly smaller than differences in profit efficiency (Berger & Humphrey, 1997; Berger et al., 1993), which can be explained in part by the fact that profit is more volatile than costs. In addition, more specialised banks (for example, small foreign branch banks) were less profit efficient than large foreign banks or domestic banks with full service. Foreign branches have a more "following their clients" operating background, in other words, not necessarily with profit maximization as a goal, therefore showed much lower profit efficiency than large foreign

banks (under group A and C banks' common frontier) and domestic banks (under group A banks' full sample common frontier).

ANZ National Bank and ASB Bank claim the top ranks in cost efficiency and profit efficiency under all three pooled banking groups. ASB bank is on average the most cost efficient bank which is not consist with Tripe (2005)'s study that revealed ASB Bank to be less efficient compared with other major foreign banks. However, the results in this study suggest that ASB bank, in a competitive banking market, has become a standout performer with a continued increase in asset growth, capital ratio and asset quality and the leader in technology and innovation in banking products and services over the last decade (KPMG, 2011).

Domestic banks such as TSB and Kiwibank are, on average, less cost and profit efficient than large foreign banks. TSB bank has dropped in ranking compared with DEA results from previous studies (Tripe, 2003, 2005a and 2005b), however, TSB bank was found to be more cost efficient than ANZ National Bank, and more profit efficient than ASB Bank. Kiwibank has been observed to have made significant improvement in efficiency which is a reflection of the inefficiency at the start of the period when banks have just registered and started to establish themselves in the market. Among the foreign branches, we found that HSBC bank were more cost efficient while Rabobank was more profit efficient than other small foreign branches over the study period examined.

7.2.3 **Determines of Foreign-owned Banks Efficiency in New Zealand**

The third research question aims to explore and analyse the relationship between cost and profit efficiency and the hypothesized determinants obtained from the cost and profit frontier (equations 4.4 and 4.7) and associated inefficiency equations (4.11-4.19). The results support the choice of industry-specific, bank-specific, and macroeconomic variables in the inefficiency equations.

The focus is on the results for the relatively higher homogenous group B banks, as the Big Four banks are economic heavyweights, systemically important in the New Zealand banking system, and the two domestic banks included in the group are the main competitors, in the retail market, with foreign banks. Furthermore, the results in the

comprehensive model (2) were analysed as they account for all explanatory variables in the inefficiency equations.

The results for group B major banks under model (2) confirm the significant impact of foreign ownership on banks' cost and profit efficiency. Major foreign banks in New Zealand are found, on average, more cost and profit efficient than domestic banks, which may relate to the openness of New Zealand's banking system, and may suggest that foreign owned banks in New Zealand might not have acted as entry barriers to new business. Foreign banks in New Zealand have increasingly used outsourcing of IT systems and other functionalities to either parent banks or third parties to reduce their costs in areas such as risk management, accounting and computer processing (Bloor & Hunt, 2011), in particular, the major foreign banks have a relatively high level of product homogeneity, easy access to market information and relatively low implied switching costs, hence, could have achieved considerable scope for efficiency gains in the banking industry.

There is evidence to support the limited global advantage hypothesis (Berger et al., 2000) that foreign banks from one specific nation, Australia, have enjoyed a competitive advantage when operating or monitoring their subsidiaries or branches in New Zealand. Australia is relatively closer to New Zealand compared with other nations, with the same language, and similar cultural, regulatory, and supervisory structures, hence facing less bias against them or other explicit or implicit barriers. Moreover, Australian-owned banks could have transferred knowledge, experience, technology and expertise in products and service to the New Zealand banking market, hence operated both more cost and profit efficiently than domestic banks and foreign banks from other nations.

The concentrated nature of the New Zealand banking system raises questions about the level of competition and its impact on banks' profit efficiency rather than cost efficiency in the market. The results imply that foreign banks exhibited comparative advantages in New Zealand, which might have contributed to their gain of an increasing share of the market. In addition, foreign banks in the monopolistically competitive market might have some degree of market power over the prices of the products and services, and can be rewarded with higher alternative profit efficiency (Berger and Mester, 1997).

The results on bank size effect suggest that technological progress could allow large multimarket banks to compete more efficiently against small, single-market banks (Berger

et al., 2007). The nature of the service provided by large foreign banks appears to be conducive to competitive behaviour, although they may have some degree of market power in the retail banking market. The ANZ's acquisition of National Bank appeared to not only increase the banks' size, but also enhanced the banks' profit efficiency which may be due to the merged bank altering their output mix toward more profitable products, rather than improved cost efficiency.

With regard to the impact of equity ratios and asset quality, the results imply that the conservative New Zealand banking regulatory capital regime may have partially contributed to the high profit efficiency for large foreign banks. Individual foreign banks with lower equity ratios might have more risk-taking preference, and thus become more cost efficient. The lower level of impaired asset ratios for large foreign banks are only associated with high cost efficiency in the New Zealand banking industry. Large foreign banks in New Zealand have low exposure to high risk loans, by advanced country standards, with impaired assets less than 2 percent of total assets (Jang & Kataoka, 2013).

The findings on the impact of macroeconomic conditions on foreign banks' cost or profit suggest that banks operating in periods with higher interest rates and inflationary pressure exhibited lower cost efficiency but not necessarily low profit efficiency. Low unemployment growth rates and fluctuations in foreign exchange rates over the study period have also shown significant impact on both foreign and domestic banks cost and profit efficiency.

7.3 Implications of the Study

Foreign banking is one of the most difficult service industries in which to measure performance, including efficiency, partially due to the absence of any standard set of production processes among the foreign banks, and also as financial information for foreign banks can be implicit and commingled and controlled by parent banks. However, efficiency measures can have predictive accuracy in bank failure prediction models (Barr et al, 1994).

Consequently, as SFA has an intuitive appeal for performance measurement for regulatory purposes (Berger and Humphrey, 1997) this study employed this sophisticated parametric

method to measure foreign banks efficiency, and represents a useful addition to current modelling by regulators for benchmarking banks' efficiency performance in New Zealand.

7.3.1 Implication for SFA Approach in Bank Efficiency Measurement

Despite the varying significant research efforts mounted over the last few years to examine foreign banks' efficiency, there is limited empirical efficiency measurement, using SFA, in a single developed nation with small data samples. To the best of the author's knowledge, of the total 65 previous studies reviewed, addressing the effect of foreign ownership on bank efficiency, none has employed an SFA approach using similar samples in terms of the size and data heterogeneity.

This is also the first study that has employed the SFA parametric method coupled with an intermediation approach, and undertaken a systematic inefficiency measurement to estimate banks' cost and profit efficiency in New Zealand. The estimated coefficients are, overall, statistically significant in the cost and profit inefficiency equations, which strongly advocates the use of stochastic frontier approach (SFA), and the Battese and Coelli (1995) model rather than the two step regression approach for bank efficiency study.

There is also evidence in this study to support the importance of accounting for data heterogeneity among sample bank groups in the SFA approach. The 10 sample banks were pooled in three panel data groups to control for differences in ownership, organisational form, bank size, business or product mix, and quality of service. The results show the efficiency scores differ remarkably for some of the banks (domestic banks and foreign branch banks) across the groups although the ranking information remains stable, particularly for extreme performers. The results support Berger and Mester's (1997) finding that failure to account for heterogeneity is a likely candidate for instability of efficiency results.

The results confirm that SFA efficiency measurement needs to account for the systematic differences across banks, since efficiency estimation in the fairly homogeneous sample of major banks (in group B) improved considerably compared with the other two groups (A and C) which included small foreign branch banks. (Bos et al., 2005) stated that controlling for heterogeneity results in efficiency studies that more accurately reflect the

management's ability to minimize costs and maximise profits, which also influence efficiency performance.

7.3.2 Policy Implication

The New Zealand banking system is unique by world standards. The Reserve Bank of New Zealand has a specific concern for bank performance, given their legislative requirement to promote a sound and efficient financial system. The findings of this study offer important policy implications from several different perspectives, but general policy implications only are provided, based on the conclusive results in this study.

From the bank authorities' perspective, the estimates of foreign banks 'efficiency and comparison of individual bank's efficiency can be a sectoral lens for the efficiency evaluation of the New Zealand banking system. The results in this study confirm that foreign banks in the highly concentrated New Zealand banking market have achieved important cost and profit efficiency gains over the period 2002-2011. These might have arisen from scale, diversification of the banks' assets portfolios, advanced risk management skills, or also through integrated branch networks in the local market and integrated markets between home and host country. The results also support banks' efficiency performance being associated with healthy competition and some favoured macroeconomic conditions in the host nation, such as low interest rates inflationary pressure, and a productive employment market.

The study may also give insights into foreign-owned banks' performance assessment for researchers and regulators in New Zealand and elsewhere, which also have a high presence of foreign banks, for example, 97.4% in Estonia and 84.1% in Croatia (in 2000), in the integrated EU market. The findings in this study suggest that foreign banks could indirectly force improvements of efficiency in the domestic financial system, and stimulate competition and condensability of domestic financial markets.

From the perspective of financial stability, the policy implications of the study are ultimately related to the debate on the issues of banks' efficiency gains and financial stability. Benchmarking the performance of the Big Four banks as systemically important banks in this study is an important element when monitoring the soundness and stability of the financial system in a country where foreign banks dominate the banking system, as

in the New Zealand context. Systemically important banks can be viewed as too-big-to fail. However, the four large foreign banks maintain higher levels of cost and profit efficiency than domestic banks and small foreign branch banks, which could be a reflection of the impact of market discipline through the requirement for disclosure statements by The Reserve Bank of New Zealand. The results provide no evidence of a trade-off between banks' efficiency gains and financial stability in New Zealand for the period 2002-2011.

The identification of most and least efficient banks is more important for regulatory policy decisions than the absolute measure of efficiency levels, as policymakers can identify if there are failing banks, which tend to be located far from the best practise frontier, then adjust their policies and procedures to avoid "worst practise" (Berger and Humphrey, 1997).The results in this study show only marginal differences among the systemically important banks, compared to the best performer, which provides no evidence of any bank failing in New Zealand. Kiwibank, as a newly established domestic bank, has been identified in this study as the least cost and profit efficient bank compared with other major banks. However, the overall improvement in both cost and profit efficiency over the study period could be the reflection of a healthy banking system and structure in New Zealand.

The results also provide the valuable insight that foreign banks could withstand the sizeable global financial crisis and exposure to the banks' lending growth, quality, cost of funds and interest margins. Given the high bank concentration and large offshore wholesale funding needs, the merits of New Zealand's conservative approach in implementing the Basel framework might have contributed to the relatively stable cost efficiency for major foreign banks during the crisis period, in spite of the significant decrease in their profit efficiency for a short period. In addition, the results prove the importance of the New Zealand government's retail guarantee program and the support from foreign banks' parent banks for the efficiency and contestability of New Zealand's banking system when facing an unexpected crisis.

From a bank group's perspective, the results in this study can provide an important lesson on the influence of similarity of home and host country characteristics such as language, culture, regulation and economic conditions in their cross-banking activities. The findings imply that cross-border banking activities can gain efficiency from the integration of financial services, resulting in a broader range of assets and services and a reduction of

cross-border operating cost (de Guevara, Maudos, & Pérez, 2007). In addition, benchmarking the performance of the their subsidiaries or branches in the host country enables the parent bank in the home country to adjust their offshore expansion motivations, entry modes, consolidation strategies and business focus in order to achieve the best efficiency performance.

The empirical evidence may also point towards some policy implications for bank management. Foreign banks should consider the rules and regulations in the host nation, and have advanced risk management skills, in particular, for controlling the quality of assets and the level of equity ratios to ensure high levels of cost and profit efficiency.

The ranking information for individual bank's efficiency provide a benchmark for bank management to analyse other bank's efficiency performance and also learn from the "best practice" bank or those with better efficiency performance. For example, ASB is ranked as the most cost efficient bank in this study, which should encourage other banks to follow ASB and focus on product and service innovation and asset quality. The ANZ National Bank ranking as the most profit efficient bank might give insight for other banks' deciding on consolidation and/or expecting improved efficiency from economies of scale.

7.4 Limitations of the Study

It is important to highlight some shortcomings in this study for future studies to address. The level of efficiency estimates, to some extent, depend on the methodology adopted which may, in turn, be affected by the data, due to accounting issues, therefore the results should also be interpreted with some caution.

In terms of the impact of the limited sample data size, the two domestic banks from the total 10 selected sample banks, with only approximately 3% of total market share, could challenge the findings of the study which generalise the efficiency comparison when examining the ownership hypothesis. However, there is no solution to the small data sample in the New Zealand context. In addition, data based on adjusted quarterly data from the banks' balance sheet and income statements, might have resulted in the volatility of quarterly profit efficiency scores, and affect the evolution of profit efficiency over the study period.

There is also an argument regarding the input variable price of physical capital, due to the concern that foreign branch banks typically choose to rent physical assets in the host nation, while nationwide foreign banks and domestic banks most likely set up administrative centres. This then reflects that each bank may face exogenous rather than the usually computed endogenous input prices. Moreover, physical capital is a durable input which can be purchased in one period and consumed over a life time or until replaced.

The changes in financial reporting standards over the study period might also raise an issue for the adjusted data. The introduction of the New Zealand equivalents to International Financial Reporting Standards (NZ IFRS) in 2005 was the most significant accounting change to impact on banks and financial institutions in New Zealand. Foreign banks had to adapt their timetable of quarterly disclosure statements with that of their parent company. As a result, the change has brought the first accounting standard on the classification and measurement of assets and liabilities to banks in New Zealand, which could have an impact on the quality of the data for the period since banks adopted the NZ IFRS.

Regulators and bank managers also need to be cautious in their interpretation the efficiency scores and ranking orders for individual banks which identify which banks are "best-practice" or "worst-practice" due to possible unobserved heterogeneity and imperfect variable measurement, which is unlikely to be resolved in SFA bank efficiency studies.

The ANZ's acquisition of the National Bank (non-Australian banks), and its effect on bank cost and profit efficiency, might have reinforced the importance of cooperation and coordination between the regulatory authorities in the Trans-Tasman market. However, only one case study of merger activity included in this study might not be enough to generate the statement. Ideally, the case may help to inform future empirical work about likely sources of efficiency gain.

The results concerning the impact of organisational form on foreign banks' efficiency appear to provide no strong evidence that foreign branches are more efficient than subsidiaries, which may possibly be affected by the complex business mode and operating structure changes of Westpac Banking Corporation. The bank registered as a foreign

branch in 1987 then, as requested by The Reserve Bank of New Zealand, incorporated its retail banking business as Westpac New Zealand Limited, a subsidiary, in 2006. Since the disclosure statement for the two entities are consolidated, Westpac was defined as a foreign branch over the whole study period. In practice, most cross-border banking activities have fairly complex organizational structures, which challenge the evaluation of the impact of organizational form on foreign banks' efficiency.

7.5 Future Research

In terms of the perspective of efficiency measurement techniques, our study provides complementary insights to the existing bank efficiency studies by David Tripe (see Table B.7) and produces more robust estimates of bank efficiency in the context of New Zealand banking industry. The results also suggest several lines of future research related to the investigation of foreign-owned banks' efficiency in New Zealand and other nations.

