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Jan-Egbert Sturm* and Barry Williams**

Characteristics determining the efficiency of foreign banks in Australia

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* KOF Swiss Economic Institute, ETH Zurich, Switzerland and CESifo, Munich, Germany and External Research Associate, Globalisation and Development Centre.

** Globalisation and Development Centre, Bond University, Gold Coast, Queensland, Australia.

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Abstract.

The factors determining foreign bank efficiency are investigated using a three stage research method. It is found that host market incumbency reduces efficiency of foreign banks in Australia, resulting in over use of inputs. Factors underlying the limited global advantage hypothesis of Berger*, et al.* (2000) are identified, in that nationality specific factors represented by dummy variables are not significant once other relevant effects are controlled for. Parent profitability is not found to result in increased host nation efficiency, while parent credit rating effects are mixed. Some evidence is presented that banks from more financially sophisticated nations are more efficient. The implications of these results are explored from the perspectives of bank management and bank regulators.

Key words: Foreign bank efficiency, distance functions, factor analysis
JEL code: G15, G21, C15, C52

[#] Corresponding author: Barry Williams, Globalisation and Development Centre, Bond University, Gold Coast, Queensland, Australia. bwilliam@bond.edu.au; Tel. +61 7 5595 2259; Fax + 61 7 5595 1160.

1. Introduction.

Factors determining the efficiency of foreign banks in the host nation is an area that has received relatively little attention to date. This paper responds to (and extends) the current research literature by considering both country-level and firm-level characteristics of multinational banks that determine differences in multinational bank efficiency in the host nation. One contribution of this paper is to add a new dimension to this area of research. The current work will extend this literature in two dimensions; (i) by considering firm-level as well as country-level characteristics, and (ii) by considering the efficiency of multinational banks. This research will have the further advantage of providing a test of the limited global advantage hypothesis of Berger*, et al.* (2000). The limited global advantage hypothesis argues that banks from some nations are able to overcome the diseconomies of cross-border operations due to various unspecified advantages. By responding to (and enlarging) the theoretical framework provided by a recent cross border merger study of Berger*, et al.* (2004) within the context of the limited global advantage hypothesis, this paper will identify at least some of the sources of these unspecified advantages within the context of multinational bank efficiency. Thus this study will also determine if those national specific effects remain after other nationality, parent and host nation effects are controlled for.

The stylised facts relating to cross-border banking commonly concludes that in developed nations foreign banks generally under-perform their domestic counterparts, with the opposite occurring in developing nations (Berger*, et al.*, 2000). Further, Berger*, et al.* (2000) find that banks from some developed nations (particularly the United States) tend to perform well in developed host nations, even when benchmarked against host nation domestic banks. An exception to this body of research is provided in the Australian case by Sturm and Williams (2004), who found foreign banks to be more efficient, on average, than domestic banks. Thus the Australian environment provides an interesting location for further investigation of multinational bank performance. This is particularly important given the importance of multinational banks in a globalised financial marketplace, yet by contrast, the relatively limited evidence regarding factors determining foreign bank performance in the host market. As far as these authors are aware, to date, there is no published evidence addressing this question from the perspective of foreign bank efficiency.

An important feature of this study is that efficiency estimates of foreign banks will be drawn from efficiency estimates from a larger bank population that includes both domestic and foreign banks. In this way any negative impact of the liability of foreignness will be controlled for (Miller and Parkhe, 2002). As argued by Miller and Parkhe (2002), foreign firms face a number of potential competitive disadvantages in the host nation due to information asymmetries, cultural and language differences and other factors.[1] In order to operate successfully across borders the foreign bank must possess compensating advantages. Under the limited global advantage approach these advantages are unspecified but related to nationality. This paper will provide a more in depth analysis of this issue than has been previously offered.

The framework to model foreign bank efficiency will be based upon the work of Buch (2003), Berger*, et al.* (2004) and Williams (2003). By applying bank-level data to estimate bank efficiency as well as to estimate the impact of parent bank-level effects, this paper provides further insights to the country-level approaches of Buch (2003) and Berger*, et al.* (2004), both of whom considered bank mergers across borders rather than bank efficiency from a country-level perspective.

It is found that increased domestic market incumbency reduces the efficiency of foreign banks in the host market, requiring foreign banks to over use inputs to produce outputs. Further, once home nation, host nation and parent bank effects are controlled for, the nationality specific effects represented by dummy variables become generally insignificant. This represents a step beyond the limited global advantage hypothesis as it provides evidence as to the factors underlying the nationality specific effects represented by this hypothesis. This study also finds that some parent bank attributes that would have been expected a priori to increase host nation efficiency actually have opposite effects. This is particularly the case for parent profitability, with the results for parent credit rating being mixed and depending upon the specification of inputs and outputs. Some evidence is presented to support the hypothesis that banks from more financially sophisticated nations (as measured by home nation GDP per capita) are able to operate more efficiently in the host nation, particularly when a production based approach to bank efficiency is adopted.

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[1] Berger, *et al*. (2004), page 334 also discusses the liability of foreignness and the resulting diseconomies of foreign operations.

The rest of this paper is structured as follows; the next section provides a review of the relevant literature. The third section will detail the method that will be used to address the research question posed by this paper. The fourth section discusses the nature of the sample that will be employed. The fifth section will present the results; while the final section will provide a conclusion and suggests directions for further research endeavour.

2. Literature Review.

This paper will consider the efficiency of foreign banks in Australian within the context offered by comparative advantage theory. The traditional approach to modelling multinational banks is based upon Ricardian comparative advantage theory. In this approach the multinational bank seeks to exploit its comparative advantage and minimise its opportunity costs. Recent examples of this framework within the context of multinational banking are offered by Williams (2003) and Kosmidou, et al. (2006). Within the structure offered by comparative advantage theory, multinational banks can be considered to be subject to home nation effects, parent bank effects and host nation effects, each providing a mix of advantages, opportunity costs and barriers to entry.

Home Nation Effects.

In multinational banking the hypothesis that banks follow their client's abroad (defensive expansion) is a traditional approach. This is usually tested by the use of a vector of measures that represent the host nation's trading and investment relationship with the home nation. As surveyed by Williams (2002) this hypothesis is usually supported for bank size studies but results for the impact of defensive expansion upon bank profits are less unambiguous. Defensive expansion relationships are most appropriately measured using direct investment relationships, as these are more likely to result in the multinational bank requiring a physical presence to defend its bank-client relationship. It is this defence of the bank-client relationship that forms the core of the defensive expansion hypothesis.

