

EFFICIENCY IN INTEGRATED BANKING MARKETS – AUSTRALIA AND NEW ZEALAND

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April 2004

Abstract:

Data Envelopment Analysis is used to investigate the efficiency of those New Zealand banks with significant branch networks relative to their Australian counterparts, and relative to other Australian banks with retail branch networks. Because of the relatively small size of individual year cross-sections, the study uses panel data covering the period 1996 to 2003.

Despite the differences in returns on equity, once we adjust for differences in the level of equity, no significant difference is found between the efficiency of New Zealand banks and the major Australian banks, although the Australian regional banks are found to be rather less efficient.

Keywords:

Banking; Data Envelopment Analysis; efficiency; New Zealand; Australia.

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1 Introduction

One of the most distinctive features of the New Zealand banking system is the extent of its foreign ownership. Thus, as at 30 September 2003, 98.6% of the assets of the New Zealand banking system were foreign-owned, a proportion that is rivalled by few other countries elsewhere in the world (and certainly not by any larger countries or other members of the OECD). Within this pattern of foreign-ownership, however, there is a particular concentration of Australian ownership: as at 30 September 2003, 66.1% of New Zealand banking system assets were Australian-owned. Since that time, the proportion of Australian ownership has increased, with the acquisition of the National Bank of New Zealand (NBNZ), which had 19.8% of banking assets at 30 September, and which was previously a subsidiary of the UK-owned Lloyds TSB, by the Australian owned ANZ Banking Group Limited.

As at 30 September 2003, seven out of eighteen registered banks in New Zealand were Australian owned, or were branches of their Australian parent banks. Each of the four major Australian banks was represented in New Zealand. The ANZ Banking Group Limited (ANZ) had a subsidiary, ANZ Banking Group (New Zealand) Limited, which we will refer to as ANZ (NZ). The Commonwealth Bank of Australia (CBA) had both a subsidiary, ASB Bank Limited (ASB), and a branch of the parent bank (CBA (NZ)), although almost all of the group's business in New Zealand is undertaken through ASB. The National Australia Bank (NAB) had a subsidiary, Bank of New Zealand (BNZ), while the Westpac Banking Corporation (Westpac) operated in New Zealand as a branch of the parent bank (Westpac NZ).¹ The other Australian banks in New Zealand were AMP Banking, which was in the process of closing down, having disposed of most of its assets, and newly established St George Bank New Zealand Limited.

Not only are these New Zealand banks Australian-owned, but they are also significantly, but to varying degrees, integrated into the operations of their parent banks in Australia. One would expect foreign owned banks to be subject to parent bank oversight for risk management purposes, but the extent of parent involvement in

¹ For some background to and history of the Australian major banks' involvement in the New Zealand market, refer to Tripe & Matthews (2003).

these New Zealand operations is generally much more extensive than that. The New Zealand banks derive significant funding from their Australian parents, and also depend on their Australian parents for support in a number of operational areas. We thus see two of the banks, ANZ (NZ) and BNZ, with their computer processing undertaken in Australia. In some cases, the New Zealand operations may be perceived as being little more than an operation in another Australian state, with staff at a variety of levels reporting into a senior manager in Australia rather than to a manager in New Zealand. There have thus been questions, particularly for the Reserve Bank of New Zealand in its attempt to exercise its supervisory roles, as to the extent to which the New Zealand banks could survive independently of their Australian parents.