Future research could extend this study to empirically investigate the efficiency determinants of full sample banks, in particular, when the new established Kiwibank and merged ANZ bank have operated longer. The total number of omitted banks for the study period only account for 3.4% of the banking sector (based on the market share data as at December 2011), which will unlikely impact on the overall results. However, future studies should attempt to study all banks to improve the small data sample quality.

In terms of data, the adjusted quarterly data might not accurately represent changes in the banks' financial performance, and position within a given year, thus, this study could be strengthened by employing both quarterly and annual data. Moreover, it could also be interesting to utilise lagged financial ratios to reduce the level of noise and other approximation problems in econometric estimation.

It has been suggested by some studies, for example, Naaborg (2007) and Lenlink et al, (2008), that cost and profit frontier functions could exclude the variable of physical capital (PPC) to avoid biased results. Future studies could do this to evaluate its possible impact.

In terms of methodology, the existing NZ efficiency literature uses DEA, the DEA-like Malmquist index and second-stage regression to estimate banks' efficiency and the

productive growth of banks in New Zealand. This study fills a gap by using the alternative efficiency measurement of SFA and a one-stage BC model. Future studies could employ both DEA and SFA with identical sample data within the same period for robustness.

Finally, with regard to the inefficiency determinants for individual banks, the present study could also be extended to include estimates on the level of efficiency for branches of the major banks. These results could give a deeper understanding and more insight to bank managers of the impact of geographic location and the level of branch management efficiency, and inform decisions on the closure of branches in order to maintain a high level of efficiency for the bank as a whole.

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Appendix A:The New Zealand Banking Sector

Table A. 1: Registered Banks in New Zealand: Relinquished by 2011

Name	Registered	Relinquished	Ownership
ABN Amro Bank NV	1998	2009	Foreign
AMP Bank limited	1998	2004	Domestic
Westland Bank Limited	1990	1994	Domestic
Bank of Tokyo-Mitsubishi(Australia) Limited	1996	2004	Foreign
Indosuez New Zealand Limited (Banque Indosuez New Zealand Limited)	1987	1991	Foreign
Banque Nationale De Paris	1997	2001	Foreign
Barclays New Zealand limited	1987	1989	Foreign
Barclay Bank	1988	1998	Foreign
BT New Zeeland (Holdings) Limited (Banker Trust New Zealand Limited)	1988	1999	Domestic
BNZ Finance Limited	1991	2001	Domestic
CIBC New Zealand Limited	1987	1989	Foreign
Countrywide Banking Corporation Limited	1987	1998	Foreign
Elders Merchant Finance Limited	1989	1990	Foreign
Macquarie Bank Limited	1987	1991	Foreign
National Mutual Corporation New Zealand Limited	1989	1990	Domestic
NZI Bank Limited (NZI Financial Corporation Limited)	1987	1992	Domestic
The National Bank of New Zealand Limited	1897	2004	Foreign
Broadbank Corporation Limited (National Australia Bank (NZ) limited)	1987	1993	Foreign
Post Office Bank Limited	1989	1994	Domestic
Primary Industry Bank of Australia Limited	1989	1999	Foreign
Rural Banking and Finance Corporation of New Zealand Limited (The Rural Bank limited)	1990	1994	Domestic
Leviathan Limited (St George Bank New Zealand Limited)	2003	2006	Foreign
Trust bank New Zealand Limited (and its subsidiaries all)	1989	1996 (1995)	Domestic
Security Pacific New Zealand Limited	1987	1988	Domestic
State bank of South Australia	1988	1994	Foreign
United Banking Group Limited	1990	1994	Foreign

Source: Reserve Bank of New Zealand
http://www.rbnz.govt.nz/regulation_and_supervision/banks/0029134.html

Table A. 2: Events in Banking Industry in New Zealand (2002-2001)

Year	Timeline of Event
2002	Significantly improved profitability across the banking sector, the key drivers were asset growth, increased non-interest income, and cost control. Kiwibank commenced February 2002
2003	ANZ Bank acquired The National Bank, each bank has retained a separate banking licence and both continue to operate their individual brands. A continued improvement in the operating cost, impaired asset declined significantly
2004	Six increases in OCR due to inflation pressure, competition intensified especially in mortgage market. Unemployment dropped to the lowest in the OECD. The introduction of New Zealand equivalents to International Financial Reporting Standards (NF IFRS)
2005	Continued intensive competition. Deutsche Bank total asset and net profit after tax reduced significantly; Impaired assets increased overall; Sign of economy slowdown; RBNZ released the finalised policy on bank outsourcing; Basel II introduced. Kiwibank turned a loss into a modest surplus.
2006	A marked slowdown in earning growth; The banking industry continued to maintain the growth rates of recent years. Interest margin continued tight due to the intense competition. House price inflation. Big four banks contributed almost 90% of total banking sector profitability; Westpac dropped return to asset significantly.
2007	The international credit crunch slowed asset growth in banking sector but increased impaired assets. RBNZ announced as a temporary measure to accept NZ 90 day's bank bills in its overnight reverse repurchase facility to ease short term interbank liquidity pressure. Reserve bank raised the OCR to 8.25% in July 2007. An impressive 10.1% profit growth from ANZ National.
2008	A broad deterioration in credit quality with strong increase in impaired assets; Domestic recession continued; Falling interest rate environment; RBNZ cut the OCR rates from 8.25% to 3%; Kiwibank grown gross loan 57% over the year driven by the aggressive pricing in the residential mortgage market. Increase in the unemployment rate. Government launched Deposit Guarantee Scheme.
2009	New entrants: Bank of Baroda (New Zealand) Limited, ABN Amro was acquired by Royal Bank of Scotland. ANZ Banking group established New Zealand Branch. Banks performance continually deteriorated substantially from the previous year. Significant increase in impaired asset expense. Majority of banks adopted Basel II capital Adequacy calculations.
2010	Overall registered banks sector improved significantly, driven by the reduction of impaired assets; deposit war deteriorated banks net interest margin among major banks; overall capital adequacy improved but operating expenses increased; ANZ National planned to put ANZ and National Bank onto one IT Platform, restructured management; Basel III final rules sent out, require minimum common equity from 2% to 4.5%, tier 1 from 4% to 6%. Employees' numbers rose sharply.
2011	Two foreign banks registered: Bank of India and The Co-operative Bank (from PSIS). The banking sector had a continuation in the growth of profits driven by reduction of impaired assets and improved interest margins in a flat lending environment.

Sources: KPMG (2002-2011a)

Appendix B: Literature Review Summaries

Table B. 1: Summary of the findings on the efficiency of foreign banks in the US

Authors	Period	Efficiency Concept	Technique	Empirical Findings
DeYoung and Nolle (1995)	1985-1990	PE	DFA	Foreign owned banks in the US are less profit efficient than us-owned banks.
Hasan and Hunter (1996)	1984-1986	CE & PE	SFA	Japanese multinational banks operating in the US market are significantly less cost and profit efficient than domestically-owned banks.
Chang, Hasan and Hunter (1998)	1984-1989	CE	SFA/OLS Tobit regression	Foreign-owned multinational banks operating in the US are significantly less efficient than their US-owned multinational banks. No relationship between banks size and efficiency.
Peek et al. (1999)	1984-1997	Input efficiency	OLS	Foreign -owned banks tend to be less profitable and less input-efficient than their domestically-owned peers.

Table B. 2: Summary of the findings on the efficiency of foreign banks in the EU market (cross-country studies)

Authors	Countries/Regions	Period	Efficiency Concept	Technique	Empirical Findings
Berger et al (2000)	France, German, Spain, UK and USA	1993-1998	PE	DFA	Foreign banks from most foreign countries may be less or about equally efficient than domestic banks in these countries, but foreign banks from one (the US) are more efficient than domestic banks.
Lozano-Vivas et al. (2001)	10 European countries (f)	1993	TE	DEA	Foreign banks performed have high pure technical efficiency levels at the countries with good environmental conditions such as Luxembourg, Belgium, Germany and the Netherlands. Environmental variables play important role in banks efficiency cross the countries in the integrated market.
Weill (2003)	Czech Republic and Poland	1997	CE	SFA	There is a positive influence of foreign ownership on cost efficiency in both transition countries. The degree of openness of the banking sector to foreign capital has a positive impact on banks performance.
Green, Murinde, and Nikolov (2004)	9 CEEs	1995-1999	CE (Scale and Scope)	Cost function	No evidence that foreign banks are more efficient than domestic banks. Economies of scale for foreign banks are not systematically more scale efficient than that for domestic banks.
Bosco (2003)	10 CEEs and 12 Mediterranean EU partners countries*	1993-2000	CE PE	Probit Logit model	The aggregate level foreign bank do perform better than domestic banks.
Rossi et al.(2005)	CEEs (b)	1995-2002	CE PE	SFA	There is a negative correlation between foreign-owned banks assets and cost efficiency and positive correlation of foreign ownership and the capitalization ratio with profit efficiency.
Zajc (2006)	6 CEEs	1995-2000	CE	SFA	foreign banks are less cost efficient than domestic banks
Bonin et al (2005)	11 transition countries	1996-2000	CE PE	SFA	Foreign-owned banks are more cost -efficient than other banks.
Kasman and Yildirim (2006)	8 countries in CEE (c)	1995-2002	CE PE	SFA	Foreign banks are more profit efficient than domestic banks.

Yildirim and Philppatos 2007)	12 countries in CEE (d)	1993-2000	CE PE	DEA & DFA	Foreign banks are found to be more cost efficient but less profit efficient compared to domestic banks.
Naaborg (2007)	CEE (d)	1998-2001	CE PE	SFA	Foreign banks are less efficient than domestic banks; foreign banks inefficiency are reduced when similarity between home and host nations rise; institutional environment differences explain the differences in banks efficiency compared foreign banks with domestic banks.
Lozano-Vivas and Weill (2008)	10 countries in EU	1994-2005	CE	SFA	Greenfield banks can enhance cost efficiency. M&A is significantly negative on cost efficiency. Only greenfield non EU bank exerts a positive role on cost efficiency.
Thi et al. (2008)	Czech Republic Hungary and Poland	1994-2005	CE	SFA	Greenfield banks are more cost efficient than foreign banks entered through mergers and acquisition due to a more selective structure of activities with the focus on multinational or corporate clients.
Poghosyan and Poghosyan(2009)	11 CEEs	1992-2006	CE	SFA	Foreign greenfield banks outperform domestic banks in terms of cost efficiency, the efficiency of foreign acquired banks is not significantly different from domestic banks.
Anayiotos et al (2010)	14 emerging European countries	2004, 2007-2009	X-Efficiency	DEA	Foreign-owned banks are somewhat more efficient than domestic banks in emerging Europe. However, foreign-owned banks are less efficient than their parent banks operating in the same region.
Košak and Zorić (2011)	8 New CEE members and 3 Baltic countries	1998-2007	CE	SFA	Foreign ownership has no significant correlation with cost efficiency.
Fang et al (2011)	6 South-Eastern Europe Countries (SEECs)	1998-2008	CE	SFA	Foreign banks are associated with higher cost efficiency.
Borovicka (2013)	19 EU transition countries	1995-2004	CE	SFA	Foreign-owned banks primarily targeting more efficient domestic banks, but have negative association between foreign ownership and cost efficiency.

Table B. 3: Summary of the findings on the efficiency of foreign banks in the EU market (single-country studies)

Authors	Countries	Period	Efficiency Concept	Technique	Empirical Findings
Developing Country					
Kraft, Hofler, and Payne (2006)	Croatia	1994-2000	CE	SFA	Reputable foreign banks have strong efficiency advantage.
Hasan and Marton(2003)	Hungary	1993-1998	PE	SFA	Domestic banks are found significantly profit efficient than banks with foreign involvement.
Haverylchyk (2005)	Poland	1997-2001	CE, X-efficiency Scale Efficiency	DEA	Foreign banks exhibit a higher level of technical and allocative efficiency than domestic banks. Dutch banks have achieved higher efficiency than banks from other countries
Styrin (2005)	Russia	1998-2002	CE	SFA and DEA	Foreign banks are more efficient than their Russian peers.
Isik and Hassan (2002)	Turkey	1988-1996	CE PE	SFA	Foreign banks both in subsidiary and branch form had higher cost and profit efficiency than their domestic peers, the difference in profit efficiency is much more pronounced.
Aysan et al (2011)	Turkey	2002-2007	CE PE	SFA	The overall cost efficiency of foreign banks in Turkey is poorer during the period of 2002-2005, whereas the state and domestic banks have better cost efficiencies.
El-Gamal & Inanoglu (2005)	Turkey	1990-2000	CE (Labour-efficiency)	SFA	Foreign owned banks are ranked at the top, followed by state-owned banks. Foreign banks net influence on overall banking system efficiency and stability is ambiguous.
Developed Country					
Gaganis and Pasiouras (2009)	Greece	1999-2004	X-efficiency scale efficiency	DEA	Foreign banks had lower pure TE but higher scale efficiency. Ownership has no significant impact on banks' efficiency
Curi et al (2012)	Luxembourg	1991-2009	X Efficiency	DEA	Group efficiency results show that foreign branch banks are more efficient than subsidiary banks; higher capital requirement appear to have significant effect on foreign bank efficiency, geographical origin of the parent banks appears to be significant.
Béjaoui Rouissi and Bouzgarrou (2012)	France	2000-2007	CE PE	SFA	Foreign commercial banks in France are more cost efficient than other domestic commercial banks.

Table B. 4: Summary of the findings on the efficiency of foreign banks in Australia

Authors	Period	Efficiency concept	Technique	Empirical Findings
Sathye (2001)	1996	TE and AE	DEA	Foreign-owned banks were **less** efficient than domestic banks. The source of inefficiency is technical rather than allocative components.
Sturm and Williams (2004)	1988-2001	TE, PTE, Scale	DEA, Malmquist Indices & SFA	The DEA results found foreign banks display superior technical efficiency due to superior scale efficiency compared with Big Four banks or the other domestic banks. 0.63 overall correlation was found between SFA and DEA results.
Sturm and Williams (2008)	1988-2001	TE	Parametric distance function	Foreign banks are on average less efficient than the domestic incumbents. Banks from the UK are significantly more efficient than the average foreign banks. Banks from the US and Switzerland are significantly less efficient than overage foreign banks, but no evidence support global limited advantage hypothesis.
Sturm and Williams (2009)	1988-2001	TE	Parametric distance function, Factor analysis	Foreign banks are on average less efficient than the domestic incumbents. The global limited advantage hypothesis was supported to US bank revenue creation efficiency. The New trading theory explains that bank from the US tends to be less efficient while banks from the UK and Japan are more efficient.
Sturm and Williams (2010)	1988-2001	TE	Parametric input-distance function	Limited global advantage hypothesis of Berger et al. (2000) applies to Australian efficiency study, the dominance of big four banks in Australia acts as barrier to foreign banks entry also reduce efficiency. Foreign banks from the UK were relatively more efficient, while banks from the US were less efficient compared with banks from other nations operating in Australia.