Export of financial practices and financial sophistication is also argued as a rationale for multinational banking. It is argued that those nations from more developed and sophisticated financial systems are more likely to be able to export efficient financial practices and so overcome the negative impact of the liability of foreignness. Nations

with higher levels of GDP per capita are more likely to possess sophisticated and efficient financial systems, so GDP per capita is the usual measure of this home nation effect. Buch and DeLong (2004) and Berger*, et al.* (2004) found that banks from nations with higher levels of GDP per capita are more likely to acquire banks in other nations, which was presumed by Buch and DeLong (2004) to be due to their higher levels of efficiency.

Parent Bank Effects.

As compared to Williams (2003), Buch (2003) and Berger*, et al.* (2004) did not employ bank-level data, instead confining their study to macroeconomic data. While parent profits were not found by Williams (2003) to impact upon host nation profits, Focarelli and Pozzolo (2001, p 2326) argued that parent profit offers a readily available measure of parent efficiency. Thus, if a bank operates in the home market more efficiently than other banks, this efficiency provides a potential source of comparative advantage when expanding offshore. Overall, it is possible that parent profitability does not translate into host market profitability, but does impact upon host market efficiency.

It is often argued that in multinational banking, size is an important variable (Hirtle, 1991), with parent size found to determine host nation size (Cho, 1985; Ursacki and Vertinsky, 1992). Further, Tschoegl (2004) suggested that the largest bank in each nation is the most likely candidate for successful offshore expansion. It would be therefore expected that banks with larger parents are more likely to be efficient in the host nations than smaller banks.

Experience of operating internationally is another possible parent characteristic that enables a multinational bank to succeed in the host nation. Tschoegl (1982) considered that this experience can have two dimensions; (i) general experience of international operations and (ii) experience of operating in a particular host nation. Experience measures of the first type have been found to be highly correlated with size measures (Cho, 1985), while Williams (1998a; 1998b) found no support for host nation experience effects for either size or profits of foreign banks in Australia. Again, however, it is possible that host nation experience impacts upon efficiency in the host nation, but not upon size or profits.

Host Nation Effects.

Barriers to entry act to reduce the benefits of firm-specific and nation-specific comparative advantages. As this study focuses upon a single nation, many of the country-specific variables used by Berger*, et al.* (2004) are a constant for each year. To alleviate statistical and interpretive problems associated with this issue, Williams (2003) applied a competitor market share variable. This measures the degree of competition confronting a foreign bank in the host market; considering the market share of the four dominant banks in Australia, plus the market share of all other banks of the same nationality. This measure reflects the degree of competition from the major Australian banks, plus the additional competition from other banks of the same nationality seeking to establish a beachhead in the host nation, (Fieleke, 1977), via defensive expansion to follow their national client base. Williams (2003) found that foreign bank profits in Australia were reduced by the impact of this competitor market share. This result may not necessarily apply for efficiency, as this level of competition may engender increased efficiency while depressing profits. Foreign banks in Australia are disproportionately active in wholesale banking, which is a price competitive sector of the banking market with an emphasis upon efficiency. Thus, the barrier to entry represented by this measure may reduce profits while increasing efficiency.

3. Method.

This paper employs a three-step research design. In the first step foreign bank efficiency is estimated from a sample panel of data that includes both domestic and foreign banks in Australia between 1988 and 2001. Bank efficiency will be estimated using parametric distance functions (Coelli and Perelman, 2000), applying both the intermediation approach and production approach to banking, as outlined below. In the second step principal component analysis is used to generate a series of variables which represent the main hypotheses in multinational banking for which a number of empirical counterparts are possible. In this way these variables represent the main underlying proposition and also reduce potential empirical difficulties associated with multicollinearity between the alternative measures of these propositions. In this step the variables employed are endogenous to those used in the first step. In the third step the estimates of foreign bank efficiency drawn from the first step are used as dependent variables, while the representative factors estimated in the second step and other appropriate variables are used as independent variables in unbalanced panel regressions.

Step 1: Bank Efficiency Estimation.

Unfortunately, the data we were able to collect which represent bank activities in Australia during 1988 and 2001 contains neither input nor output prices. Hence, techniques based on cost or profit functions are not applicable. As a result we will use parametric input distance functions as described by Coelli and Perelman (1999). This approach applies maximum likelihood estimation of a translog function using multiple outputs and inputs to achieve an index of relative efficiency. Such an approach allows for the multiple inputs and outputs nature of banking and has the additional advantage of allowing different specifications of inputs and outputs. In that way, it will be possible to carry out some sensitivity analysis. We will include a time trend in the efficiency estimation to allow for the impact of changing technology and other time-dependent circumstances.

To be somewhat more precise, we follow Coelli and Perelman (1999) and define a production technology of the bank which satisfies the axioms listed in Fare and Primont (1995). From there, we define the input-distance function as

$$D(x,y) = \max\left\{\theta : (x/\theta) \in L(y)\right\}. \tag{1}$$

Here the input set, $L(y)$, represents the set of all inputs, $x \in R_+^K$, which can produce the output vector, $y \in R_+^M$. The input distance function, $D(x,y)$, is non-decreasing, positively linearly homogeneous and concave in x, and decreasing in y. It will take a value which is greater than or equal to one if the input vector, x, is an element of the feasible input set, $L(y)$. That is, $D(x,y) \geq 1$ if $x \in L(y)$. Furthermore, the distance function will take a value of unity if x is located on the inner boundary of the input set.

We use a second-order translog approximation of the input distance function which for the case of M outputs and K inputs is specified as

$$\begin{aligned} \ln D = {} & \alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_m + \frac{1}{2}\sum_{m=1}^{M}\sum_{n=1}^{M} \alpha_{mn} \ln y_m \ln y_n \\ & + \sum_{k=1}^{K} \beta_k \ln x_k + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \beta_{kl} \ln x_k \ln x_l \\ & + \sum_{k=1}^{K}\sum_{m=1}^{M} \delta_{km} \ln x_k \ln y_m \end{aligned} \tag{2}$$

Symmetry implies $\alpha_{mn} = \alpha_{nm}$ and $\beta_{kl} = \beta_{lk}$. The restrictions required for homogeneity of degree $+1$ in inputs are[2]

$$(3) \qquad \sum_{k=1}^{K} \beta_k = 1; \sum_{l=1}^{K} \beta_{kl} = 0, k = 1,...,K; \sum_{k=1}^{K} \delta_{km} = 0, m = 1,...,M.$$