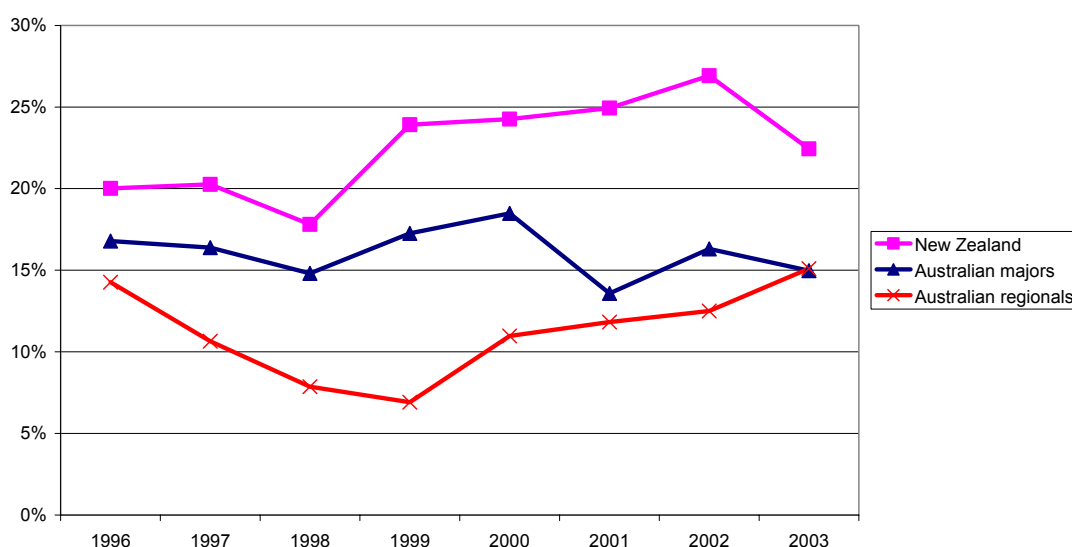
One of the areas in which such questions arise is in respect of the levels of capital maintained by the Australian banks in their New Zealand business. Although the New Zealand incorporated banks are required to adhere to New Zealand capital adequacy requirements in terms of the 1988 Basel Capital Accord, they don't always appear to hold relatively as much capital as their parent banks, nor do they necessarily seek to manage their book capital as efficiently as they might. After all, any capital held in New Zealand is still available to meet consolidated capital requirements for the Australian Prudential Regulatory Authority (APRA) at group level, and it is at group level that capital management is important for ensuring returns to shareholders.²

If one looks at the performance of the banks in New Zealand, they appear to be particularly profitable, more profitable than the operations of the banking group as a whole, although some of this may reflect things such as lower levels of capital being held in New Zealand, or implicit support, such as is reflected in the credit ratings of the New Zealand subsidiaries being the same as for their Australian parent banks. This is a relatively recent phenomenon: as Tripe & Matthews (2003) show, in the years up to 2000, there was not generally a major difference between the returns on assets earned by the Australian and New Zealand businesses. The intention of this research is to try and explore some of the reasons for the apparent differences between the performance of the New Zealand and Australian banks.

² As a branch, Westpac NZ is not required to hold any capital in New Zealand, although it has in practice, since around the beginning of 2000, been holding rather higher levels of equity relative to on-balance sheet assets than a number of its major bank rivals (in New Zealand).

We also seek to follow through on another issue identified by Tripe & Matthews (2003), which is the rather lower returns earned by the Australian regional banks relative to the four major banks (which are those with significant international business). The differences in the reported returns over the eight-year period 1996 to 2003 are highlighted in Figure 1.³

Figure 1: RELATIVE RETURNS ON EQUITY - AUSTRALIA AND NEW ZEALAND



Inclusion of the Australian regional banks also provides us with an enlarged cross-sectional data set, which substantially enhances the analysis we can undertake. Because of the extent of integration between the Australian and New Zealand economies, and between their banking systems in particular, we would expect there to be a fair degree of similarity in bank performance, and this paper looks to explore this issue through a study of the efficiency of the banks in question.

The rest of the paper is structured as follows. The next section looks at prior research on bank efficiency, to identify some of the key methodological issues that relate to this research, and justifies the basic method employed. Section 3 discusses the data that we use, and details the methodology. Section 4 reports the results obtained, while Section 5 provides a summary and conclusion.

³ New Zealand data do not include Westpac NZ because of its branch status (with no consequent requirement to hold capital), although its return on assets has generally been comparable with that of the other New Zealand banks studied. The set of Australian regional banks does not include Suncorp-Metway, noting that they are omitted from analysis elsewhere in this paper (for reasons explained in Section 3).

2 Previous relevant research

In general terms, a financial institution can be said to be efficient if it can produce more output without a corresponding relative increase in inputs, or if it can reduce its inputs without a corresponding relative decrease in output. Popular approaches to measurement of efficiency are inclined to focus on simple ratios, although ratios have a number of deficiencies, in that they don't take account of the differences in the business undertaken by different banks, which will in turn be reflected in different combinations of inputs and outputs. DeYoung (1998) suggests that blind pursuit of accounting-based benchmarks might reduce a bank's cost efficiency by cutting back on those expenditures necessary to run the bank properly. More generally, Berger et al (1993) note that financial ratios may be misleading because they do not control for product mix or input prices.