Table B. 5: Summary of the findings on the efficiency of foreign banks in other countries (cross-country studies)

Authors/country	Countries/Regions	Period	Efficiency Concept	Technique	Empirical Findings
Miller and Parkhe (2002)	13 host countries worldwide	1989-1996	X-Efficiency	SFA	Average level of foreign owned banks are significantly less than host country banks.
Nguyen and Williams (2003)	5 South East Asian countries	1990-2002	PE	SFA	Foreign ownership yields a significantly higher level of mean profit efficiency irrespective of the host country.
Saif and Yaseen (2005)	11 Middle East and North Africa countries	1995-2002	X-Efficiency	Translog function	There is virtually no evidence that foreign banks are more efficient than domestic banks in terms of an absolute cost advantage, or in terms of economies of scale and scope.
Figueira et al (2006)	40 African countries	2001-2002	X-Efficiency CE	DEA and SFA	Domestic banks are less efficient than foreign banks in Africa. Environmental variables were significant in explaining banks performance differences.
Figueira et al. (2009)	20 countries in Latin America	2001	X-Efficiency	DEA and SCF	DEA results show evidence that domestic banks are more efficient than banks under majority foreign ownership.
Lensink et al (2008)	105 countries world wide	1998-2003	CE	SFA	On avergea, Foreign ownership negatively affected bank efficiency. Higher similarity between home and host country institutional quality reduce foreign bank inefficiency.
Pasiouras et al (2009)	74 countries	2000-2004	CE	SFA	Higher proportion of foreign banks has a positive impact on banks cost efficiency.
Wezel (2010)	5 countries in Central American region	2002-2007	TE, CE	DEA and SFA	Foreign banks were not more technical efficient than domestic banks however, foreign banks had a better cost efficiency. Environmental conditions are significant effect on individual banks efficiency scores.
Chan and Karim (2011)	4 countries in southeast Asian	2001-2008	CE PE	SFA	Foreign banks in Malaysia are the most cost and profit efficient while Indonesia the least.

Table B. 6: Summary of the findings on the efficiency of foreign banks in other single countries

Authors	Country	Period	Efficiency Concept	Technique	Empirical Findings
Chantapong and Menkhoff (2005)	Thailand	1995-2003	CE	Translog function	Foreign banks did not outperform domestic banks in terms of cost efficiency.
Sensarma (2006)	India	1986-2000	CE	SFA	Foreign banks had poor cost efficiency and productivity.
Sufian (2011)	Malaysia	1995-2007	CE,TE	DEA	Foreign banks from North America were the most efficient banking group, support the global limited advantage hypothesis.
Berger et al (2009)	China	1994-2003	CE PE	SFA	Majority of foreign banks are the most cost and profit efficient banks. Minority foreign ownership is associated with significantly improved efficiency.
Tahir et al (2010)	Malaysia	2000-2006	CE PE	SFA	Majority of foreign banks are the most cost and profit efficient banks.
San, Theng, and Heng (2011)	Malaysia	2002-2009	PTE	DEA	Domestic banks have higher TE than foreign banks, which mainly effect by capital strength, loan quality, and expense and asset size.
Vu and Nahm (2013)	Vietnam	2000-2006	PE	Tobit model	Foreign banks from Australia, Japan, the US and Europe perform better in terms of profit efficiency than domestic banks and banks from other Asian nations.
Tecles and Tabak (2010)	Brazil	2000-2007	CE	SFA	Foreign banks show lower cost efficiency but higher profit efficiency compared with domestic banks.
Yamori and Harimaya (2010)	Japan	1994-2005	TE	Stochastic distance function	The traditional Japanese trust banks have experienced superior technical efficiency compared with foreign-owned trust banks.
Jiang and Yao (2010)	China	1995-2008	CE PE	SFA	Foreign owned banks are less cost efficient than domestic banks.
Pessarossi and Weill (2013)	China	2004-2009	CE	SFA DEA	Foreign banks are more efficient than other banks. Increase in capital ratio improves banks cost efficiency, depends on some extent on the banks' ownership type, but not in bank size.
Sharma et al (2013)	Fiji	2000-2010	X-efficiency scale efficiency	DEA	Scale efficiency scores are generally lower than the TE scores especially for larger foreign banks.

Table B. 7: Summary of the findings on the efficiency of foreign banks in New Zealand

Authors	Study period	Efficiency concept	Technique	Empirical Findings
Liu and Tripe (2003)	1989-1998	X Efficiency	DEA	DEA results shows greater efficiency in New Zealand than other countries over the same period and banks gained efficiency associated with mergers and acquisitions in New Zealand.
Tripe (2003)	1996-2002	X Efficiency Scale efficiency	DEA	New Zealand banks has become more efficient, which may possibly due to the fall of interest rate, improved managerial practice or technical progress.
Tripe (2004)	1996-2003	X Efficiency	DEA	No significant difference in efficiency scores between NZ banks and Australia-owned banks in DEA model.
Vedula & Tripe (2004)	2000-2002	X Efficiency	DEA	Overall banks efficiency scores were high, which indicates banks in New Zealand have improved their efficiency over time
Tripe (2005a)	1996-2003	X Efficiency	DEA	There has been an improvement in bank efficiency over the time with significant differences in efficiency between banks. There is negative correlation between banks efficiency and 90-day bill rate.
Tripe(2005b)	1996-2003	Scale efficiency X-Efficiency	DEA Malmquist Index	DEA results by panel data approach shows that most efficient banks were TSB and ANZ, the least efficient bank was ASB.
Adjei-Frimpong et al.,(2014)	2007-2011	X-efficiency	DEA Malmquist Index	New Zealand banks generally have higher levels of efficiency. The DEA results suggests scale inefficiency for the banks rather than pure technical inefficiency.

Appendix C: Parameters Estimations

Table C. 1: Parameters Estimations-Cost Functions

Dependent variable: Ln(TC/PL)		Group A				Group B				Group C			
		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
Parameters		Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
β0	Constant	-2.416[a]	-4.294	-1.890[a]	-3.199	2.187[a]	3.078	2.336[a]	3.482	-5.003[a]	-9.341	-5.622[a]	-12.379
β1	ln(PF/PL)	-0.010	-0.046	-0.265	-1.432	0.656[a]	3.456	-0.005	-0.025	-0.708[a]	-4.498	-1.265[a]	-8.220
β2	ln(PPC/PL)	0.908[a]	9.369	0.782[a]	8.229	0.687[a]	6.908	0.753[a]	7.489	0.664[a]	9.151	0.738[a]	10.869
β3	ln(LOAN)	0.581[a]	6.041	0.555[a]	5.312	0.676[a]	5.698	0.740[a]	6.916	1.240[a]	13.697	1.383[a]	17.355
β4	ln(OIEA)	0.762[a]	9.977	0.705[a]	10.238	-0.446[a]	-2.946	-0.563[a]	-4.189	0.714[a]	10.240	0.628[a]	9.993
β5	1/2{ln(PF/PL)}	-0.119[a]	-3.408	-0.142[a]	-4.345	0.073	1.106	-0.126[c]	-1.636	-0.207[a]	-7.464	-0.311[a]	-11.718
β6	$1/2\{ln(PPC/PL)\}^2$	-0.086[a]	-6.489	-0.071[a]	-4.827	0.028[b]	2.091	0.003	0.249	-0.082[a]	-7.427	-0.079[a]	-7.580
β7	$1/2\{ln(LOAN)\}^2$	0.146[a]	17.416	0.141[a]	15.711	0.257[a]	9.543	0.242[a]	10.045	0.101[a]	12.988	0.083[a]	11.520
β8	$1/2\{ln(OIEA\}^2$	0.074[a]	11.619	0.069[a]	10.133	0.315[a]	6.266	0.299[a]	6.783	0.081[a]	10.777	0.079[a]	12.286
β9	ln(PF/PL)Ln(PPC/PL)	0.087[a]	5.081	0.086[a]	5.117	-0.070[a]	-3.517	-0.005	-0.210	0.103[a]	7.254	0.149[a]	11.213
β10	ln(PF/PL)ln(LOAN)	0.059[a]	3.611	0.080[a]	5.751	0.115[a]	4.380	0.151[a]	5.854	0.122[a]	10.130	0.159[a]	13.448
β11	ln(PF/PL)ln(OIEA)	0.000[a]	-7.884	0.000[a]	-6.955	-0.118[a]	-3.114	-0.106[a]	-2.868	0.000[a]	-3.209	0.000[a]	-5.491
β12	ln(PPC/PL)ln(LOAN)	-0.051[a]	-7.986	-0.045[a]	-6.676	-0.137[a]	-9.053	-0.146[a]	-11.013	-0.057[a]	-9.530	-0.070[a]	-14.841
β13	ln(PPC/PL)ln(OIEA)	-0.019[b]	-2.110	-0.018[c]	-1.857	0.086[a]	3.814	0.097[a]	5.025	0.013	1.630	0.024[a]	3.139
β14	ln(LOAN)ln(OIEA)	-0.115[a]	-17.873	-0.106[a]	-17.011	-0.227[a]	-5.885	-0.210[a]	-6.127	-0.132[a]	-26.315	-0.123[a]	-28.040
β15	ln(PF/PL)T	-0.006[a]	-4.208	-0.005[a]	-3.206	0.006[a]	3.028	0.002	0.764	-0.010[a]	-7.589	-0.013[a]	-10.056
β16	ln(PPC/PL)T	0.008[a]	8.210	0.008[a]	6.658	-0.002[b]	-1.994	0.000	-0.089	0.008[a]	9.945	0.009[a]	11.196
β17	ln(LOAN)T	0.002[a]	3.674	0.002[a]	3.453	0.001	1.244	0.001	0.999	0.002[a]	3.387	0.003[a]	5.133
β18	ln(OIEA)T	-0.001	-1.210	-0.001	-1.410	-0.004[b]	-2.191	-0.002	-1.291	0.002[b]	2.468	0.001	1.355
β19	T	-0.053[a]	-5.640	-0.054[a]	-5.270	0.015	1.292	-0.006	-0.636	-0.081[a]	-10.362	-0.082[a]	-11.774
β20	$1/2\ T^2$	0.000[b]	2.376	0.000[a]	2.710	0.001[a]	4.849	0.000[a]	4.800	0.000	1.079	0.000	-0.143

Table 1 Continued

Industry specific variables												
DO	Dummy Ownership	-0.293 [a]	-4.159	-0.387 [a]	-5.366	0.150	0.557	-0.215 [c]	-1.723			
DM	Dummy Merger	0.360 [b]	2.519	0.362 [b]	2.137	0.480 [c]	1.651	0.541 [a]	4.738	0.303 [a]	3.971	0.724 [a]	2.576
MKCT	Market concentration	-0.643	-0.578	-1.310	-1.101	3.702	0.953	-1.053	-1.375	2.066 [a]	4.301	4.852 [a]	5.760
DS	Dummy Similarity									-1.263 [a]	-10.176	-1.697 [a]	-10.266
DORG	Dummy Organizational Form									-0.479 [a]	-7.445	0.035	0.279
Bank Specific Variables													
	Constant	5.775 [a]	4.729	5.347 [a]	4.632	-2.082 [a]	-0.636	0.576	0.785	-0.182	-0.354	-1.704 [a]	-2.510
LnTA	Ln(Total Assets)	-0.626 [a]	-9.678	-0.596 [a]	-10.350	-0.157[b]	-2.072	-0.062 [b]	-2.240	-0.159 [a]	-4.572	-0.224 [a]	-6.972
EQR	Equity ratio	2.225 [a]	3.758	1.408 [b]	2.309	0.528	0.962	0.622 [c]	1.760	2.675 [a]	7.290	3.683 [a]	9.067
AQ	Impaired assets ratio	-47.72[a]	-3.808	-39.14[a]	-4.160	15.487	1.120	3.845 [b]	2.437	-5.448 [a]	-10.266	-8.787 [a]	-6.151
Macroeconomic Variables													
GDPG	GDP growth			0.000	-0.398			0.000	-0.232			0.000	0.033
IR	Interest rate			3.428 [a]	3.280			6.710 [a]	4.156			0.787	0.630
IFR	Inflation rate			0.046	1.600			0.027 [b]	2.000			-0.048 [a]	-2.850
FX	Foreign exchange rate			0.009 [b]	2.210			0.004 [b]	2.479			-0.005 [b]	-2.108
UNEMP	Unemployment rate			0.005 [a]	2.917			0.007 [a]	4.328			-0.003 [a]	-3.529
Model Indicators:													
	sigma-squared	0.175 [a]	5.067	0.131 [a]	6.262	0.009 [b]	2.228	0.007 [a]	7.369	0.058 [a]	11.839	0.089 [a]	17.316
	gamma	0.995 [a]	300.290	0.983 [a]	206.753	0.824 [a]	8.115	0.790 [a]	14.594	0.986 [a]	246.027	0.997 [a]	640.293
	Log Likelihood function	275.381		276.632		375.923		385.215		317.561		328.910	
	Likelihood ratios	220.811		223.313		78.784		97.369		203.467		226.164	

Notes: a=1 % Level of statistical Significance, **b=**5 % Level of Statistical significance, **c=**10% level of Statistical Significance; *t*-test in parentheses. **Coeff**: coefficients

Table C. 2: Parameters estimations-Alternative Profit Functions

Dependent variable: Ln(TC/PL)		Group A				Group B				Group C			
		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
Parameters		Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
θ0	Constant	3.882 [a]	3.200	4.162 [a]	3.535	0.467	0.245	-0.159	-0.054	-18.99[a]	-8.088	-5.731 [a]	-2.600
θ1	ln(PF/PL)	1.763 [a]	3.713	1.927 [a]	3.873	3.609 [a]	3.861	3.527 [a]	4.137	-1.408 [c]	-1.714	-2.157 [a]	-3.446
θ2	ln(PPC/PL)	-1.072 [a]	-3.166	-0.971 [a]	-3.244	-0.915	-1.638	-0.786	-1.220	0.215	0.813	-0.670 [b]	-2.046
θ3	ln(LOAN)	-0.342	-1.392	-0.492 [b]	-2.076	-1.074 [c]	-1.733	-0.976	-1.518	2.357 [a]	5.347	1.225 [a]	3.634
θ4	ln(OIEA)	0.986 [a]	3.935	1.028 [a]	3.967	2.512 [a]	3.374	2.534 [a]	3.360	0.253	0.739	0.903 [a]	2.936
θ5	$1/2\{\ln(PF/PL)\}^2$	0.373 [a]	4.208	0.383 [a]	4.107	0.133	0.333	0.077	0.219	-0.354 [a]	-2.573	-0.407 [a]	-4.516
θ6	$1/2\{\ln(PPC/PL)\}^2$	0.179 [a]	2.953	0.141 [b]	2.509	0.240 [b]	2.324	0.232 [b]	2.117	-0.002	-0.050	0.138 [a]	3.331
θ7	$1/2\{\ln(LOAN)\}^2$	0.134 [a]	4.014	0.159 [a]	4.414	0.606 [a]	4.137	0.590 [a]	4.586	-0.323 [a]	-4.203	0.110 [a]	3.181
θ8	$1/2\{\ln(OIEA\}^2$	0.006	0.181	0.009	0.313	0.193	0.722	0.177	0.738	-0.111 [b]	-2.074	0.064 [c]	1.935
θ9	ln(PF/PL)Ln(PPC/PL)	-0.377 [a]	-6.046	-0.368 [a]	-5.878	-0.250 [c]	-1.777	-0.267 [b]	-2.148	0.039	0.618	0.006	0.132
θ10	ln(PF/PL)ln(LOAN)	-0.013	-0.315	-0.031	-0.754	-0.265 [c]	-1.722	-0.256 [c]	-1.749	0.142 [a]	2.548	0.220 [a]	4.435
θ11	ln(PF/PL)ln(OIEA)	0.000 [c]	1.811	0.000 [b]	2.071	0.030	0.136	0.026	0.126	0.000 [b]	-2.152	0.000	0.994
θ12	ln(PPC/PL)ln(LOAN)	0.104 [c]	5.067	0.102 [c]	4.981	-0.048	-0.580	-0.059	-0.712	-0.046 [c]	-1.845	-0.001	-0.055
θ13	ln(PPC/PL)ln(OIEA)	-0.037	-1.185	-0.040	-1.574	0.128	1.036	0.128	1.039	0.025	1.121	0.043 [c]	1.859
θ14	ln(LOAN)ln(OIEA)	-0.065 [a]	-2.965	-0.072 [a]	-3.452	-0.457 [b]	-2.433	-0.447 [a]	-2.643	0.027	0.447	-0.141 [a]	-4.437
θ15	ln(PF/PL)T	0.017 [a]	2.890	0.016 [a]	2.618	0.010	0.680	0.008	0.653	-0.002	-0.709	-0.002	-0.521
θ16	ln(PPC/PL)T	-0.019 [a]	-3.991	-0.015 [a]	-3.323	-0.022 [a]	-3.238	-0.021 [a]	-3.149	0.006 [b]	2.492	0.002	0.684
θ17	ln(LOAN)T	-0.002	-0.905	-0.003	-1.273	-0.012 [b]	-2.086	-0.011 [c]	-1.996	-0.009 [a]	-2.647	-0.003	-0.752
θ18	ln(OIEA)T	-0.002	-0.363	-0.002	-0.330	0.013	1.252	0.013	1.441	0.008 [c]	1.788	-0.002	-0.342
θ19	T	0.025	0.799	0.029	0.864	0.016	0.367	0.003	0.081	1.967 [b]	4.586	-0.037	-0.664
θ20	$1/2\ T^2$	0.003 [a]	4.824	0.003 [a]	4.045	0.003 [a]	3.826	0.002 [a]	3.343	6.921 [a]	5.527	0.003 [a]	4.108
θ21	ln(NPI)	*-0.324 [a]*	*-6.879*	*-0.334 [a]*	*-6.834*	*-0.305 [a]*	*-2.929*	*-0.346 [a]*	*-3.788*	*5.050 [a]*	*2.122*	*-0.345 [a]*	*-7.361*