Lovell at al. (1994) use these homogeneity restrictions to transform the above equation into a form that can be estimated using maximum likelihood. For that, we arbitrarily choose one of the inputs, such as the K^{th} input, and set $\omega = 1/x_K$. We obtain $D(x/x_M,y) = D(x,y)/x_K$. For the translog form and by noting that $\ln(D/x_K) = \ln(D) - \ln(x_K)$ this provides

$$\begin{aligned} (4) \qquad & \ln(x_K) = -\alpha_0 - \sum_{m=1}^{M} \alpha_m \ln y_m - \frac{1}{2} \sum_{m=1}^{M} \sum_{n=1}^{M} \alpha_{mn} \ln y_m \ln y_n \\ & - \sum_{k=1}^{K-1} \beta_k \ln x_k^* + \frac{1}{2} \sum_{k=1}^{K-1} \sum_{l=1}^{K-1} \beta_{kl} \ln x_k^* \ln x_l^* \\ & - \sum_{k=1}^{K-1} \sum_{m=1}^{M} \delta_{km} \ln x_k^* \ln y_m + \ln(D), \end{aligned}$$

where $x_k^* = x_k/x_K$ and the same symmetry and homogeneity restrictions apply as before. In the empirical implementation, we follow Battese and Coelli (1995) and add a random disturbance term which are assumed to be normally and independently distributed. The technical inefficiency term, ln(D), is assumed to be independently distributed as truncations at zero of the $N(m_{it}, \sigma_U^2)$ distribution, where we allow m_i to contain a trend. The log-likelihood function of this model is presented in the appendix of Battese and Coelli (1993). We use FRONTIER (Version 4.1) to produce maximum likelihood estimates and derive the implied technical efficiency measures.

Efficiency of banks in Australia will be modelled using both the intermediation and production approaches. From this sample of efficiency estimates the efficiency estimates of the foreign banks in Australian will be drawn. In the intermediation approach a bank is viewed as using inputs such as deposits, staff and equity to produce outputs such as loans and off-balance sheet items. This approach is commonly used in modelling bank efficiency (Berger and Humphrey, 1992; Berger and Mester, 1997). As efficiency estimation can be sensitive to input and output specification (Berger*, et al.*, 1993), several different combinations of inputs and outputs will be applied to the

[2] Homogeneity in inputs implies that $D(\omega x,y) = \omega D(x,y)$, for any $\omega>0$.

available data. In the base line approach, following Allen and Rai (1996), banks will be considered to use equity, employees and deposits to produce loans and off-balance sheet items (Model 1). Extending this approach, outputs will be expanded into housing loans and other loans (Model 1a) and in Model 1b outputs will include wholesale activity.

A revenue based model of inputs and outputs will also be estimated, following Avkiran (1999; and 2000) and Sturm and Williams (2004); inputs will be considered to be interest expenses and non-interest expenses, while outputs will be considered net interest income and non-interest income (Model 2). This specification of inputs and outputs can be considered closer in spirit to profit efficiency (given the data limitations outlined above) while Model 1 and its variations can be considered closer in spirit to cost efficiency. As discussed by Berger and Humphrey (1997) and Maudos*, et al.* (2002) the correlations between cost and profit efficiency estimates can be low.

In addition to the main models based upon the intermediation approach as discussed above, an additional measure of bank efficiency will be estimated based upon the production approach to bank efficiency. In the production approach a bank is viewed as providing financial services such as deposit and loans. Such an approach is best modelled using transaction flow data, which is rarely available. Thus it is usual to consider the stock of deposits and loans as outputs and proceed accordingly (Berger and Humphrey, 1997, p 197). Thus Model 3 will be based upon Model 1, with deposit specified as an output rather than an input. This additional approach allows us to test the robustness of our results.
Table 1 summarizes the five different models we use to estimate technical inefficiency.

INSERT Table 1 ABOUT HERE.

Step 2: Principal Component Analysis.

Given the theory discussed above, there are a number of potential variables that measure some of these theoretical constructs, in particular defensive expansion (following clients), parent size and parent profitability. Principal component analysis will be applied to determine the common characteristics of these variables and to obtain a few uncorrelated variables that are linear combinations of the original variables. This approach will have the advantages of reducing the number of possible variables to a few key measures, of reducing the problems associated with multicollinearity in the third

stage of this study, and (hopefully) ensuring that any complex interrelationships are reduced to a few variables representing the fundamental effects of concern. In each case the principal components analysis extracted one factor only, illustrating that the alternative empirical variables indeed represent the same underlying theoretical proposition. Hence, we are in a position to employ the first extracted factor as the variable for the third stage model estimation.

Step 3: Model Estimation.

In step three the estimated factors from step two will be used as independent variables, together with other independent variables representing those theories for which a single empirical measure was available or possible, as well as control variables. The efficiency estimates from step one will be employed as dependent variables in unbalanced pooled regressions. Because the efficiency estimates from step one are estimated from a sample that includes both domestic and foreign banks, the potential diseconomies resulting from the liability of foreignness will be controlled for. In order to achieve a parsimonious model specification, general-to-specific modelling (Hendry, 1995) will also be employed.

4. Data.

The sample for the first stage of this study will be drawn from banks operating in Australia between 1988 and 2001. Following Sturm and Williams (2004) these banks will be classified as Big Four (the dominant four banks in Australia), Other Domestic (mainly regional banks) and Foreign Banks. The data will be sourced mainly from the bank's individual annual reports, with some additional details, such as housing loans, obtained from the Reserve Bank of Australia (RBA) *Bulletin* and the website of the Australian Prudential Regulation Authority (APRA). Table 2 gives an overview of the years and the number of banks included in our sample used to estimate the technical efficiency scores.[3]

INSERT Table 2 ABOUT HERE.

Data for the analysis in the second stage was obtained from a number of different sources. Details regarding parent banks were obtained from Moody's *Credit Opinions:*

[3] Further descriptive statistics of this data are available from the authors on request.

Financial Institutions. Trade and investment stocks and flows from the parent bank's home nations were obtained from Australian Bureau Statistics publications. Parent nation data was obtained from the International Financial Statistics of the International Monetary Fund (IMF).

Several measures of home nation comparative advantage are possible. These include trade measures and investment measures. Following the defensive expansion approach to multinational banking, several measures of following clients will be employed. The first measure will be home nation investment income, measured according to the IMF's Balance of Payments convention, in that flows from Australia to the home nations will be measured as an outflow, with a negative value. Additional measures of defensive expansion effects will be home nation capital flow into Australia, and home nation capital stock in Australia, both in the relevant calendar year in billions of Australian dollars. In each case the investment measures will reflect direct investment rather than portfolio investment, reflecting the argument of Williams (2002) that direct investment is more likely to result in a need for a physical presence to satisfy the requirements of defensive expansion. These measures will be combined to provide a single measure of defensive expansion via the extraction of the first factor estimated in principal components analysis.