Although traditional perspectives on economic theory have tended to focus on economies of scale and scope, research on financial institutions has generally found these are not the main source of potential improvement in bank performance, with this deriving instead from X-efficiencies (Berger & Humphrey, 1991). X-efficiency (economic efficiency) relates to the way an institution does its business, and following the work of Farrell (1957) it is commonly subdivided into allocative and technical (productive) efficiency. As Siems & Barr (1998) describe it:

“Allocative efficiency is about doing the right things, productive efficiency is about doing things right, and economic efficiency is about doing the right things right” (p 13).

X-efficiencies are measured relative to an efficient frontier which defines the maximum levels of outputs that can be obtained with any specified usage of inputs, or the minimum levels of inputs that can be used to obtain a specified level of output. There are five approaches to determining the position of this efficient frontier, three of which are parametric and two of which are non-parametric. A major challenge for both sets of approaches is in distinguishing random error, arising from accounting practice or some other source, from inefficiency. Each of the parametric approaches

has different ways of dealing with random error, whereas the non-parametric approaches have generally ignored it.

This study uses Data Envelopment Analysis (DEA), a non-parametric technique originally developed by Charnes Cooper & Rhodes (1978). This was developed on a basis of constant returns to scale (referred to as CCR after the authors of the original article), but subsequently extended by Banker Charnes & Cooper (1984) into a model providing for variable returns to scale (referred to as BCC). DEA is a linear programming technique where the frontier is assembled on a piecewise basis from the best practice observations (which will then be classified as 100% efficient). It does not specify any functional form for the data, allowing this (reflected in the weights for the inputs and outputs) to be determined by the data.

Because DEA assesses efficiency by comparing a financial institution's efficiency with those of others, each inefficient financial institution will have a group of efficient institutions against which its performance is identified as inefficient. This group of efficient institutions is then described as being the reference set for that inefficient institution. This is a basis for arguing that DEA provides an operational approach to measurement of efficiency, in that it more directly identifies ways in which inefficiency can be reduced.

DEA has a number of strengths and weaknesses as a technique, but the most important advantage from our perspective is the issue of sample size. As Evanoff & Israilevich (1991) note, use of DEA allows one to work with less data, fewer assumptions and a smaller sample. A rule of thumb commonly used with DEA suggests that the number of observations in the data set should be at least three times the sum of the number of input and output variables (Cooper et al, 2000).⁴ That is not to say, however, that DEA will not generate better results with larger data sets, and Berger Leusner & Mingo (1997) identify a major problem with prior studies of bank branch efficiency as the small number of observations relative to the input, output and environmental variables. Where a sample is small, it is possible that a high proportion

⁴ There is an alternative expression by Dyson et al (2001), which says that the number of observations should be at least twice the product of the number of inputs and outputs. Avkiran (2002) suggests a further rule of thumb – that a sample is large enough if the number of fully efficient DMUs does not exceed one third of the sample.

of firms will be classed as efficient, some of which would not otherwise show as efficient if a larger sample were used.

Further support for use of DEA can be found from looking at previous studies of Australasian bank efficiency. Avkiran (1999a) and Liu & Tripe (2002) looked at the effects of mergers on bank efficiency, and both of these studies used DEA. Sathye (2001) used DEA in his study of the sources of inefficiency in Australian banks in 1996, while Tripe (2003) also used DEA in his exploration of the efficiency of New Zealand banks through time. Only one study has been reported which used a parametric approach to the specification of the efficient frontier (Walker, 1998) and that study noted a number of difficulties as a result of the relatively small sample size.

One way of relieving degrees of freedom constraints arising from small samples is to use panel data, either through the technique of window analysis (Yue, 1992; Lovell, 1993; Cooper et al, 2000), or by looking at the whole panel as a set of individual observations. These approaches also provide an alternative way (to the Malmquist Index) of measuring changes in efficiency through time. Bhattacharyya et al (1997) used a panel (which they described as a grand frontier) for their study of Indian banks, noting the advantage such an approach brings in terms of relieving degrees of freedom pressures and increasing the variation in calculated efficiencies.