Notes: Coeff: Coefficients; NPI: negative profit indicator

Table C.2 Continued

Inefficiency equations													
Industry-specific variables													
	Constant	9.004 [a]	5.816	6.262 [a]	4.845	5.015 [a]	2.666	32.72 [a]	5.966	26.11 [b]	2.322	0.151	0.141
DO	Dummy Ownership	2.532 [a]	6.158	3.109 [a]	7.967	-3.96 [a]	-5.587	-3.44 [a]	-3.396				
DS	Dummy Similarity									-1.964	-0.242	-2.308 [a]	-2.986
DORG	Dummy Organizational form									9.399 [c]	1.675	-2.421 [a]	-3.186
DM	Dummy Merger	-7.59 [a]	-3.823	-7.70 [a]	-5.732	-6.38 [a]	-19.627	-5.83 [a]	-6.368	-2.975 [a]	-4.152	-5.468 [b]	-2.129
MKCT	Market concentration	4.395 [a]	3.695	4.842 [a]	3.761	-13.96 [a]	-4.801	-27.83 [a]	-4.446	2.039 [a]	4.930	0.334	0.329
Bank-specific Variables													
LnTA	Ln(Total assets)	-1.71 [a]	-9.486	-1.84 [a]	-10.852	0.54 [a]	3.633	-0.465	-1.428	-13.797	-1.328	-0.725 [b]	-2.216
EQR	Equity ratio	-10.29 [a]	-2.874	-6.23 [a]	-2.566	-5.571 [a]	-3.645	-22.62 [a]	-5.755	0.827 [a]	3.755	-3.028 [b]	-2.195
AQ	Impaired assets ratio	1.327	1.274	2.48 [b]	2.135	3.098 [b]	2.521	15.306 [a]	4.683	-0.038 [a]	-3.279	0.751	0.638
Macroeconomic variables													
GDPG	GDP growth			-0.013	-1.168			0.012	1.366			-0.022	-1.292
IR	Interest rate			2.012 [c]	1.725			-40.84 [a]	-4.979			4.997 [c]	1.683
IFR	Inflation rate			-0.25 [b]	-2.179			-1.165 [a]	-6.997			-0.322 [b]	-2.405
FX	Foreign exchange rate			0.046 [b]	2.277			-0.094 [a]	-2.680			0.084 [a]	3.318
UNEMP	Unemployment rate			0.001	0.150			0.043 [a]	4.789			0.018 [b]	2.482
Model Indicators:													
	sigma-squared	2.351 [a]	7.850	2.428 [a]	9.690	2.151 [a]	7.026	4.682 [a]	12.696	4.721 [a]	4.010	2.718 [a]	4.010
	gamma	0.988 [a]	226.478	0.986 [a]	212.513	0.987 [a]	210.787	0.995 [a]	679.315	0.993 [a]	389.084	0.987 [a]	197.478
	Log Likelihood functions		-356.08		-353.13		-106.18		-96.81		-232.18		-251.26
	Likelihood ratios		182.01		187.92		142.73		161.48		282.80		167.56

Notes: (1) a=1 % Level of statistical Significance, **b**=5 % Level of Statistical significance, **c**=10% level of Statistical Significance; *t*-test in parentheses

Appendix D: Quarterly Mean Cost Efficiency

Table D. 1: Quarterly Mean CE for Group A Banks in Model (1) (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.907	0.983	0.959	0.968	0.722	0.034	0.818	0.977	0.903	0.766	0.804
2	0.879	0.985	0.960	0.974	0.727	0.097	0.760	0.957	0.991	0.709	0.804
3	0.868	0.929	0.962	0.838	0.721	0.211	0.940	0.982	0.963	0.779	0.819
4	0.877	0.959	0.963	0.972	0.714	0.255	0.903	0.965	0.744	0.722	0.807
5	0.864	0.925	0.945	0.953	0.689	0.325	0.404	0.946	0.991	0.693	0.774
6	0.849	0.946	0.942	0.869	0.685	0.377	0.914	0.925	0.672	0.725	0.790
7	0.842	0.877	0.889	0.950	0.689	0.403	0.863	0.981	0.841	0.745	0.808
8	0.977	0.890	0.959	0.918	0.694	0.403	0.841	0.968	0.836	0.657	0.814
9	0.984	0.877	0.945	0.934	0.674	0.403	0.864	0.956	0.841	0.712	0.819
10	0.952	0.856	0.945	0.862	0.689	0.408	0.871	0.941	0.886	0.723	0.813
11	0.930	0.786	0.965	0.900	0.686	0.439	0.825	0.958	0.834	0.291	0.761
12	0.940	0.881	0.969	0.931	0.690	0.439	0.885	0.956	0.926	0.787	0.840
13	0.944	0.865	0.971	0.957	0.688	0.439	0.432	0.952	0.804	0.988	0.804
14	0.861	0.855	0.969	0.906	0.674	0.487	0.844	0.932	0.486	0.360	0.737
15	0.948	0.807	0.970	0.904	0.668	0.469	0.975	0.941	0.770	0.976	0.843
16	0.944	0.846	0.966	0.951	0.687	0.402	0.835	0.936	0.711	0.546	0.782
17	0.941	0.962	0.954	0.886	0.679	0.516	0.867	0.958	0.777	0.673	0.821
18	0.938	0.958	0.957	0.957	0.662	0.524	0.895	0.948	0.986	0.645	0.847
19	0.963	0.932	0.966	0.877	0.666	0.565	0.885	0.950	0.685	0.460	0.795
10	0.950	0.962	0.964	0.914	0.681	0.562	0.893	0.922	0.614	0.712	0.817
21	0.975	0.952	0.987	0.928	0.666	0.649	0.625	0.949	0.844	0.662	0.824
22	0.980	0.975	0.978	0.951	0.622	0.598	0.956	0.914	0.748	0.618	0.834
23	0.979	0.969	0.985	0.935	0.630	0.722	0.892	0.872	0.729	0.662	0.838
24	0.980	0.961	0.983	0.947	0.611	0.714	0.934	0.882	0.730	0.474	0.822
25	0.984	0.928	0.936	0.983	0.388	0.737	0.974	0.864	0.755	0.551	0.810
26	0.984	0.980	0.929	0.976	0.571	0.725	0.895	0.861	0.797	0.397	0.812
27	0.980	0.978	0.923	0.973	0.573	0.762	0.955	0.976	0.773	0.424	0.832
28	0.982	0.967	0.937	0.974	0.573	0.788	0.930	0.925	0.763	0.991	0.883
29	0.977	0.979	0.953	0.973	0.632	0.799	0.922	0.923	0.893	0.535	0.859
30	0.980	0.977	0.953	0.971	0.606	0.837	0.929	0.910	0.683	0.533	0.838
31	0.952	0.974	0.970	0.967	0.633	0.513	0.945	0.905	0.858	0.521	0.824
32	0.934	0.959	0.951	0.974	0.645	0.523	0.901	0.943	0.879	0.553	0.826
33	0.956	0.967	0.964	0.975	0.639	0.839	0.918	0.973	0.962	0.517	0.871
34	0.936	0.960	0.965	0.975	0.595	0.889	0.924	0.914	0.811	0.530	0.850
35	0.922	0.970	0.967	0.977	0.629	0.922	0.957	0.938	0.852	0.457	0.859
36	0.945	0.964	0.968	0.972	0.619	0.973	0.956	0.908	0.782	0.483	0.857
37	0.907	0.960	0.964	0.965	0.615	0.924	0.987	0.949	0.833	0.519	0.862
38	0.950	0.962	0.957	0.971	0.643	0.922	0.963	0.956	0.751	0.492	0.857
39	0.907	0.937	0.957	0.961	0.756	0.900	0.965	0.986	0.972	0.421	0.876
40	0.943	0.947	0.918	0.983	0.668	0.931	0.988	0.970	0.885	0.159	0.839
Mean	0.938	0.934	0.957	0.944	0.653	0.586	0.876	0.939	0.814	0.604	0.824
Rank	4	5	1	2	8	10	6	3	7	9	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Table D. 2: Quarterly Mean CE for Group A Banks in Model (2)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.938	0.978	0.963	0.968	0.767	0.047	0.814	0.978	0.965	0.891	0.831
2	0.910	0.980	0.961	0.971	0.707	0.112	0.765	0.956	0.990	0.803	0.815
3	0.897	0.942	0.961	0.868	0.705	0.228	0.924	0.975	0.959	0.910	0.837
4	0.908	0.967	0.962	0.967	0.710	0.272	0.895	0.963	0.786	0.840	0.827
5	0.894	0.951	0.949	0.955	0.680	0.323	0.447	0.954	0.989	0.826	0.797
6	0.879	0.963	0.949	0.893	0.668	0.371	0.901	0.947	0.826	0.878	0.827
7	0.872	0.912	0.907	0.952	0.688	0.402	0.876	0.978	0.900	0.893	0.838
8	0.973	0.925	0.959	0.929	0.682	0.407	0.850	0.969	0.785	0.789	0.827
9	0.983	0.918	0.949	0.941	0.651	0.396	0.879	0.957	0.819	0.850	0.834
10	0.960	0.892	0.949	0.883	0.671	0.403	0.881	0.945	0.959	0.893	0.844
11	0.948	0.810	0.964	0.916	0.674	0.434	0.840	0.952	0.832	0.387	0.776
12	0.952	0.912	0.964	0.938	0.663	0.433	0.886	0.946	0.909	0.878	0.848
13	0.954	0.900	0.965	0.955	0.669	0.427	0.510	0.941	0.831	0.989	0.814
14	0.887	0.888	0.965	0.918	0.632	0.462	0.834	0.918	0.543	0.483	0.753
15	0.963	0.856	0.964	0.916	0.640	0.451	0.962	0.939	0.757	0.977	0.842
16	0.955	0.871	0.961	0.950	0.653	0.411	0.854	0.931	0.692	0.562	0.784
17	0.953	0.958	0.953	0.899	0.644	0.493	0.887	0.942	0.769	0.796	0.829
18	0.953	0.956	0.956	0.955	0.623	0.505	0.905	0.931	0.968	0.755	0.851
19	0.964	0.938	0.961	0.893	0.626	0.547	0.900	0.933	0.679	0.495	0.794
10	0.958	0.959	0.960	0.926	0.650	0.544	0.906	0.903	0.609	0.685	0.810
21	0.972	0.953	0.980	0.937	0.645	0.618	0.636	0.927	0.807	0.701	0.818
22	0.976	0.968	0.972	0.953	0.589	0.571	0.946	0.890	0.730	0.655	0.825
23	0.975	0.965	0.978	0.946	0.610	0.693	0.895	0.853	0.727	0.745	0.839
24	0.977	0.959	0.976	0.954	0.586	0.684	0.931	0.861	0.717	0.526	0.817
25	0.979	0.937	0.942	0.975	0.366	0.696	0.963	0.842	0.725	0.590	0.802
26	0.980	0.973	0.940	0.970	0.542	0.684	0.902	0.844	0.757	0.425	0.802
27	0.977	0.972	0.938	0.971	0.549	0.724	0.952	0.971	0.725	0.415	0.819
28	0.978	0.964	0.949	0.971	0.548	0.760	0.937	0.914	0.734	0.989	0.874
29	0.973	0.972	0.959	0.970	0.616	0.784	0.938	0.920	0.877	0.624	0.863
30	0.974	0.967	0.958	0.969	0.595	0.828	0.942	0.916	0.699	0.597	0.844
31	0.956	0.965	0.967	0.966	0.626	0.524	0.954	0.914	0.870	0.598	0.834
32	0.942	0.954	0.956	0.970	0.636	0.534	0.923	0.939	0.883	0.629	0.836
33	0.960	0.962	0.964	0.972	0.632	0.841	0.939	0.962	0.962	0.584	0.878
34	0.949	0.957	0.965	0.972	0.584	0.889	0.944	0.919	0.838	0.591	0.861
35	0.943	0.965	0.966	0.974	0.620	0.920	0.963	0.939	0.884	0.535	0.871
36	0.956	0.962	0.966	0.970	0.613	0.961	0.963	0.914	0.809	0.549	0.866
37	0.931	0.961	0.964	0.965	0.615	0.922	0.981	0.947	0.859	0.582	0.873
38	0.957	0.961	0.956	0.970	0.637	0.923	0.964	0.954	0.778	0.550	0.865
39	0.953	0.944	0.958	0.963	0.835	0.904	0.966	0.975	0.967	0.442	0.891
40	0.954	0.954	0.936	0.977	0.668	0.933	0.982	0.964	0.914	0.168	0.845
Mean	0.949	0.942	0.958	0.948	0.638	0.577	0.883	0.933	0.821	0.677	0.833
Rank	2	4	1	3	9	10	6	5	7	8	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Table D. 3: Quarterly Mean CE for Group B Banks in Model (1)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Mean
1	0.916	0.992	0.986	0.992	0.962	0.950	0.966
2	0.876	0.991	0.985	0.992	0.982	0.693	0.920
3	0.859	0.986	0.983	0.988	0.975	0.823	0.935
4	0.872	0.987	0.986	0.992	0.978	0.895	0.951
5	0.875	0.984	0.981	0.990	0.972	0.914	0.953
6	0.874	0.987	0.986	0.987	0.956	0.936	0.954
7	0.886	0.988	0.987	0.990	0.978	0.976	0.967
8	0.986	0.988	0.989	0.987	0.978	0.972	0.983
9	0.993	0.992	0.989	0.989	0.985	0.956	0.984
10	0.989	0.990	0.989	0.985	0.980	0.956	0.982
11	0.990	0.962	0.991	0.987	0.973	0.977	0.980
12	0.988	0.977	0.989	0.987	0.971	0.940	0.976
13	0.987	0.981	0.989	0.987	0.963	0.874	0.963
14	0.972	0.977	0.990	0.982	0.918	0.910	0.958
15	0.990	0.985	0.986	0.973	0.907	0.956	0.966
16	0.981	0.957	0.984	0.985	0.938	0.890	0.956
17	0.982	0.984	0.981	0.985	0.936	0.833	0.950
18	0.983	0.988	0.984	0.987	0.893	0.855	0.948
19	0.986	0.980	0.985	0.949	0.893	0.819	0.935
10	0.980	0.985	0.985	0.977	0.947	0.823	0.950
21	0.987	0.983	0.991	0.984	0.926	0.934	0.967
22	0.985	0.986	0.990	0.983	0.844	0.851	0.940
23	0.986	0.983	0.991	0.981	0.876	0.933	0.958
24	0.984	0.980	0.990	0.978	0.840	0.897	0.945
25	0.987	0.963	0.980	0.988	0.646	0.872	0.906
26	0.982	0.983	0.972	0.968	0.769	0.826	0.917
27	0.981	0.982	0.977	0.959	0.788	0.881	0.928
28	0.988	0.988	0.982	0.976	0.802	0.929	0.944
29	0.990	0.990	0.986	0.980	0.923	0.957	0.971
30	0.987	0.985	0.986	0.975	0.873	0.968	0.962
31	0.978	0.981	0.985	0.966	0.912	0.767	0.932
32	0.980	0.973	0.981	0.970	0.931	0.811	0.941
33	0.988	0.986	0.990	0.985	0.959	0.978	0.981
34	0.981	0.985	0.990	0.981	0.899	0.983	0.970
35	0.986	0.989	0.992	0.987	0.960	0.988	0.983
36	0.986	0.989	0.990	0.983	0.951	0.990	0.981
37	0.977	0.989	0.990	0.984	0.955	0.986	0.980
38	0.988	0.989	0.989	0.986	0.976	0.986	0.986
39	0.993	0.984	0.990	0.984	0.975	0.978	0.984
40	0.988	0.991	0.990	0.991	0.989	0.987	0.989
Mean	0.967	0.983	0.986	0.982	0.922	0.911	0.959
Rank	4	2	1	3	5	6	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Table D. 4: Quarterly Mean CE for Group C Banks in Model (1)