An alternative measure of defensive expansion effects will be total home nation trade (exports plus imports) as a share of Australian GDP. Following the arguments of Williams (2002), trade effects will be considered separately from investment effects and so will not be included in the principal components analysis for investment driven following clients.

As a last measure of home nation comparative advantage, the arguments of Buch and DeLong (2004) and Berger*, et al.* (2004) will be applied, in that nations with higher GDP per capita are more likely to have efficient domestic financial systems and so are able to export efficient financial practices into the host nation.

Measures of parent bank comparative advantage encompass parent profitability, parent size and parent experience. Measures of this type were not used by Buch and DeLong (2004) and Berger*, et al.* (2004). Two measures of parent profits in the home nation will

be used: parent Return on Assets and parent Net Interest Margin. These will again be combined into a single variable via principal components analysis. With parent bank size found to have an important role in multinational banking (Cho, 1985; Ursacki and Vertinsky, 1992), two measures of parent size will be used, log of parent assets and log of parent capital. In each case the foreign currency values will be converted into Australian dollars using the average of the relevant year's exchange rate, and single principal components analysis based variable will again be applied. A further parent bank advantage may be its experience of operating in the host nation (Tschoegl, 1982). A dummy variable representing pre-deregulation (pre-1985) transactions will be used to represent this experience effect.[4]

As a measure of host nation effects, this study will consider the barriers to entry confronting foreign banks in Australia. In this case these barriers to entry will be measured as competitor market share. As with Williams (2003), this will be specified as the market share of the Big Four banks, which dominate the Australian banking system, plus the market share of all other banks of the same nationality.

Some control variables will also be included to ensure that there are no nation- or firm-specific effects excluded from our consideration. It is possible that a combination of parent characteristics that are represented by its credit rating impact upon efficiency in the host nation. Thus a measure of parent credit rating will be included. This will be applied as three dummy variables. The first dummy variable will represent banks that have parents with high credit ratings of AAA to A1, the second dummy variable will represent those banks with parent credit ratings of A2 or A3. The final dummy variable represents the lowest credit ratings in the sample, of B1, B2 or B3. This set of dummy variables encompasses all parent credit ratings in the study sample.

5. Results.

Theoretically, our efficiency scores derived from step 1 range from 0 to 1, with 1 representing full efficiency. As reported by Table 3, the average estimated efficiency lies roughly between 70 and 90 per cent which is consistent with previous Australian

[4] As an alternative we have also considered the number of years since the first transaction based activity in Australia. The qualitative results are not affected by this.

studies.[5] As can be seen by especially comparing Model 2 with the other models, efficiency scores crucially depend upon the model specification. Furthermore, differences with other studies are also likely to be due to differences in estimation technique and increases in sample size.

As shown by Table 3, foreign banks are on average less efficient than the domestic incumbents, also consistent with previous global studies. This difference is only significant for Models 1 and 3.[6] Reflecting the relatively high variability within the group of foreign banks, both the most and least efficient banks are foreign in each model. Consistent with Sturm and Williams (2004) the correlations between efficiency scores derived from Models 1, 1a, 1b and 3 are quite high, and the correlations with Model 2 are even negative. This is not affected by whether we take all banks active in Australia (domestic and foreign) or focus upon the foreign banks only.

INSERT Table 3 ABOUT HERE.

The limited global advantage hypothesis posits that some (unspecified) national characteristics allow banks from certain nations to overcome the diseconomies of operating away from their home nation. Table 4 provides results of tests for nationality effects in the efficiency of the sample of foreign banks employed in this study. An F-test for nationality differences is supported in all cases except Model 2. It is found that banks from the United Kingdom are significantly more efficient than the average foreign bank for all models, except Model 2. Conversely, banks from the United States and Switzerland are significantly less efficient than the average foreign bank, except for Model 2. There is some evidence, but less conclusive across models, that Japanese and German banks are more efficient than the average foreign bank. Overall, the evidence strongly supports, at least initially, the presence of nationality effects in foreign bank efficiency.

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[5] See for example Kirkwood and Nahm (2006), Sturm and Williams (2004), Neal (2004), Sathye (2001) and Avkiran (1999).

[6] This outcome differs from that of Sturm and Williams (2004), this difference is most likely due to the difference in estimation technique, with Sturm and Williams (2004) applying non-parametric Data Envelopment Analysis (DEA). The outcome for this paper is also consistent with the main results of other studies of foreign bank efficiency in developed nations, with foreign banks generally to be found to be less efficient than domestic banks (Berger, 2007).

INSERT Table 4 ABOUT HERE.

Table 5 gives an overview of the variables we use to explain the differences in technical efficiency amongst the foreign banks. As discussed above, theory suggests a number of possible variables to reflect defensive expansion, with similar issues for parent profits and parent size. Table 5 shows that in all three cases the correlation between the first extracted factors (as indicated by principle components analysis) and the underlying individual variables is very high. It should be noted that in each case one factor only was extracted by principle component analysis.

INSERT Table 5 ABOUT HERE.

The correlation coefficients between the explanatory variables are shown in Table 6. Only in the cases of home investment, home trade and home GDP per capita do the correlation coefficients exceed 0.5. Hence, we do not expect severe multicollinearity problems in our analysis, which will facilitate interpretation. The explanatory variables are also not very strongly correlated with either of our technical efficiency measures. Only the competitor market share and our dummy measuring whether operations already started before 1985 are consistently and significantly correlated to technical efficiency in Models 1, 1a, 1b and 3. For Model 2 only low parent credit ratings appear to be correlated with technical efficiency.

INSERT Table 6 ABOUT HERE.

To alleviate the interpretation of the estimated coefficients in the subsequent regression tables, all explanatory variables except for the dummy variables and the trend variables have been normalised before estimation. Furthermore, the panel regressions include bank-specific random effects. Hausman tests do not allow us to reject the null hypothesis that a bank-specific fixed effects model is to be preferred over the chosen random effects version. In each set of analysis all nationality dummy variables are included. Furthermore, a time trend is included in each regression. The results for these variables are shown in the upper half of each of the results tables. The F-statistic tests for the presence of significant nationality effects, while the nationality dummy variables

report the country-specific difference (and its significance) from the overall foreign bank sample.