DEA can be used to derive measures of scale efficiency by using the variable returns to scale, BCC model alongside the constant returns to scale, CCR model. Coelli et al (1998) note that variable returns to scale models have been most commonly used since the beginning of the 1990s. Caution must be exercised in use of variable returns to scale models, however, particularly where cross sections are small, and where there is diversity in size among the institutions being studied. As Dyson et al (2001) note, if a BCC model is used, small and large units will tend to be over-rated in the efficiency assessment. This means that scale inefficiencies identified for such institutions may be spurious, with the actual cause of inefficiency being X-inefficiency. If we are using a CCR model and find that a DMU is inefficient, it may be difficult to ascertain whether the source of that inefficiency is scale or X-inefficiency.

A DEA model can be constructed either to minimise inputs or to maximise outputs. An input orientation aims at reducing the input amounts as much as possible while keeping at least the present output levels, while an output orientation aims at maximising output levels without increasing use of inputs (Cooper et al, 2000). The focus on costs in banking means that input-oriented models are most commonly used

A challenge that applies in all studies of financial institution efficiency is identification of the inputs (to be minimised) and outputs (to be maximised). Previous research has discussed the production and intermediation approaches to modelling the banking firm. Under the production approach, banks are regarded as using labour and capital to produce deposits and loans, with both inputs and outputs typically measured as physical magnitudes, rather than in dollars. The intermediation approach sees deposits and other funds being transformed into loans (Sealey & Lindley, 1977), with its different versions including the asset approach, which uses funds as inputs and loans as outputs, the user cost approach, which looks at the various contributions to banks' net revenue, and the value added approach, where inputs and outputs are identified according to their share of value added (Berger & Humphrey, 1992).

In practice, the importance of the taxonomic distinctions may be overstated. One key factor determining what input and output variables are used will be what can be measured, and in most cases it is not possible to obtain data at a bank level for numbers of (deposit or loan) accounts or transactions processed. One may also want to take note of input and output variables used in previous research, and the impacts of the variables chosen on the results obtained.

A more important issue is one that is highlighted by Dyson et al (2001), particularly where using DEA, that the input/output set should cover the full range of resources used and outputs created, particularly if one really wants to assess a financial institution's efficiency at converting inputs to outputs. At the same time, the researcher will also want to be mindful of degrees of freedom constraints, and to avoid using these up by using input or output variables which don't contribute to the identification of bank efficiency. Common sense and expert judgement can play a role in this. It is important to include key resources as inputs and to include in outputs those objectives which are regarded as key to the DMU's success (Avkiran, 1999b).

This leads to the question of which banks should be included in an efficiency study. Because we are looking at relative efficiency, it is important that the banks should be sufficiently similar, so that comparisons are meaningful. This is particularly the case with DEA, where Dyson et al (2001) have developed what they describe as a series of homogeneity assumptions.

The first of these is that the units the performance of which is being compared should be undertaking similar activities and producing comparable products or services so that a common set of outputs can be defined. This might extend to a requirement to use common technologies, and also relates to the issue of whether or not a common frontier applies to all the firms whose performance is being compared (noting that this is a particular issue when comparing banks in different countries).

The second homogeneity assumption (and a closely related implicit third assumption) is that a similar range of resources is available to all the units, and they operate in a similar environment. If the environments are different, these might need to be specifically accounted for in the analysis.

These can be particular issues for cross-border studies, such as those reported in this paper. The difficulty with cross-country comparisons is that the regulatory and economic environments are likely to differ between countries, as will expectations regarding product offerings and customer service. These mean that it may not be valid to assume a common frontier for measurement of efficiency.

Berger et al (2000) further note the potential impact of differences in the intensity of competition between countries. This means that a finding of greater X-efficiency for banks in one country cannot be construed as meaning that banks from that country would be equally efficient were they to operate in some other country. Operation in a different country would in any case be likely to be under different conditions from those which might be experienced in a bank's home country.

Various attempts have been made to overcome some of these problems. A basic assumption has been that efficiency differences reflect differences in the technology

used in different countries. Chaffai et al (2001) and Lozano-Vivas et al (2002) have argued that earlier bank-level studies failed to properly take account of country-specific conditions or norms. Differences in efficiency scores might reflect differences in operating conditions.