T	ANZN	BNZ	ASB	Westpac	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.975	0.991	0.980	0.983	0.569	0.951	0.806	0.690	0.868
2	0.949	0.993	0.979	0.986	0.557	0.885	0.979	0.607	0.867
3	0.936	0.965	0.981	0.861	0.725	0.919	0.740	0.725	0.857
4	0.952	0.990	0.981	0.985	0.706	0.874	0.580	0.621	0.836
5	0.944	0.984	0.971	0.978	0.567	0.867	0.964	0.644	0.865
6	0.922	0.987	0.973	0.896	0.731	0.851	0.671	0.710	0.843
7	0.914	0.967	0.932	0.974	0.728	0.971	0.676	0.739	0.863
8	0.979	0.977	0.983	0.955	0.684	0.957	0.561	0.609	0.838
9	0.989	0.980	0.978	0.964	0.717	0.927	0.607	0.687	0.856
10	0.969	0.959	0.979	0.892	0.743	0.894	0.821	0.805	0.883
11	0.965	0.847	0.987	0.931	0.714	0.902	0.629	0.272	0.781
12	0.969	0.944	0.987	0.957	0.730	0.880	0.683	0.794	0.868
13	0.971	0.943	0.988	0.976	0.377	0.889	0.685	0.988	0.852
14	0.881	0.924	0.989	0.936	0.711	0.833	0.421	0.325	0.752
15	0.969	0.893	0.986	0.937	0.822	0.908	0.582	0.810	0.863
16	0.958	0.900	0.984	0.971	0.752	0.880	0.518	0.347	0.789
17	0.955	0.981	0.979	0.920	0.822	0.906	0.610	0.566	0.842
18	0.945	0.979	0.980	0.973	0.837	0.857	0.884	0.605	0.882
19	0.975	0.948	0.984	0.891	0.749	0.855	0.529	0.312	0.780
10	0.964	0.978	0.982	0.939	0.753	0.832	0.474	0.466	0.798
21	0.982	0.968	0.992	0.956	0.536	0.895	0.641	0.559	0.816
22	0.985	0.981	0.988	0.973	0.781	0.817	0.593	0.722	0.855
23	0.983	0.975	0.991	0.962	0.694	0.759	0.609	0.752	0.841
24	0.984	0.975	0.990	0.968	0.747	0.735	0.608	0.523	0.816
25	0.986	0.942	0.968	0.986	0.932	0.731	0.586	0.647	0.847
26	0.986	0.986	0.948	0.974	0.782	0.713	0.593	0.375	0.795
27	0.984	0.985	0.944	0.968	0.805	0.970	0.559	0.339	0.819
28	0.986	0.985	0.959	0.979	0.828	0.768	0.632	0.988	0.891
29	0.984	0.989	0.972	0.979	0.789	0.811	0.859	0.707	0.886
30	0.985	0.987	0.976	0.979	0.849	0.777	0.573	0.632	0.845
31	0.969	0.986	0.985	0.973	0.864	0.767	0.761	0.623	0.866
32	0.962	0.974	0.972	0.979	0.860	0.780	0.929	0.692	0.894
33	0.972	0.981	0.982	0.981	0.889	0.878	0.955	0.635	0.909
34	0.958	0.979	0.983	0.972	0.875	0.783	0.808	0.647	0.876
35	0.958	0.984	0.985	0.968	0.896	0.776	0.798	0.585	0.869
36	0.971	0.982	0.985	0.968	0.873	0.772	0.751	0.590	0.861
37	0.943	0.977	0.981	0.975	0.967	0.794	0.744	0.634	0.877
38	0.975	0.977	0.981	0.970	0.930	0.780	0.684	0.544	0.855
39	0.982	0.968	0.977	0.975	0.946	0.912	0.940	0.540	0.905
40	0.971	0.966	0.949	0.988	0.974	0.801	0.737	0.250	0.829
Mean	0.965	0.967	0.977	0.960	0.770	0.846	0.695	0.608	0.848
Rank	4	5	1	2	6	3	7	9	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Table D. 5: Quarterly Mean CE for Group C Banks in Model (2)

T	ANZN	BNZ	ASB	Westpac	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.947	0.994	0.967	0.983	0.551	0.955	0.820	0.678	0.867
2	0.909	0.995	0.967	0.988	0.596	0.904	0.985	0.589	0.839
3	0.895	0.943	0.969	0.832	0.658	0.941	0.762	0.713	0.826
4	0.911	0.985	0.972	0.989	0.728	0.907	0.518	0.602	0.853
5	0.902	0.965	0.948	0.976	0.524	0.892	0.985	0.634	0.834
6	0.882	0.978	0.955	0.883	0.750	0.867	0.650	0.708	0.855
7	0.878	0.927	0.909	0.971	0.725	0.986	0.710	0.731	0.832
8	0.949	0.948	0.982	0.941	0.687	0.974	0.575	0.597	0.852
9	0.989	0.957	0.971	0.956	0.711	0.949	0.613	0.668	0.879
10	0.945	0.918	0.974	0.875	0.753	0.918	0.855	0.794	0.775
11	0.935	0.813	0.988	0.920	0.704	0.931	0.656	0.255	0.860
12	0.943	0.902	0.988	0.953	0.742	0.904	0.675	0.772	0.839
13	0.945	0.898	0.989	0.979	0.296	0.906	0.713	0.985	0.739
14	0.851	0.875	0.990	0.929	0.702	0.856	0.408	0.297	0.842
15	0.918	0.836	0.987	0.925	0.800	0.929	0.606	0.733	0.776
16	0.922	0.861	0.983	0.978	0.766	0.902	0.505	0.289	0.842
17	0.919	0.981	0.971	0.927	0.839	0.939	0.617	0.546	0.891
18	0.897	0.985	0.967	0.988	0.854	0.895	0.934	0.605	0.781
19	0.972	0.938	0.980	0.902	0.756	0.892	0.540	0.265	0.799
10	0.952	0.983	0.974	0.947	0.762	0.869	0.493	0.415	0.820
21	0.979	0.966	0.994	0.960	0.543	0.930	0.675	0.512	0.867
22	0.988	0.983	0.985	0.982	0.786	0.840	0.628	0.745	0.854
23	0.980	0.974	0.992	0.974	0.691	0.784	0.645	0.794	0.829
24	0.983	0.972	0.989	0.982	0.755	0.761	0.643	0.544	0.854
25	0.985	0.931	0.944	0.991	0.945	0.748	0.616	0.674	0.796
26	0.987	0.989	0.902	0.979	0.795	0.742	0.618	0.360	0.817
27	0.984	0.988	0.902	0.979	0.820	0.978	0.580	0.302	0.901
28	0.989	0.989	0.922	0.984	0.838	0.812	0.685	0.989	0.911
29	0.985	0.993	0.939	0.985	0.799	0.860	0.912	0.813	0.866
30	0.986	0.992	0.961	0.986	0.862	0.826	0.619	0.695	0.890
31	0.953	0.990	0.985	0.980	0.877	0.816	0.820	0.702	0.914
32	0.941	0.974	0.958	0.985	0.870	0.834	0.962	0.787	0.932
33	0.958	0.985	0.979	0.986	0.908	0.936	0.990	0.715	0.894
34	0.937	0.981	0.984	0.972	0.889	0.835	0.832	0.723	0.888
35	0.935	0.988	0.988	0.963	0.910	0.830	0.822	0.667	0.879
36	0.954	0.985	0.988	0.962	0.886	0.826	0.769	0.657	0.893
37	0.917	0.978	0.979	0.975	0.982	0.853	0.774	0.683	0.870
38	0.961	0.979	0.984	0.967	0.942	0.837	0.703	0.586	0.921
39	0.984	0.959	0.977	0.971	0.959	0.973	0.974	0.570	0.830
40	0.953	0.961	0.937	0.992	0.984	0.861	0.745	0.204	0.830
Mean	0.945	0.956	0.968	0.960	0.774	0.880	0.716	0.615	0.852
Rank	4	3	1	2	6	5	7	8	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Appendix E: Quarterly Mean Alternative Profit Efficiency

Table E. 1: Quarterly Mean APE for Group A Banks in Model (1) (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.774	0.724	0.446	0.237	0.443	0.735	0.093	0.154	0.185	0.413	0.420
2	0.946	0.659	0.468	0.831	0.631	0.555	0.054	0.043	0.141	0.602	0.493
3	0.797	0.621	0.470	0.941	0.614	0.327	0.254	0.167	0.358	0.593	0.514
4	0.799	0.772	0.494	0.716	0.553	0.301	0.165	0.080	0.080	0.655	0.461
5	0.853	0.857	0.570	0.832	0.504	0.242	0.760	0.143	0.154	0.859	0.578
6	0.862	0.860	0.562	0.082	0.680	0.168	0.188	0.047	0.036	0.879	0.436
7	0.891	0.825	0.554	0.757	0.707	0.178	0.183	0.126	0.196	0.712	0.513
8	0.742	0.865	0.637	0.866	0.768	0.051	0.257	0.615	0.256	0.708	0.577
9	0.844	0.914	0.615	0.887	0.690	0.092	0.318	0.199	0.112	0.612	0.528
10	0.762	0.885	0.592	0.912	0.879	0.109	0.186	0.169	0.330	0.893	0.572
11	0.756	0.448	0.641	0.873	0.802	0.118	0.342	0.129	0.135	0.872	0.512
12	0.723	0.779	0.636	0.901	0.807	0.323	0.428	0.201	0.077	0.822	0.570
13	0.765	0.820	0.701	0.881	0.724	0.461	0.228	0.293	0.124	0.621	0.562
14	0.837	0.764	0.701	0.871	0.875	0.369	0.065	0.176	0.033	0.462	0.515
15	0.897	0.242	0.676	0.875	0.845	0.311	0.790	0.199	0.144	0.256	0.523
16	0.839	0.806	0.684	0.874	0.811	0.358	0.170	0.114	0.417	0.211	0.528
17	0.804	0.728	0.684	0.856	0.812	0.692	0.098	0.209	0.261	0.751	0.590
18	0.792	0.786	0.661	0.857	0.862	0.550	0.470	0.330	0.013	0.835	0.616
19	0.867	0.779	0.632	0.876	0.874	0.299	0.397	0.209	0.131	0.047	0.511
10	0.836	0.866	0.716	0.741	0.845	0.509	0.396	0.276	0.117	0.050	0.535
21	0.879	0.830	0.599	0.865	0.735	0.951	0.018	0.280	0.164	0.020	0.534
22	0.782	0.871	0.780	0.823	0.887	0.045	0.668	0.327	0.200	0.018	0.540
23	0.866	0.840	0.480	0.804	0.846	0.659	0.184	0.363	0.246	0.292	0.558
24	0.830	0.815	0.557	0.753	0.752	0.776	0.469	0.333	0.063	0.036	0.538
25	0.859	0.901	0.782	0.912	0.818	0.431	0.010	0.345	0.471	0.196	0.573
26	0.720	0.803	0.478	0.900	0.770	0.465	0.065	0.363	0.126	0.018	0.471
27	0.547	0.825	0.366	0.645	0.738	0.507	0.501	0.153	0.817	0.267	0.537
28	0.564	0.916	0.573	0.707	0.845	0.792	0.914	0.528	0.856	0.596	0.729
29	0.847	0.731	0.632	0.294	0.631	0.646	0.882	0.562	0.331	0.912	0.647
30	0.283	0.484	0.432	0.187	0.890	0.781	0.334	0.645	0.545	0.426	0.501
31	0.830	0.018	0.450	0.418	0.868	0.275	0.727	0.599	0.264	0.335	0.478
32	0.842	0.795	0.633	0.300	0.798	0.244	0.303	0.848	0.108	0.063	0.493
33	0.518	0.758	0.571	0.543	0.663	0.422	0.513	0.760	0.190	0.106	0.504
34	0.915	0.884	0.673	0.731	0.724	0.303	0.519	0.790	0.153	0.066	0.576
35	0.814	0.236	0.755	0.537	0.577	0.260	0.825	0.720	0.178	0.052	0.495
36	0.863	0.804	0.681	0.655	0.514	0.152	0.789	0.900	0.091	0.094	0.554
37	0.809	0.584	0.677	0.658	0.383	0.023	0.407	0.709	0.196	0.491	0.494
38	0.884	0.734	0.804	0.626	0.566	0.203	0.341	0.671	0.094	0.237	0.516
39	0.647	0.946	0.827	0.830	0.266	0.466	0.384	0.882	0.225	0.802	0.628
40	0.943	0.942	0.871	0.763	0.571	0.507	0.395	0.071	0.065	0.032	0.516
Mean	0.791	0.743	0.619	0.715	0.714	0.391	0.377	0.368	0.217	0.423	0.536
Rank	1	2	5	3	4	9	7	8	10	6	