Despite the use of principle component analysis to reduce the number of available variables to a parsimonious set, there remains a large number of possible combinations of variables supported by the underlying theories. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Columns (8) include all possible available variables at once and the final columns show the results of the general to specific modelling.

INSERT Table 7, Table 8 and Table 9 ABOUT HERE.

What is immediately apparent is that once the additional country-specific and nation-specific variables are added to the model, the majority of the previous nationality effects become insignificant. Only in the cases of Models 1 and 1b do the F-statistics find significant nationality effects. In each case these nationality effects are driven by the significantly below average efficiency of the banks from the United States. Thus, overall, once controlling for additional variables, this study finds no evidence to support the limited global advantage hypothesis.

It is found that the barrier to entry resulting from higher competitor market share results in lower foreign bank efficiency. This outcome is consistent with the profits results of Williams (2003). Thus, the increased dominance of the Australian market by the incumbent banks results in the foreign entrants increasing expenditure on inputs to produce the same level of outputs, resulting in lower profits and efficiency. There is also evidence (particularly in the case of Model 1b) that banks with lower credit ratings tend to be slightly more efficient. The wholesale model (Model 1b) also finds that the attribute of having a more profitable parent results in slightly lower efficiency on average, which is opposite to prior expectations. This indicates that profitable parent banks are not necessarily able to export the attributes that generate this profitability to new host nations. Overall, it is found that there is no evidence of significant time effects in efficiency estimates, with the time trend uniformly insignificant in each of the general

to specific reduced form regressions for all specifications of inputs and outputs (column 2).[7]

INSERT Table 10 ABOUT HERE.

The Model 2 results reveal some different dimensions to the process that determines foreign bank efficiency in Australia. Model 2 measures the efficiency of the foreign bank in transforming the costs expended on inputs into revenue, which is a different dimension of bank efficiency as compared to Model 1. This is closer in spirit to profit efficiency, while Model 1 and its variations are closer in spirit to cost efficiency. As discussed by Berger and Humphrey (1997) correlations between estimates of cost and profit efficiency can be low, with similar results found by Maudos, *et al*. (2002). As further discussed by Berger and Mester (1997) it is possible that banks with lower cost efficiency have offsetting higher revenue efficiency, or, alternatively that these differences reflect unmeasured differences in quality of outputs. This study has applied different specifications of firm output to control for this possibility, within the limitations imposed by data availability.

What is interesting about the results for Model 2 is the different result for the parent credit rating dummy variables. The parent bank credit rating results indicate that those banks with lower credit ratings (B1, B2 or B3), tend to be less efficient in profit creation efficiency. This outcome indicates the value at the margin of credit ratings in informing bank management about the value of the foreign direct investment decision in multinational banking, at least in terms of profit creation potential. Unlike Model 1 and its variations, competitor market share has no impact upon profit creation efficiency.

INSERT Table 11 ABOUT HERE.

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[7] In order to ensure that this result was not driven by changing sample size effects, we re-estimated all models after first removing all banks with less than three observations, with no significant impact upon the overall results. This approach was adopted following evidence from the bank merger literature such as Houston*, et al.* (2001), Rhoades (1998), Focarelli and Panetta (2003) and Focarelli and Pozzolo (2005), which found that it takes 2-3 years for merger benefits to be realised. Thus excluding banks with fewer observations we remove the impact of any start up effects. These results are available from the authors on request. We are grateful to an anonymous referee for his or her helpful suggestions in this area.

Model 3 adopts a different perspective to the bank production process, viewing banks as purveyors of financial products that add value for both borrowers and lenders. The negative impact of competitor market share is again confirmed, similar to Model 1 and its variations. In the same vein as Model 1b, the negative impact of parent profitability is also confirmed. In addition to these outcomes, a positive impact for home GDP per capita is found, indicating in the case of a value added perspective, that home nation financial sophistication is an important attribute in improving bank efficiency.

6. Conclusion.

This study has two main results. First, nationality effects as represented by dummy variables largely become insignificant once nation and firm specific variables are introduced into our model. Thus, no evidence was found to support the limited global advantage hypothesis of Berger*, et al.* (2000). Thus, the approach adopted in this study provides a mechanism to identify those factors underlying the previously unspecified nationality specific influences. Second, increased domestic market incumbency reduces the efficiency of foreign banks in the host market. This results in over use of inputs to produce outputs, and, as shown by Williams (2003), subsequently leads to lower profits.

Modification of the specification of inputs and outputs reveals some additional information to this second main result. It was found that credit ratings have mixed effects upon bank efficiency, depending upon input and output specification. Further, the attribute of being owned by a profitable parent does not seem to improve efficiency in the host market, with this study finding the opposite for the wholesale based specification of bank efficiency. Thus some parent bank attributes which we would expect *a priori* to improve bank efficiency seem to have limited positive impact (in the case of parent credit ratings in Model 2) and largely negative impacts in the case of Models 1b and 3. However, Model 3 also indicates that banks from more financially sophisticated nations, as measured by home GDP per capital, are more likely to be efficient.

As with Berger*, et al.* (2004) (in the case of cross-border bank mergers), we hope that this paper will provide a call to research into factors determining foreign bank efficiency. This study has considered foreign bank efficiency from the perspective of one host nation, Australia, and using parametric distance functions and principle

component analysis. Thus, there is a need to address this research question in a variety of nations and using different techniques. The techniques applied in this study were the result of the limitations imposed by data availability[8] and it is possible that the results of this approach, combined with the impact of the single nation focus, will mean different outcomes in different settings. Thus, an important extension to this study will be to determine how robust these results are to differences in national settings.

For bank management, the results of Model 2 bear more interest, as they reflect, as closely as possible given data limitations, the efficiency of foreign banks in transforming costs into revenue. Banks with lower credit ratings are less likely to efficiently transform expenses into revenue. It is also interesting to note that in this case no negative impact of market concentration / bank incumbency was found. Thus from a profit maximisation perspective this potential barrier to entry is less of a concern.

From a regulatory perspective these results are a little less clear cut in some ways. Model 1 (and its variations) and Model 3 are potentially the most informative. If the national authorities in a developed country wish to encourage the presence of foreign banks they should reduce the barriers to entry for those banks. This study has found incumbency of the existing banks to be a significant barrier to entry for foreign bank efficiency. Given that a number of nations, including Australia, are adopting various policies aimed at encouraging various locations as global financial centres, this is an important result. Thus, those nations wishing to develop global financial centre status should consider the efficiency impact of domestic market incumbency. Solutions to this negative efficiency impact are potentially controversial as they include allowing foreign banks to acquire large domestic banks. Such a policy has wide-reaching implications extending beyond the efficiency impact of transforming inputs into outputs, and thus need to be evaluated in a wider context than this paper can offer.[9]

As also shown by this study, the measurement of potential efficiency gains from foreign bank entry also depend upon the perspective adopted with respect to financial institution function. If the national regulator takes the perspective that the key issue is the process

[8] In that the data required for profit and cost functions was not available.