In their study, Chaffai et al (2001) used separate frontiers for each country, but then looked at the differences between the frontiers applying to the four countries studied. Environmental differences were found to be greatly more important than technological differences, while German banks were the most efficient, followed by French and then Italian banks, with Spanish banks least efficient.

This study attempts to highlight some of the practical issues in trying to interpret these distinctions in the Australia and New Zealand environments. Details of the method and the data that we use are discussed in the next section.

3 Data and Method

Issues relating to the method used and data employed for this study have already been discussed in the previous section of this paper, and we are now required to justify that approach relative to the previous discussion. Thus, because of the relatively small number of banks with retail branch networks in the New Zealand and Australian markets, we use DEA, with an input-oriented model, to accord with the focus of many Australasian banks in trying to reduce costs.

Partly in response to the wide divergence in asset size among the banks included in the study, we used a constant returns to scale model, with the idea that we could later apply a variable returns to scale study if we wanted to look for scale effects. Our results showed, however, that we had both very small and very large banks on our efficient frontier, and it was therefore considered that attempts to look for scale effects might generate results that were not reliable or meaningful.⁵

⁵ Some of the Australian major banks sometimes showed scale inefficiency, while there were also suggestions of decreasing returns to scale in the BCC model used (for reasons of economy, results are not reported).

Six banks operating in New Zealand with extensive branch networks and a significant focus on retail banking were included in the study: ANZ, ASB, BNZ, NBNZ, TSB Bank Limited (TSB) and Westpac NZ. Although the government has recently established Kiwibank through New Zealand Post, its relatively short period of operation and its failure to yet earn consistent profits would make it unfair to include it in the study, despite its extensive branch network. Data for all of these banks have been obtained from their quarterly disclosure statements, although the study relies on annual financial results only. These banks together typically account for around 85% of the New Zealand banking market. Figures in New Zealand dollars were converted to Australian dollars at the average exchange rate for the period in question.⁶

The Australian banks included in the study are the four major banks – ANZ, CBA, NAB and Westpac – and five out of six of the so-called regional banks, each of which has a strong network presence in one or more states – Adelaide Bank (Adelaide), Bank of Queensland (BoQ), BankWest, Bendigo Bank (Bendigo), and St George Bank (St George). Financial statements are publicly available for each of these banks as they are listed companies.⁷ These 9 banks together typically account for around 80% of the assets of the Australian banking system.

It was initially envisaged that the Australian data set would also have included the sixth of the so-called regional banks, Suncorp-Metway, although that bank also has a significant general insurance business. Initial investigation, however, showed Suncorp-Metway as being greatly more efficient than any of its peers, which gave rise to serious questions as to whether it was sufficiently similar to justify inclusion in our analysis alongside the other Australian regional banks. A decision was made to remove it from the data set.

The study uses panel data covering an 8-year period from 1996 to 2003 (inclusive) for the 15 banks included. For New Zealand, this covers the period from the introduction of the disclosure regime in 1996, up to the point of the ANZ's acquisition of the

⁶ Exchange rate information has been obtained from the Reserve Bank of New Zealand's web-site at www.rbnz.govt.nz.

⁷ BankWest has now ceased being listed following its acquisition by its parent, HBOS, which previously held only a partial stake.

NBNZ in late 2003. Apart from some mergers, the time period covered has been a period of relative stability for both the Australian and New Zealand banking markets: the relevant Australian regional banks had all converted to bank status prior to the period of the study, while the major banks had also recovered from the worst effects of their loan losses in the early 1990s.

Although quarterly data has been available for New Zealand banks since the beginning of 1996, data for the Australian banks has been annual, and we have therefore limited ourselves to using banks' annual results. We do not believe that the diversity of balance dates has led to any significant distortion of results, and where, in the case of BankWest, accounting periods were for other than 12 months, figures have been adjusted.⁸

A major methodological issue was in selecting the inputs and outputs to be used in the efficiency models. One approach followed in other studies has been to look at the totality of inputs and outputs used by banks in their role as financial intermediaries, and thus to use interest and non-interest expense as inputs, and then to report net interest income and non-interest income as outputs. Such a model was used by Avkiran (1999a), although in his alternative model he used deposits and staff numbers as inputs and net loans (instead of net interest income) as outputs.