Note: T: 40 quarters (Q1:2002-Q4:2011)

Table E. 2: Quarterly Mean APE for Group A Banks in Model (2) (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.800	0.760	0.481	0.262	0.493	0.777	0.131	0.187	0.216	0.461	0.457
2	0.945	0.685	0.502	0.855	0.700	0.612	0.083	0.055	0.156	0.642	0.524
3	0.818	0.669	0.502	0.944	0.675	0.377	0.308	0.203	0.433	0.645	0.558
4	0.815	0.776	0.523	0.762	0.606	0.350	0.214	0.100	0.087	0.680	0.491
5	0.859	0.860	0.612	0.859	0.561	0.283	0.800	0.174	0.175	0.872	0.605
6	0.866	0.854	0.586	0.088	0.719	0.188	0.232	0.059	0.041	0.885	0.452
7	0.891	0.820	0.584	0.785	0.745	0.203	0.219	0.146	0.237	0.734	0.536
8	0.724	0.857	0.655	0.873	0.798	0.058	0.309	0.692	0.292	0.698	0.596
9	0.826	0.905	0.634	0.890	0.734	0.105	0.367	0.225	0.122	0.597	0.540
10	0.748	0.877	0.609	0.911	0.890	0.124	0.215	0.192	0.350	0.896	0.581
11	0.752	0.462	0.663	0.882	0.826	0.134	0.379	0.148	0.151	0.876	0.527
12	0.707	0.775	0.645	0.900	0.822	0.350	0.486	0.224	0.079	0.799	0.579
13	0.748	0.814	0.705	0.881	0.744	0.494	0.240	0.317	0.131	0.568	0.564
14	0.817	0.761	0.701	0.869	0.875	0.388	0.069	0.193	0.034	0.476	0.518
15	0.887	0.249	0.681	0.871	0.847	0.325	0.789	0.211	0.152	0.223	0.524
16	0.825	0.800	0.688	0.875	0.817	0.384	0.183	0.122	0.412	0.179	0.528
17	0.792	0.734	0.691	0.862	0.819	0.720	0.103	0.226	0.263	0.675	0.589
18	0.787	0.800	0.670	0.873	0.862	0.580	0.497	0.364	0.014	0.797	0.624
19	0.859	0.789	0.639	0.886	0.871	0.315	0.407	0.228	0.132	0.042	0.517
10	0.827	0.867	0.719	0.762	0.844	0.531	0.407	0.297	0.118	0.040	0.541
21	0.868	0.831	0.606	0.864	0.743	0.950	0.019	0.298	0.171	0.018	0.537
22	0.772	0.865	0.778	0.828	0.880	0.048	0.677	0.342	0.208	0.018	0.542
23	0.856	0.838	0.486	0.815	0.844	0.690	0.184	0.382	0.252	0.299	0.564
24	0.823	0.813	0.567	0.772	0.756	0.795	0.479	0.353	0.063	0.038	0.546
25	0.850	0.896	0.785	0.905	0.802	0.455	0.010	0.360	0.472	0.196	0.573
26	0.721	0.803	0.492	0.898	0.773	0.495	0.066	0.385	0.125	0.019	0.478
27	0.553	0.828	0.379	0.675	0.750	0.543	0.537	0.175	0.802	0.252	0.549
28	0.568	0.912	0.594	0.728	0.847	0.824	0.917	0.564	0.861	0.645	0.746
29	0.839	0.737	0.658	0.303	0.651	0.684	0.875	0.594	0.335	0.915	0.659
30	0.279	0.481	0.447	0.191	0.891	0.802	0.328	0.673	0.552	0.435	0.508
31	0.831	0.018	0.460	0.426	0.871	0.304	0.710	0.623	0.260	0.349	0.485
32	0.829	0.785	0.651	0.306	0.809	0.270	0.297	0.851	0.109	0.064	0.497
33	0.519	0.755	0.589	0.555	0.688	0.439	0.499	0.772	0.189	0.107	0.511
34	0.906	0.877	0.693	0.739	0.748	0.316	0.504	0.800	0.153	0.063	0.580
35	0.808	0.239	0.770	0.549	0.603	0.272	0.804	0.733	0.182	0.053	0.501
36	0.861	0.814	0.706	0.676	0.548	0.160	0.771	0.897	0.093	0.093	0.562
37	0.810	0.614	0.711	0.682	0.418	0.025	0.398	0.723	0.201	0.439	0.502
38	0.884	0.760	0.822	0.653	0.607	0.215	0.333	0.685	0.096	0.205	0.526
39	0.678	0.944	0.847	0.843	0.340	0.490	0.374	0.879	0.224	0.754	0.637
40	0.940	0.941	0.884	0.780	0.614	0.530	0.381	0.073	0.069	0.032	0.524
Mean	0.787	0.747	0.635	0.727	0.736	0.415	0.390	0.388	0.225	0.419	0.547
Rank	1	2	5	4	3	7	8	9	10	6	

Note:T: 40 quarters (Q1:2002-Q4:2011)

Table E. 3: Quarterly Mean APE for Group B Banks in Model (1) (2002-2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Mean
1	0.861	0.807	0.662	0.236	0.831	0.875	0.712
2	0.962	0.747	0.685	0.854	0.617	0.841	0.784
3	0.893	0.670	0.677	0.933	0.630	0.713	0.752
4	0.890	0.836	0.708	0.685	0.649	0.878	0.774
5	0.907	0.882	0.776	0.805	0.566	0.341	0.713
6	0.919	0.898	0.747	0.084	0.710	0.226	0.597
7	0.932	0.776	0.670	0.743	0.863	0.300	0.714
8	0.595	0.839	0.775	0.848	0.855	0.120	0.672
9	0.882	0.851	0.713	0.889	0.697	0.158	0.698
10	0.767	0.819	0.668	0.913	0.864	0.212	0.707
11	0.657	0.431	0.730	0.873	0.883	0.242	0.636
12	0.659	0.857	0.738	0.915	0.814	0.689	0.779
13	0.726	0.841	0.774	0.900	0.806	0.809	0.809
14	0.780	0.813	0.727	0.915	0.825	0.614	0.779
15	0.924	0.243	0.796	0.904	0.871	0.655	0.732
16	0.903	0.853	0.799	0.904	0.812	0.913	0.864
17	0.873	0.764	0.798	0.886	0.793	0.897	0.835
18	0.906	0.830	0.790	0.877	0.829	0.848	0.847
19	0.872	0.759	0.767	0.895	0.845	0.391	0.755
10	0.833	0.884	0.848	0.800	0.842	0.738	0.824
21	0.842	0.835	0.766	0.882	0.833	0.949	0.851
22	0.790	0.869	0.864	0.867	0.906	0.046	0.724
23	0.861	0.852	0.616	0.842	0.903	0.747	0.803
24	0.853	0.845	0.721	0.797	0.811	0.857	0.814
25	0.876	0.917	0.880	0.916	0.528	0.403	0.753
26	0.773	0.847	0.621	0.928	0.753	0.429	0.725
27	0.586	0.868	0.447	0.732	0.729	0.392	0.626
28	0.600	0.934	0.709	0.807	0.776	0.637	0.744
29	0.830	0.746	0.781	0.329	0.561	0.741	0.665
30	0.249	0.447	0.490	0.209	0.874	0.906	0.529
31	0.756	0.017	0.505	0.469	0.872	0.588	0.534
32	0.811	0.725	0.690	0.341	0.776	0.472	0.636
33	0.478	0.703	0.628	0.623	0.625	0.737	0.632
34	0.903	0.866	0.689	0.821	0.650	0.520	0.742
35	0.806	0.227	0.779	0.631	0.525	0.423	0.565
36	0.862	0.797	0.705	0.770	0.465	0.255	0.642
37	0.801	0.577	0.742	0.751	0.374	0.037	0.547
38	0.880	0.729	0.823	0.729	0.499	0.357	0.669
39	0.527	0.950	0.845	0.890	0.702	0.790	0.784
40	0.942	0.941	0.883	0.831	0.515	0.842	0.826
Mean	0.794	0.752	0.726	0.751	0.732	0.565	0.720
Rank	1	2	4	3	5	6	

Notes: (1) T: 40 quarters (Q1: 2002-Q4:2011)

Table E. 4: Quarterly Mean APE for Group C Banks in Model (1) (2002-2011)

T	ANZN	BNZ	ASB	Westpac	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.814	0.920	0.826	0.316	0.546	0.503	0.430	0.409	0.595
2	0.947	0.863	0.841	0.874	0.555	0.057	0.371	0.589	0.637
3	0.859	0.889	0.828	0.955	0.807	0.594	0.938	0.520	0.799
4	0.818	0.832	0.796	0.717	0.767	0.303	0.122	0.904	0.658
5	0.842	0.843	0.853	0.769	0.829	0.393	0.432	0.850	0.727
6	0.827	0.859	0.822	0.090	0.705	0.171	0.080	0.811	0.546
7	0.871	0.768	0.810	0.690	0.469	0.327	0.776	0.701	0.677
8	0.615	0.797	0.828	0.801	0.716	0.929	0.893	0.789	0.796
9	0.698	0.834	0.808	0.833	0.630	0.442	0.531	0.761	0.692
10	0.699	0.810	0.757	0.897	0.442	0.356	0.876	0.886	0.715
11	0.636	0.431	0.780	0.843	0.473	0.286	0.631	0.867	0.618
12	0.619	0.798	0.755	0.885	0.846	0.390	0.365	0.835	0.687
13	0.695	0.798	0.784	0.850	0.791	0.512	0.430	0.774	0.704
14	0.768	0.780	0.742	0.837	0.112	0.319	0.128	0.860	0.568
15	0.917	0.271	0.750	0.813	0.819	0.310	0.589	0.281	0.594
16	0.882	0.816	0.758	0.872	0.313	0.172	0.882	0.254	0.619
17	0.838	0.685	0.751	0.854	0.132	0.319	0.602	0.782	0.620
18	0.902	0.852	0.759	0.896	0.772	0.545	0.034	0.451	0.651
19	0.899	0.736	0.729	0.898	0.400	0.306	0.298	0.013	0.535
10	0.851	0.878	0.846	0.802	0.464	0.400	0.176	0.036	0.557
21	0.874	0.808	0.809	0.865	0.023	0.339	0.326	0.012	0.507
22	0.844	0.843	0.874	0.845	0.842	0.370	0.279	0.004	0.613
23	0.898	0.805	0.675	0.838	0.204	0.391	0.339	0.173	0.540
24	0.890	0.757	0.725	0.800	0.690	0.368	0.077	0.007	0.539
25	0.908	0.790	0.845	0.856	0.013	0.335	0.496	0.098	0.543
26	0.845	0.772	0.678	0.878	0.094	0.322	0.085	0.012	0.461
27	0.663	0.789	0.487	0.548	0.551	0.484	0.811	0.497	0.604
28	0.648	0.872	0.750	0.604	0.440	0.440	0.831	0.846	0.679
29	0.834	0.606	0.826	0.273	0.923	0.528	0.483	0.694	0.646
30	0.274	0.418	0.529	0.169	0.412	0.705	0.695	0.281	0.435
31	0.257	0.016	0.527	0.385	0.863	0.665	0.484	0.232	0.429
32	0.805	0.684	0.721	0.280	0.488	0.766	0.284	0.035	0.508
33	0.460	0.668	0.668	0.524	0.679	0.881	0.578	0.033	0.562
34	0.881	0.846	0.761	0.696	0.792	0.881	0.592	0.076	0.691
35	0.765	0.216	0.846	0.515	0.862	0.819	0.658	0.034	0.590
36	0.833	0.814	0.755	0.652	0.857	0.907	0.349	0.050	0.652
37	0.780	0.636	0.776	0.662	0.613	0.806	0.634	0.423	0.666
38	0.874	0.796	0.864	0.659	0.482	0.845	0.352	0.634	0.688
39	0.715	0.947	0.901	0.855	0.747	0.927	0.776	0.904	0.846
40	0.936	0.952	0.921	0.817	0.704	0.048	0.423	0.615	0.677
Mean	0.775	0.737	0.769	0.705	0.572	0.487	0.478	0.451	0.622
Rank	2	3	1	4	5	6	7	8	

Notes: T: 40 quarters (Q1:2002-Q4:2011)

Table E. 5: Quarterly Mean APE for Group C Banks in Model (2) (2002-2011)

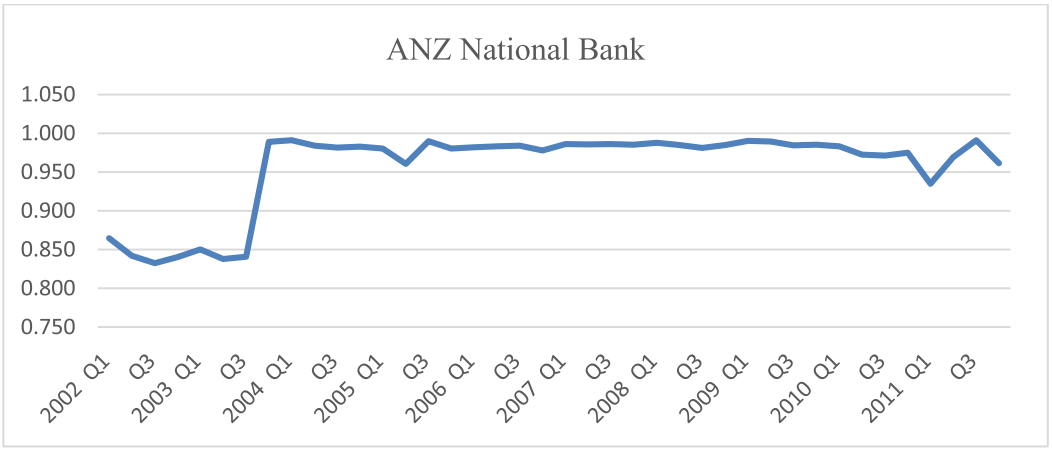
T	ANZN	BNZ	ASB	Westpac	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.756	0.797	0.572	0.288	0.424	0.334	0.421	0.467	0.507
2	0.942	0.707	0.610	0.877	0.236	0.106	0.275	0.691	0.555
3	0.833	0.752	0.630	0.953	0.613	0.376	0.895	0.610	0.708
4	0.824	0.784	0.653	0.815	0.543	0.184	0.380	0.721	0.613
5	0.867	0.852	0.774	0.885	0.845	0.306	0.335	0.839	0.713
6	0.879	0.851	0.711	0.099	0.525	0.108	0.071	0.830	0.509
7	0.898	0.807	0.696	0.837	0.441	0.230	0.593	0.700	0.650
8	0.692	0.833	0.749	0.890	0.637	0.870	0.801	0.612	0.761
9	0.758	0.876	0.735	0.905	0.677	0.320	0.346	0.490	0.638
10	0.761	0.864	0.691	0.921	0.399	0.275	0.577	0.906	0.674
11	0.757	0.511	0.753	0.900	0.603	0.211	0.355	0.679	0.596
12	0.724	0.842	0.750	0.913	0.806	0.321	0.220	0.808	0.673
13	0.781	0.862	0.793	0.898	0.645	0.448	0.267	0.450	0.643
14	0.828	0.853	0.772	0.896	0.125	0.276	0.092	0.442	0.535
15	0.930	0.323	0.799	0.892	0.767	0.277	0.299	0.332	0.577
16	0.893	0.874	0.805	0.891	0.281	0.157	0.893	0.701	0.687
17	0.870	0.789	0.806	0.873	0.140	0.284	0.570	0.832	0.645
18	0.902	0.827	0.816	0.863	0.676	0.449	0.023	0.860	0.677
19	0.866	0.777	0.783	0.867	0.497	0.287	0.268	0.137	0.560
10	0.828	0.865	0.852	0.752	0.509	0.364	0.216	0.083	0.559
21	0.860	0.815	0.799	0.851	0.024	0.335	0.262	0.030	0.497
22	0.769	0.848	0.889	0.806	0.818	0.411	0.308	0.019	0.609
23	0.850	0.811	0.669	0.753	0.228	0.473	0.375	0.299	0.557
24	0.823	0.812	0.774	0.672	0.574	0.427	0.086	0.044	0.527
25	0.866	0.879	0.880	0.888	0.011	0.457	0.663	0.195	0.605
26	0.723	0.814	0.689	0.862	0.074	0.426	0.168	0.037	0.474
27	0.535	0.823	0.509	0.524	0.558	0.669	0.875	0.755	0.656
28	0.569	0.913	0.757	0.662	0.921	0.562	0.820	0.931	0.767
29	0.848	0.758	0.816	0.263	0.867	0.629	0.341	0.817	0.667
30	0.284	0.478	0.553	0.162	0.331	0.755	0.784	0.378	0.466
31	0.840	0.018	0.508	0.331	0.703	0.629	0.355	0.287	0.459
32	0.840	0.756	0.720	0.251	0.296	0.817	0.149	0.055	0.485
33	0.553	0.736	0.653	0.481	0.474	0.787	0.318	0.101	0.513
34	0.898	0.866	0.750	0.609	0.475	0.815	0.311	0.059	0.598
35	0.779	0.234	0.813	0.451	0.723	0.731	0.445	0.038	0.527
36	0.852	0.820	0.740	0.570	0.674	0.891	0.204	0.076	0.603
37	0.763	0.633	0.751	0.602	0.333	0.729	0.386	0.347	0.568
38	0.884	0.760	0.830	0.572	0.264	0.699	0.218	0.167	0.549
39	0.329	0.940	0.859	0.784	0.305	0.832	0.479	0.786	0.664
40	0.934	0.940	0.897	0.689	0.268	0.065	0.124	0.702	0.577
Mean	0.785	0.758	0.740	0.700	0.483	0.458	0.389	0.458	0.596
Rank	1	2	3	4	5	6	8	7	