[9] There is a growing literature considering cross-border bank mergers, relevant recent studies include Berger*, et al.* (2004), Buch and DeLong (2004) and Focarelli and Pozzolo (2005).

of intermediation then the evidence from Models 1, 1a and 1b are germane. Alternatively, if the national regulator is concerned with the provision of financial services, then guidance from Model 3 is more appropriate. In the first case, the issue of national market concentration and merger policy become more important. In the second case, parent nation financial development and parent bank profits are additionally relevant. Thus, when measuring benefits from foreign bank entry, an important starting point will be the perspective of why foreign bank entry is being encouraged. It should be noted that this study considers one nation with a particular institutional structure. There is a need for both additional highly focussed single nation studies in other countries as well as wider ranging multi-nation studies to determine if these results apply in other circumstances.

References.

Allen, Linda, and Anoop Rai, 1996, Operational efficiency in banking: An international comparison, *Journal of Banking and Finance* 20, 655-672.

Avkiran, Necmi Kemal, 1999, The evidence on efficiency gains: The role of mergers and the benefits to the public, *Journal of Banking and Finance* 23, 991-1013.

Avkiran, Necmi Kemal, 2000, Rising productivity of Australian trading banks under deregulation 1986-1995, *Journal of Economics and Finance* 24, 122-140.

Battese, George, and Tim Coelli, 1993, A stochastic frontier production function incorporating a model for technical efficiency effects, Working papers in Econometrics and Applied Statistics (Armidale).

Battese, George, and Tim Coelli, 1995, A model for technical inefficiency effects in a stochastic frontier production function for panel data, *Empirical Economics* 20.

Berger, Allen N, 2007, Obstacles to a Global Banking System: "Old Europe" versus "New Europe", *Journal of Banking and Finance* 31, 1955-1973.

Berger, Allen N., Claudia M. Buch, Gayle DeLong, and Robert DeYoung, 2004, Exporting financial institutions management via foreign direct investment mergers and acquisitions, *Journal of International Money and Finance* 23, 333-366.

Berger, Allen N., Robert DeYoung, Hesna Genay, and Gregory F. Udell, 2000, Globalisation of financial institutions: Evidence from cross-border banking performance, *Brookings-Wharton Papers on Financial Service* 3, 23-120.

Berger, Allen N., and David B. Humphrey, 1992, Measurement and Efficiency Issues in Comercial Banking, in Zvwi Griliches, ed.: *Output measurement in the service sector* (University of Chicago Press, Chicago).

Berger, Allen N., and David B. Humphrey, 1997, Efficiency of financial institutions: International survey and directions for future research, *European Journal of Operational Research* 98, 175-212.

Berger, Allen N., William C. Hunter, and Stephen G. Timme, 1993, The efficiency of financial institutions: A review and preview of research past, present, and future, *Journal of Banking and Finance* 17, 221-249.

Berger, Allen N., and Loretta J. Mester, 1997, Inside the black box: What explains differences in the efficiencies of financial institutions, *Journal of Banking and Finance* 21, 895-947.

Buch, Claudia, 2003, Information or regulation: What drives the international activities of commercial banks?, *Journal of Money, Credit and Banking* 35, 851-869.
Buch, Claudia M., and Gayle L. DeLong, 2004, Cross-Border Bank Mergers: What Lures the Rare Animal?, *Journal of Banking and Finance* 28, 2077-2102.
Cho, Kang-Rae, 1985. *Multinational banks; Their identities and determinants* (UMI Research Press).
Coelli, Tim, and Sergio Perelman, 1999, A comparison of parametric and non-parametric distance functions: with application to European railways, *European Journal of Operational Research* 117, 326-339.
Coelli, Tim, and Sergio Perelman, 2000, Technical efficiency of European railways: a distance function approach, *Applied Economics* 32, 1967-1976.
Fare, R., and D. Primont, 1995. *Multi-output production and duality theory and applications* (Kluwer Academic Publications, Boston).
Fieleke, Norman S., 1977, The growth of US banking abroad: an analytical survey, Key issues in international banking.
Focarelli, Dario, and Fabio Panetta, 2003, Are mergers beneficial to consumers? Evidence from the market for bank deposits, *American Economic Review* 93, 1152-1172.
Focarelli, Dario, and Alberto Franco Pozzolo, 2001, The patterns of cross-border bank mergers and shareholdings in OECD countries, *Journal of Banking and Finance* 25, 2305-2337.
Focarelli, Dario, and Alberto Franco Pozzolo, 2005, Where do banks expand abroad? An empirical analysis, *Journal of Business* 78, 2435-2463.
Hendry, David, 1995. *Dynamic Econometrics* (Oxford University Press, Oxford).
Hirtle, Beverly, 1991, Factors affecting the competitiveness of internationally active financial institutions, *Federal Reserve Bank of New York (FRBNY) Quarterly Review* 16, 38-51.
Houston, Joel, Christopher James, and Michael Ryngaert, 2001, Where do merger gains come from? Bank mergers from the perspective of insiders adn outsiders, *Journal of Financial Economics* 60, 285-331.
Kirkwood, Joshua, and Daehoon Nahm, 2006, Australian banking efficiency and its relation to stock returns, *Economic Record* 82, 253-267.
Kosmidou, Kyriaki, Fotios Pasiouras, and Angelos Tsaklanganos, 2006, Domestic and multinational determininants of foreign bank profits: The case of Greek banks operating abroad., *Journal of Multinational Financial Management* forthcoming.
Maudos, Joaquin, Jose Pastor, Francisco Perez, and Javier Quesada, 2002, Cost and Profit Efficiency in European Banks, *Journal of International Financial Markets, Institutions and Money* 12, 33-58.
Miller, Stewart R., and Arvind Parkhe, 2002, Is there a liability of foreignness in global banking? An empirical test of banks' X-efficiency, *Strategic Management Journal* 23, 55-76.
Miller, Stewart R., and Arvind Parkhe, 2002, Is there a liability of foreignness in global banking? An empirical test of banks' X-Efficiency, *Strategic Management Journal* 23, 55-75.
Neal, P, 2004, X-efficiency and productivity change in Australian banking, *Australian Economic Papers* 174-191.
Rhoades, Stephen A., 1998, The efficiency effects of bank mergers: An overview of case studies of nine mergers, *Journal of Banking and Finance* 22, 273-291.
Sathye, Milind, 2001, X-efficiency in Australian banking: An empirical investigation, *Journal of Banking and Finance* 25, 613-630.