Tripe (2003) found problems with use of gross interest expense as an input variable in studies covering different time periods, with differences in financial institutions' interest costs inclined to reflect differences in the general level of interest rates, rather than differences in efficiency in raising deposits (or risk). We have therefore chosen to use total deposits (retail, wholesale and interbank, but not including subordinated debt or equity) as an input, with this item reflecting the funds being used in the intermediation process. Note also that this choice of total deposits has to some extent been forced on us by the differences in the way individual banks classify their interest-bearing liabilities.

⁸ One effect of this is that the results for BankWest described as being for 2002 and 2003 are actually for periods up to December 2001 and 2002 respectively.

Because of concerns over the differing levels of capital between Australia and New Zealand, which may reflect differences in banks' exposure to risk, but also because of the lack of any specific capital requirement for Westpac NZ, we have included capital as an input in the first of our models.

An alternative input to non-interest expense, used in a number of previous studies, has been staff numbers. There is some question as to the appropriateness of staff numbers as an input, however, because of the increased level of outsourcing being undertaken by the banks, which means that staff numbers may not reflect the supply of staff resources to the banks' activities. In any case, non-interest expense covers a broader range of inputs into banks' production/intermediation processes.

Another variable sometimes used is total loans, reflecting a bank's effectiveness in promoting financial intermediation. This takes no account of the returns being earned on those loans, however, and unless additional output variables are included to account for the remainder of the bank's assets, may provide a rather less than full accounting for the range of activities the bank undertakes.

The input and output variables used in the two models in this study are reported in Table 1.

Table 1: Inputs and outputs

	Model 1	Model 2
Inputs	Total deposits	Total deposits
	Non-interest expense	Non-interest expense
	Equity capital	
Outputs	Net interest income	Net interest income
	Non-interest income	Non-interest income

Tests of the correlations between the inputs and outputs show that the inputs have a relationship with the outputs, and can thus be justified as contributing towards them. On the other hand, neither the inputs themselves nor the outputs themselves are so highly correlated with each other that their simultaneous inclusion in the models is redundant.

The final methodological question was whether it was appropriate to apply a common frontier to these three groups of banks, operating in two different countries. Although all the banks in the study operate through significant branch networks, and although in the case of the Australian major banks we look at both their global operations and at the New Zealand business on a stand-alone basis, we cannot answer this question a priori. We need to examine the efficiency scores generated, particularly between the New Zealand and Australian banks, and see if there are differences in efficiency. It is much more likely that the two groups of Australian banks operate relative to a single frontier, and if there are significant differences in the scores generated, we can be more confident that these differences reflect efficiency differences.

4 Results and their interpretation

Average (mean) efficiency scores for the groups of banks, for Model 1, across the whole time period, are reported in Table 2.⁹

Table 2: Model 1 results (i.e. with capital as an input)

	Average efficiency scores
Australian regional banks	0.810
Australian major banks	0.929
New Zealand banks	0.922

Because the distribution of efficiency scores is censored at one, and because the distribution is not normal, testing for the significance of any apparent differences between the groups has to be undertaken using the non-parametric Mann-Whitney test (Cooper et al, 2000; Casu & Molyneux, 2003).

⁹ Individual bank results for each time period are available on request. Although the ability to produce detailed results is a strength of DEA, we have not provided these figures in this paper as we are not wishing to focus attention on the performance of individual banks. Looking at averages also reduces our potential exposure to random error, which is one of the identified weaknesses of DEA.

In the first place, we find a significant difference between the efficiency of the New Zealand banks and the Australian banks as a whole. Median scores are 0.940 compared to 0.874, and the difference is significant at 0.02%.

If we compare the New Zealand banks with just the Australian major banks, the efficiency differences are not found to be significant, although the median score for the New Zealand banks is marginally higher. There is, however, a significant difference between the efficiency scores for the Australian majors relative to the Australian regional banks: median scores are 0.925 compared with 0.791, with the difference significant at 0.00%.