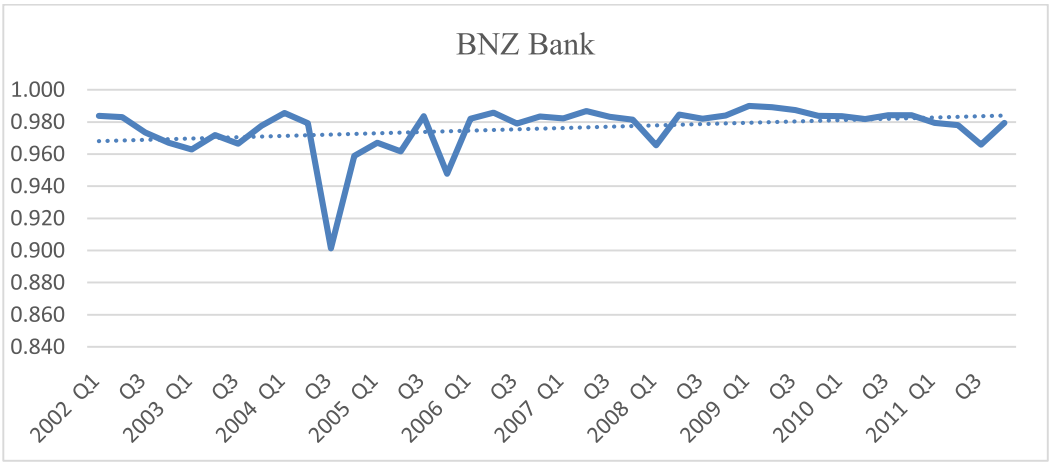
Note: T: 40 quarters (Q1:2002-Q4:2011)

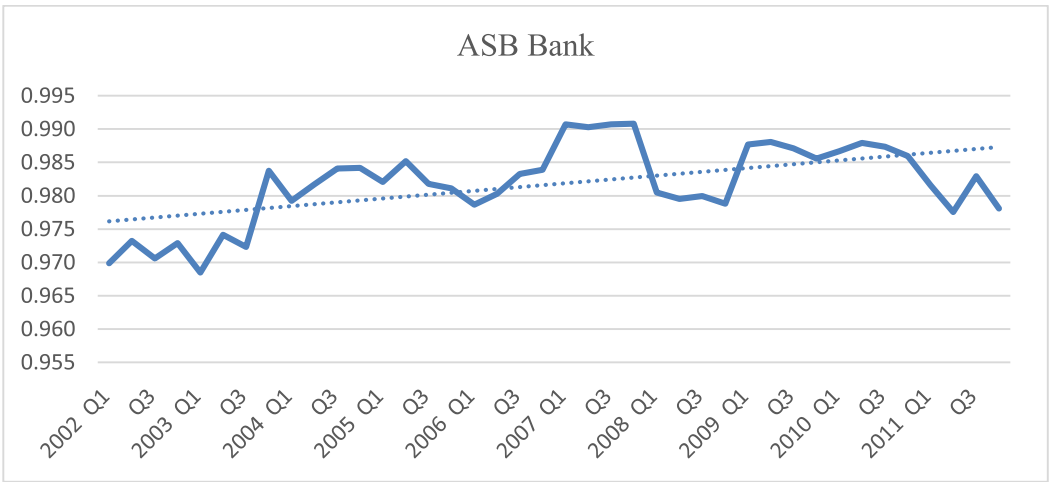
Appendix F: Trends of CE APE Over Time

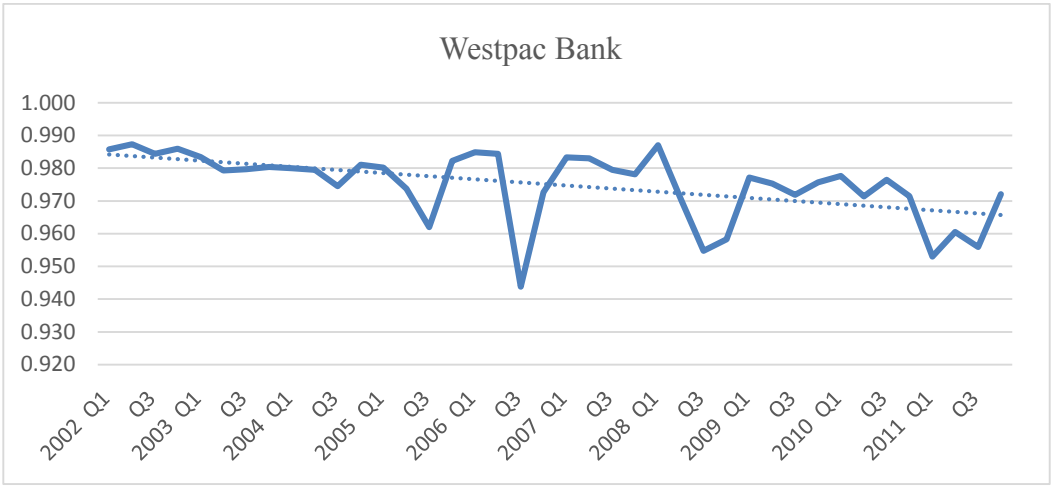
Figure F. 1: Major Banks: Quarterly Mean CE (Model 2) over 2002-2011

Foreign Banks:

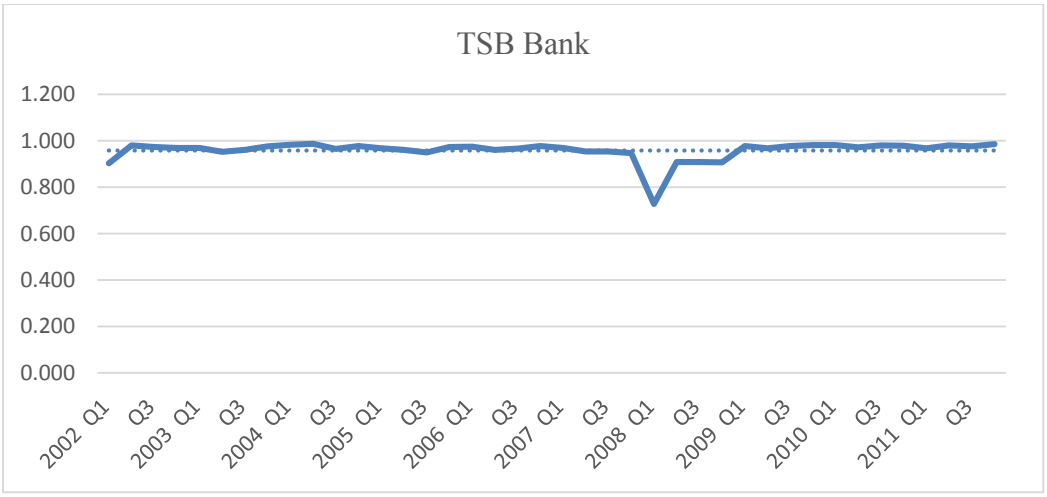








Domestic Banks:



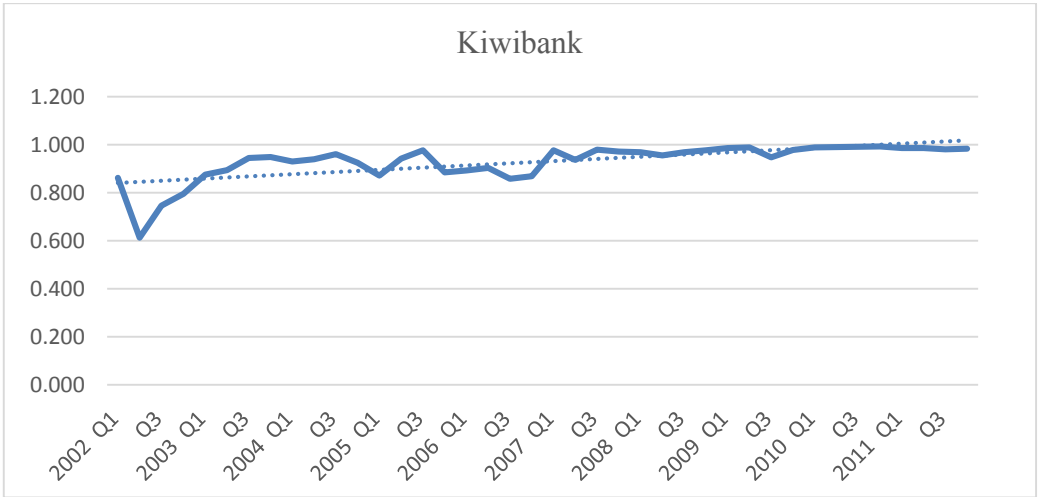
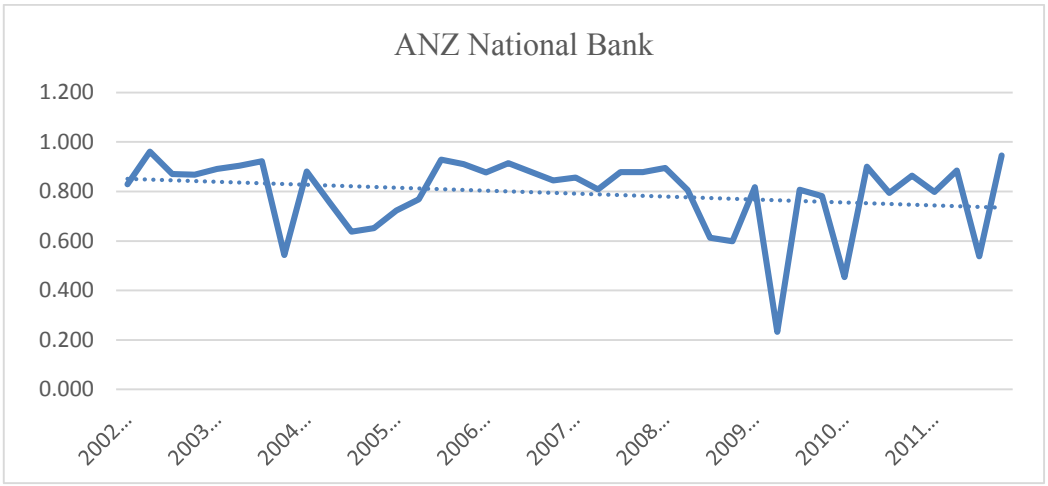
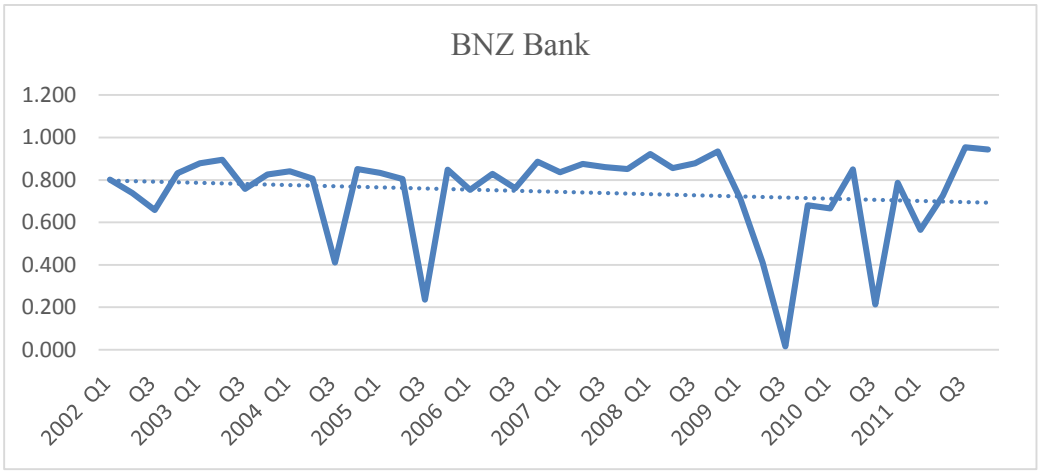
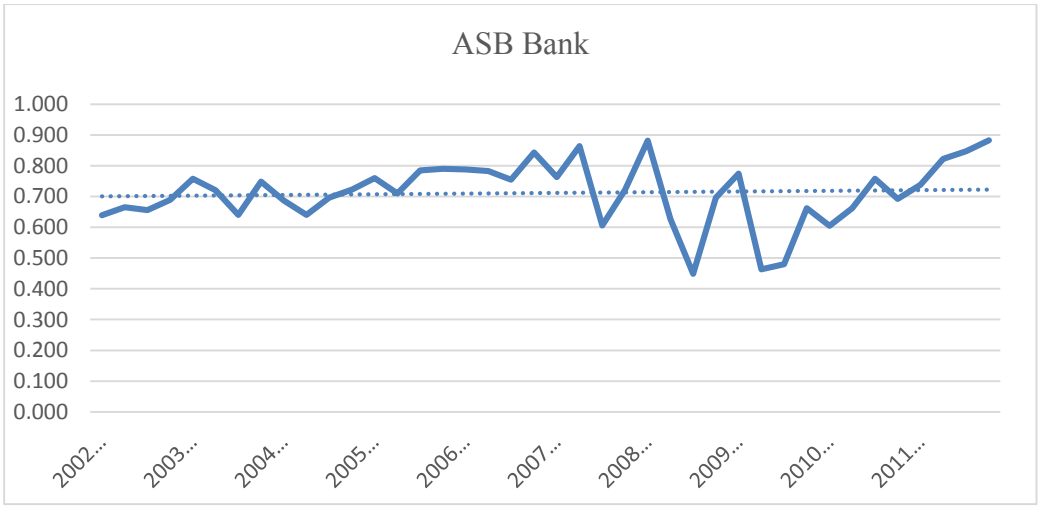