Sturm, Jan-Egbert, and Barry Williams, 2004, Foreign banks entry, deregulation and bank efficiency: Lessons from the Australian experience, *Journal of Banking and Finance* 28, 1775-1799.
Tschoegl, Adrian E., 1982, Foreign bank entry into Japan and California, in Alan M. Rugman, ed.: *New theories of the multinational enterprise* (Croom Helm).
Tschoegl, Adrian E., 2004, Who owns the major US subsidiaries of foreign banks? A note, *International Financial Markets Institutions and Money* 14, 255-266.
Ursacki, Terry, and Ilan Vertinsky, 1992, Choice of entry timing and scale by foreign banks in Japan and Korea, *Journal of Banking and Finance* 16, 405-421.
Williams, Barry, 1998, Factors affecting the performance of foreign-owned banks in Australia: A cross-sectional study, *Journal of Banking and Finance* 22, 197-219.
Williams, Barry, 1998, A pooled study of the profits and size of foreign banks in Australia, *Journal of Multinational Financial Management* 8, 211-231.
Williams, Barry, 2002, The defensive expansion approach to multinational banking: Evidence to date, *Financial Markets, Institutions & Instruments* 11, 127-203.
Williams, Barry, 2003, Domestic and international determinants of bank profits: Foreign banks in Australia, *Journal of Banking and Finance* 27, 1185-1210.

Table 1: Summary of models employed

	Inputs	Outputs
Model 1	(i) employees (ii) deposits and borrowed funds (iii) equity capital	(i) loans (ii) off balance sheet activity
Model 1a (retail model)	(i) employees (ii) deposits (iii) equity capital	(i) loans less housing loans (ii) housing loans (iii) off balance sheet activity
Model 1b (wholesale model)	(i) employees (ii) deposits (iii) equity capital	(i) loans (ii) investments (iii) off balance sheet activity
Model 2 (revenue model)	(i) interest expenses (ii) non-interest expenses	(i) net interest income (ii) non-interest income
Model 3 (production model)	(i) employees (ii) equity capital	(i) loans (ii) off balance sheet activity (iii) deposits and borrowed funds

Table 2: Sample characteristics

	Model 1				Model 1a				Model 1b				Model 2				Model 3			
	Big4	Other_domestic	Foreign	Total	Big4	Other_domestic	Foreign	Total	Big4	Other_domestic	Foreign	Total	Big4	Other_domestic	Foreign	Total	Big4	Other_domestic	Foreign	Total
1988	2	3	13	18	2	1	3	6	2	3	13	18	4	8	7	19	2	3	13	18
1989	3	8	15	26	3	4	12	19	3	8	15	26	4	9	8	21	3	8	15	26
1990	3	8	13	24	3	8	13	24	3	8	13	24	4	10	7	21	3	8	13	24
1991	4	9	13	26	4	9	13	26	4	9	13	26	4	10	7	21	4	9	13	26
1992	4	9	12	25	4	9	12	25	4	9	12	25	4	10	7	21	4	9	12	25
1993	4	9	11	24	4	9	11	24	4	9	11	24	4	12	7	23	4	9	11	24
1994	4	10	11	25	4	10	11	25	4	10	11	25	4	10	7	21	4	10	11	25
1995	4	10	9	23	4	10	9	23	4	10	9	23	4	11	5	20	4	10	9	23
1996	4	10	6	20	4	10	6	20	4	10	6	20	4	11	4	19	4	10	6	20
1997	4	7	6	17	4	7	6	17	4	7	6	17	4	8	4	16	4	7	6	17
1998	4	5	4	13	4	5	4	13	4	5	4	13	4	9	5	18	4	5	4	13
1999	4	5	5	14	4	5	5	14	4	5	5	14	4	7	6	17	4	5	5	14
2000	4	5	4	13	4	5	4	13	4	5	4	13	4	8	7	19	4	5	4	13
2001	4	5	3	12	4	5	3	12	4	5	3	12	4	8	4	16	4	5	3	12

Note: For a description of the models see Table 1.

Table 3: Descriptive statistics and correlation coefficient of the technical efficiency variables

	All banks					Foreign banks					Differences means		
	Obs.	Avg.	S.E.	Min.	Max.	Obs.	Avg.	S.E.	Min.	Max.	Est.	S.E.	p-value
Model 1	280	0.83	0.12	0.24	0.96	125	0.80	0.17	0.24	0.96	-0.046	0.015	0.00
Model 1a	261	0.83	0.09	0.51	0.96	112	0.83	0.11	0.51	0.96	-0.009	0.011	0.40
Model 1b	280	0.86	0.08	0.51	0.97	125	0.85	0.10	0.51	0.97	-0.007	0.010	0.50
Model 2	272	0.87	0.10	0.16	0.97	85	0.85	0.13	0.16	0.97	-0.021	0.013	0.12
Model 3	280	0.71	0.19	0.11	0.95	125	0.66	0.24	0.11	0.95	-0.096	0.022	0.00

	All banks					Foreign banks				
	1	1a	1b	2	3	1	1a	1b	2	3
Model 1	280	0.70	0.63	-0.03	0.68	125	0.74	0.68	-0.15	0.69
Model 1a	261	261	0.61	-0.01	0.51	112	112	0.64	-0.16	0.47
Model 1b	280	261	280	-0.08	0.51	125	112	125	-0.17	0.48
Model 2	232	221	232	272	-0.21	78	73	78	85	-0.44
Model 3	280	261	280	232	280	125	112	125	78	125

Notes: For a description of the models see Table 1. The upper half shows the number of observations in each sample, their averages, standard errors and the minimum and maximum values. The lower half shows the correlation coefficients in each sample and the numbers of observations used to calculate these correlation coefficients. The left-side tables report results including all banks in the sample; the right-side concentrates on only foreign banks active in Australia and for which we have data.