The high degree of similarity between the efficiency scores of the New Zealand banks and the Australian major banks (who are in most cases their owners) would seem to be supportive of arguments that there was a measure of integration between the Australian and New Zealand banking systems. It could be, however, that the similarities in efficacy are largely co-incidental, and that the two groups of banks were at quite different points on the efficient frontier. To explore this point further, we therefore need to look at the reference sets for the inefficient banks in both groups, and see the extent to which New Zealand banks have Australian majors in their reference sets, and vice versa. Table 3 reports the numbers of times banks from each country appear in the references sets of the New Zealand and Australian major banks.

Table 3: Frequency with which types of banks appear in reference sets.

	Australian banks	New Zealand banks
Australian major banks	63	36
New Zealand banks	27	93

Although the other country's banks appear a considerable number of times in individual banks' reference sets, we are unable to accept a hypothesis that there are no country-specific concentrations in the reference sets (χ^2 statistic is 37.9, which is significant at 0.0%). Even though the proportion of New Zealand banks in the reference sets of NBNZ and TSB (which were not part of the major Australian

banking groups) is greater than for the New Zealand banks as a whole, if we remove these banks from the analysis, the χ^2 statistic remains highly significant.

Average (mean) scores for the groups of banks, for Model 2, across the whole time period, are reported in Table 4.¹⁰

Table 4: Model 2 results (i.e. without capital as an input)

	Average efficiency scores
Australian regional banks	0.776
Australian major banks	0.921
New Zealand banks	0.881

Note that there now appears to be a greater degree of difference in relative efficiency between the New Zealand and Australian major banks. When we use the Mann-Whitney test for differences in efficiency between the groups, we find that the New Zealand banks as a whole are more efficient than the Australian ones (median of .898 compared to .859, with the difference significant at the 5% level). The difference in efficiency between the Australian majors and the Australian regionals remains highly significant (medians of .908 and .761, with the difference significant at 0.00%). For the New Zealand banks and the Australian majors, the median scores are .908 and .898 respectively, with the difference significant at the 10% level (p-value .0777).

This can be interpreted as meaning that, if we make no allowance for differences in the amount of capital employed, the Australian major banks are more efficient than those in New Zealand: once we allow for differences in the employment of capital, there is no measurable difference in efficiency. Moreover, these results have been obtained with a data-set that includes both NBNZ and TSB in the New Zealand banks, and those banks have tended to hold relatively higher levels of equity than their Australian-owned counterparts. We have therefore re-run the Mann-Whitney test, comparing only the four New Zealand banks owned by the Australian majors with their parent banks. Median scores are reported in Table 5.

¹⁰ The lower levels of average efficiency scores are likely to be a result of the reduction in the number of inputs and outputs, from 5 to 4, compared with model 1.

Table 5: Median efficiency scores for Australian majors and their New Zealand operations.

	Median score from Model 1	Median score from Model 2
Australian major banks	.925	.908
New Zealand banks owned by Australian majors	.929	.868

The difference between the two groups, from the model (Model 2) without equity is now significant at the 1% level. The Model 1 results were, in effect, adjusted for the differences in utilisation of equity, and it is thus apparent that differences in utilisation of equity between the Australian majors and the New Zealand banks are significant.

5 Summary and Conclusion

This paper has noted the strong links between the New Zealand banking system and the Australian major banks, arising primarily through ownership. Although the New Zealand banks with branch networks are more efficient than the Australian banks with branch networks, this appears to be largely a consequence of the relative inefficiency of the Australian regional banks. If we compare the performance of the New Zealand banks with the Australian majors, provided we take account of the differences in the level of equity, no significant difference in efficiency is found.

A problem in making cross-country comparisons of bank efficiency, however, is in knowing whether a common efficient frontier applies across the different countries, or whether there are environmental factors which provide relative advantages or disadvantages to banks from particular countries. It may therefore be that the relative inefficiency of the Australian banks is a consequence of some environmental disadvantage in terms of regulation, competitive conditions, or some other factor. This analysis cannot answer that question, although it does encourage us to think about it, and may lead to the identification of further factors which might allow for a more extensive analysis.

We have attempted another approach to proving the existence of a common frontier by looking at the inefficient banks' reference sets. This failed to confirm the existence

of a common frontier, although there may be other approaches to this question which might lead to different answers. At this stage, despite the degree of integration between the New Zealand and Australian banking markets, we have to suspect that there is still a degree of difference between them.

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