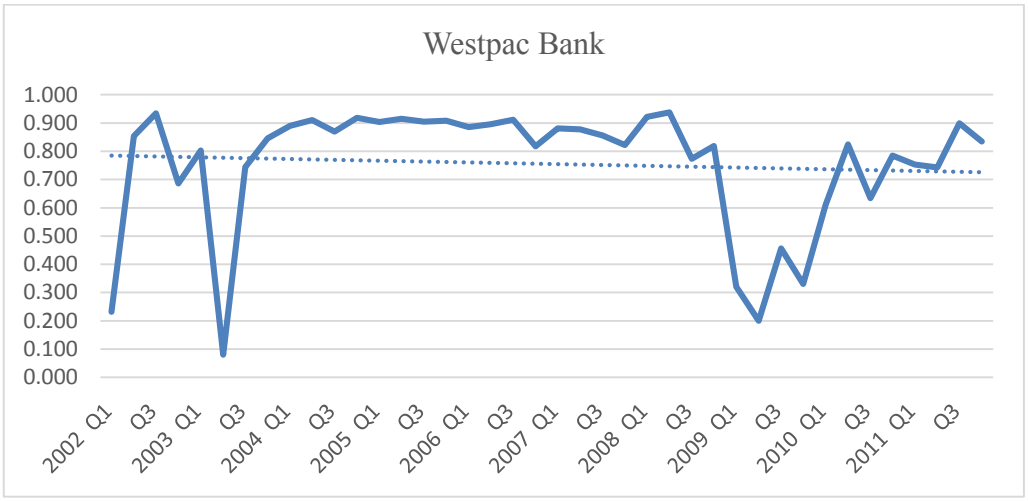
Figure F. 2: Major Banks: Quarterly Mean APE (Model 2) over 2002-2011

Foreign Banks:

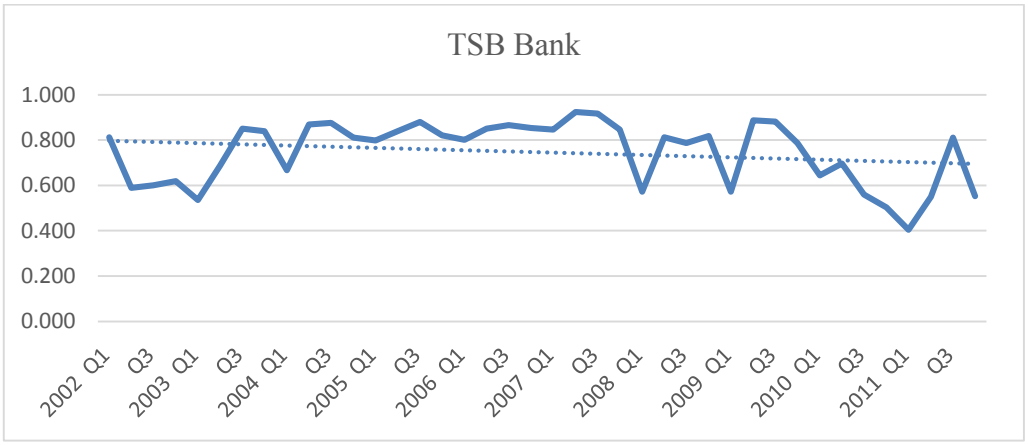


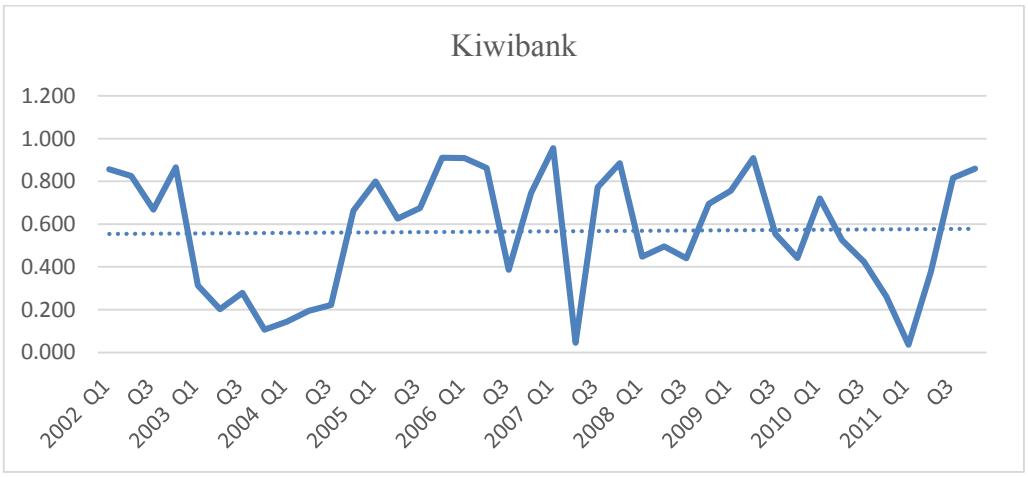






Domestic Banks





Appendix G:Quarterly Equity Ratios

Table G. 1: Full Sample Banks: Equity Ratios (Q1:2001-Q4:2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Deutsche	Mean
1	0.05	0.05	0.04	0.11	0.07	0.10	0.05	0.00	0.02	0.03	0.05
2	0.06	0.05	0.04	0.11	0.07	0.38	0.04	0.00	0.02	0.03	0.08
3	0.05	0.06	0.04	0.12	0.07	0.20	0.05	0.00	0.03	0.04	0.06
4	0.05	0.06	0.05	0.13	0.07	0.15	0.05	0.00	0.03	0.05	0.06
5	0.05	0.06	0.05	0.13	0.07	0.10	0.05	0.00	0.03	0.05	0.06
6	0.05	0.06	0.05	0.10	0.07	0.08	0.04	0.00	0.03	0.06	0.05
7	0.05	0.06	0.05	0.13	0.07	0.09	0.04	0.00	0.04	0.06	0.06
8	0.09	0.06	0.05	0.12	0.07	0.08	0.04	0.01	0.03	0.08	0.06
9	0.09	0.06	0.05	0.11	0.07	0.07	0.05	0.00	0.00	0.06	0.06
10	0.10	0.06	0.05	0.10	0.01	0.08	0.04	0.00	0.01	0.08	0.05
11	0.10	0.06	0.05	0.10	0.07	0.07	0.05	0.00	0.01	0.06	0.06
12	0.10	0.06	0.06	0.10	0.07	0.07	0.04	0.00	0.01	0.09	0.06
13	0.10	0.06	0.06	0.10	0.07	0.07	0.05	0.00	0.01	0.07	0.06
14	0.09	0.06	0.06	0.09	0.07	0.07	0.04	0.00	0.01	0.10	0.06
15	0.09	0.06	0.06	0.09	0.07	0.06	0.05	0.00	0.02	0.12	0.06
16	0.10	0.06	0.06	0.07	0.08	0.06	0.04	0.00	0.02	0.23	0.07
17	0.09	0.06	0.06	0.07	0.07	0.05	0.04	0.00	0.03	0.22	0.07
18	0.09	0.06	0.06	0.07	0.07	0.06	0.04	0.00	0.01	0.22	0.07
19	0.09	0.06	0.06	0.07	0.08	0.06	0.05	0.00	0.02	0.25	0.07
10	0.09	0.06	0.05	0.06	0.08	0.05	0.04	0.00	0.01	0.22	0.07
21	0.09	0.06	0.05	0.06	0.08	0.06	0.05	0.00	0.02	0.02	0.05
22	0.08	0.06	0.05	0.06	0.08	0.05	0.04	0.00	0.01	0.02	0.05
23	0.08	0.06	0.05	0.06	0.08	0.05	0.05	0.01	0.02	0.04	0.05
24	0.08	0.06	0.06	0.06	0.08	0.05	0.04	0.00	0.02	0.03	0.05
25	0.08	0.07	0.06	0.08	0.08	0.05	0.05	0.00	0.02	0.03	0.05
26	0.08	0.07	0.05	0.08	0.08	0.05	0.04	0.00	0.02	0.04	0.05
27	0.08	0.06	0.05	0.09	0.08	0.04	0.04	0.00	0.03	0.04	0.05
28	0.08	0.05	0.04	0.09	0.08	0.03	0.02	0.00	0.03	0.05	0.05
29	0.08	0.06	0.04	0.07	0.08	0.03	0.03	0.00	0.03	0.05	0.05
30	0.08	0.05	0.05	0.07	0.08	0.03	0.05	0.01	0.04	0.07	0.05
31	0.09	0.05	0.05	0.07	0.08	0.04	0.04	0.00	0.05	0.08	0.05
32	0.09	0.06	0.05	0.07	0.08	0.03	0.03	0.01	0.03	0.07	0.05
33	0.09	0.06	0.05	0.07	0.08	0.04	0.04	0.00	0.06	0.06	0.05
34	0.10	0.06	0.06	0.07	0.08	0.05	0.03	0.01	0.05	0.06	0.05
35	0.09	0.06	0.05	0.07	0.08	0.05	0.07	0.00	0.06	0.05	0.06
36	0.09	0.06	0.06	0.07	0.08	0.05	0.07	0.01	0.05	0.03	0.06
37	0.09	0.06	0.06	0.07	0.07	0.04	0.06	0.00	0.06	0.03	0.06
38	0.09	0.06	0.06	0.08	0.08	0.04	0.06	0.01	0.06	0.04	0.06
39	0.09	0.06	0.06	0.07	0.08	0.04	0.06	0.00	0.07	0.04	0.06
40	0.10	0.07	0.06	0.08	0.08	0.05	0.06	0.00	0.07	0.04	0.06
Mean	0.08	0.06	0.05	0.09	0.07	0.07	0.04	0.00	0.03	0.07	0.06
Rank	2	6	7	1	4	5	8	10	9	3	

Note:T: 40 quarters (Q1:2002-Q4:2011)

Appendix H:Quarterly Impaired Asset Ratios

Table H. 1: Full Sample Banks: Impaired Asset Ratios (Q1:2001-Q4:2011)

T	ANZN	BNZ	ASB	Westpac	TSB	Kiwibank	Rabobank	HSBC	Citibank	Mean
1	0.004	0.009	0.003	0.011	0.001	0.000	0.001	0.051	0.067	0.015
2	0.003	0.008	0.003	0.010	0.001	0.000	0.002	0.001	0.064	0.009
3	0.003	0.008	0.002	0.009	0.001	0.000	0.002	0.043	0.070	0.014
4	0.002	0.007	0.003	0.008	0.002	0.000	0.002	0.035	0.073	0.013
5	0.002	0.007	0.003	0.007	0.002	0.000	0.001	0.035	0.073	0.013
6	0.002	0.006	0.002	0.006	0.002	0.001	0.002	0.030	0.074	0.013
7	0.002	0.007	0.002	0.007	0.001	0.000	0.001	0.028	0.078	0.013
8	0.001	0.001	0.002	0.003	0.001	0.000	0.000	0.007	0.000	0.001
9	0.003	0.002	0.002	0.002	0.001	0.000	0.001	0.006	0.000	0.002
10	0.003	0.003	0.002	0.002	0.000	0.000	0.001	0.005	0.000	0.002
11	0.003	0.004	0.001	0.002	0.002	0.000	0.001	0.005	0.000	0.002
12	0.002	0.003	0.001	0.002	0.001	0.000	0.001	0.004	0.000	0.001
13	0.003	0.003	0.002	0.002	0.001	0.000	0.001	0.004	0.000	0.002
14	0.003	0.004	0.002	0.003	0.001	0.000	0.001	0.004	0.000	0.002
15	0.003	0.004	0.001	0.003	0.002	0.001	0.002	0.003	0.000	0.002
16	0.003	0.003	0.001	0.004	0.001	0.001	0.001	0.003	0.000	0.002
17	0.003	0.003	0.002	0.002	0.000	0.000	0.001	0.002	0.000	0.001
18	0.003	0.002	0.002	0.002	0.000	0.000	0.002	0.002	0.000	0.001
19	0.002	0.002	0.002	0.002	0.000	0.000	0.002	0.002	0.000	0.001
10	0.002	0.001	0.002	0.002	0.000	0.001	0.002	0.002	0.000	0.001
21	0.002	0.001	0.002	0.002	0.000	0.001	0.001	0.002	0.000	0.001
22	0.002	0.002	0.002	0.002	0.000	0.000	0.002	0.002	0.000	0.001
23	0.002	0.002	0.002	0.003	0.000	0.000	0.002	0.002	0.000	0.001
24	0.003	0.002	0.002	0.003	0.000	0.000	0.002	0.002	0.000	0.001
25	0.003	0.003	0.003	0.009	0.001	0.000	0.001	0.002	0.000	0.002
26	0.004	0.004	0.003	0.009	0.001	0.002	0.001	0.006	0.000	0.003
27	0.005	0.005	0.004	0.012	0.002	0.003	0.005	0.007	0.000	0.004
28	0.006	0.006	0.007	0.017	0.002	0.002	0.023	0.005	0.000	0.007
29	0.009	0.008	0.010	0.020	0.003	0.003	0.031	0.005	0.000	0.009
30	0.012	0.008	0.012	0.022	0.002	0.004	0.027	0.009	0.000	0.010
31	0.014	0.012	0.013	0.019	0.003	0.004	0.042	0.013	0.000	0.012
32	0.015	0.013	0.014	0.019	0.002	0.004	0.042	0.009	0.000	0.012
33	0.019	0.017	0.013	0.019	0.002	0.006	0.041	0.009	0.000	0.013
34	0.019	0.015	0.014	0.022	0.002	0.006	0.049	0.009	0.000	0.014
35	0.020	0.014	0.014	0.023	0.003	0.006	0.047	0.013	0.000	0.014
36	0.021	0.015	0.015	0.021	0.002	0.008	0.049	0.014	0.000	0.015
37	0.019	0.016	0.012	0.022	0.002	0.009	0.047	0.014	0.000	0.014
38	0.020	0.014	0.012	0.022	0.002	0.010	0.043	0.014	0.000	0.014
39	0.018	0.012	0.008	0.019	0.002	0.009	0.043	0.013	0.000	0.012
40	0.017	0.011	0.008	0.018	0.002	0.009	0.044	0.015	0.000	0.012
Mean	0.007	0.007	0.005	0.010	0.001	0.002	0.014	0.011	0.012	0.007
Rank	4	5	6	7	9	8	1	3	2	

Notes : (1) T: 40 quarters (Q1:2002-Q4:2011) (2) Deutsche bank New Zealand branch disclosed no imparied assets over the study period.