Table 4: Descriptive statistics for foreign banks - comparing technical efficiency across countries

	Largest sample of foreign banks					Sample used in the regression analysis				
	Model 1	Model 1a	Model 1b	Model 2	Model 3	Model 1	Model 1a	Model 1b	Model 2	Model 3
Observations	125	112	125	85	125	90	84	90	62	90
F-test	7.61	2.36	5.04	1.80	7.80	9.58	3.53	4.62	0.49	9.80
p-value	0.00	0.01	0.00	0.10	0.00	0.00	0.00	0.00	0.74	0.00
Sample average	0.80	0.83	0.85	0.85	0.66	0.80	0.82	0.85	0.86	0.67
ΔUnited Kingdom	0.07	0.03	0.03	0.02	0.07	0.07	0.05	0.02	0.01	0.07
	(3.18)	(1.85)	(2.36)	(0.67)	(2.27)	(2.84)	(2.57)	(1.66)	(0.38)	(2.10)
ΔUnited States	-0.15	-0.04	-0.07	0.01	-0.20	-0.18	-0.06	-0.07	0.01	-0.27
	(-6.02)	(-2.19)	(-4.35)	(0.30)	(-5.97)	(-5.91)	(-2.67)	(-4.03)	(0.41)	(-6.45)
ΔJapan	0.06	-0.02	0.03	-0.01	0.13	0.06	-0.02	0.03	-0.02	0.13
	(2.36)	(-0.95)	(2.06)	(-0.20)	(3.61)	(2.05)	(-1.03)	(1.76)	(-0.53)	(3.22)
ΔNetherlands	-0.15	-0.01	-0.10	-0.28	0.22	-0.24	-0.09	-0.14	-0.16	0.20
	(-1.50)	(-0.13)	(-1.55)	(-3.23)	(1.61)	(-1.66)	(-0.88)	(-1.62)	(-1.17)	(1.01)
ΔGermany	0.12	0.09	0.05		0.02	0.12	0.10	0.05		0.02
	(2.04)	(1.98)	(1.43)		(0.31)	(2.04)	(2.19)	(1.41)		(0.19)
ΔSingapore	0.05	0.03	0.05		0.08	-0.27	-0.09	-0.09		0.23
	(0.93)	(0.66)	(1.37)		(1.04)	(-1.85)	(-0.90)	(-0.99)		(1.16)
ΔSwitzerland	-0.30	-0.14	-0.16	0.02	-0.43					
	(-3.74)	(-2.29)	(-3.16)	(0.34)	(-3.92)					
ΔCanada	0.15	0.10	0.10	-0.08	0.22					
	(1.49)	(1.41)	(1.57)	(-0.95)	(1.63)					
ΔJordan	0.06	0.08	-0.08	0.05	-0.11					
	(0.73)	(1.42)	(-1.65)	(0.75)	(-0.96)					
ΔHong Kong	-0.05	-0.10	0.04		0.23					
	(-0.36)	(-0.93)	(0.47)		(1.22)					

Notes: For a description of the models see Table 1. The upper half shows the number of observations in each sample, an F-test whether banks of different countries differ with respect to their average technical efficiency levels and it p value. For reference, the average technical efficiency across all foreign banks is listed. The bottom part of the table reports the extent to which technical bank efficiency level in one country differs from the overall sample average. t-statistics are reported in brackets.

Table 5: Descriptive statistics of the parent characteristics

	Obs.	Avg.	S.E.	Min.	Max.
Home Investment (PC)	126	-0.09	0.79	-1.16	2.28
Parent Profits (PC)	121	-0.09	0.95	-4.21	1.92
Parent Size (PC)	127	0.06	0.91	-2.64	1.82
Home Trade	129	0.03	0.02	0.00	0.06
Home GDP per capita	132	10.30	0.50	7.89	11.10
Competitor Market Share	132	0.58	0.08	0.46	0.71
Operations Before 1985	132	0.59	0.49	0.00	1.00
Parent Credit Rating (High)	109	0.68	0.47	0.00	1.00
Parent Credit Rating (Mid)	109	0.19	0.40	0.00	1.00
Parent Credit Rating (Low)	109	0.12	0.33	0.00	1.00

	Obs.	Avg.	S.E.	Min.	Max.	Obs.\Correl. (1)	(2)	(3)	(4)
(1) Home Investment (PC)	126	-0.09	0.79	-1.16	2.28	126	-0.81	0.66	0.88
(2) Home Investment Income	127	-435.98	1,738.47	-3,535.00	2,342.00	126	127	-0.20	-0.55
(3) Home Nation Capital Flow	128	1,283.36	1,274.51	-666.00	6,054.00	126	126	128	0.55
(4) Home Nation Capital Stock	129	21,872.09	12,704.35	747.00	57,062.00	126	127	128	129

	Obs.	Avg.	S.E.	Min.	Max.	Obs.\Correl. (1)	(2)	(3)
(1) Parent Profits (PC)	121	-0.09	0.95	-4.21	1.92	121	0.75	0.84
(2) Home Return on Assets	132	0.63	0.62	-1.66	3.02	121	132	0.27
(3) Home Net Interest Margin	121	2.52	1.37	-1.62	4.93	121	121	121

	Obs.	Avg.	S.E.	Min.	Max.	Obs.\Correl. (1)	(2)	(3)
(1) Parent Size (PC)	127	0.06	0.91	-2.64	1.82	127	0.89	0.86
(2) Parent assets	132	12.13	1.04	9.04	14.04	127	132	0.52
(3) Parent Capital	127	9.44	1.10	6.79	12.71	127	127	127

Table 6: Correlation table of all variables used in the regression analysis

	Total Efficiency Model 1	Total Efficiency Model 1a	Total Efficiency Model 1b	Total Efficiency Model 2	Total Efficiency Model 3	Home Investment (PC)	Parent Profits (PC)	Parent Size (PC)	Home Trade	Home GDP per capita	Competitor Market Share	Operations Before 1985	Parent Credit Rating (High)	Parent Credit Rating (Mid)	Parent Credit Rating (Low)
Total Efficiency Model 1	125	0.74	0.68	-0.15	0.69	-0.25	-0.02	0.13	-0.13	-0.23	-0.28	-0.32	0.07	-0.08	-0.03
Total Efficiency Model 1a	112	112	0.64	-0.16	0.47	-0.06	0.04	0.02	-0.21	-0.29	-0.25	-0.26	0.07	-0.13	0.05
Total Efficiency Model 1b	125	112	125	-0.17	0.48	-0.24	-0.31	0.23	-0.09	-0.09	-0.31	-0.34	0.28	-0.31	-0.04
Total Efficiency Model 2	78	73	78	85	-0.44	0.14	0.06	-0.13	0.01	-0.07	0.19	-0.09	0.04	0.18	-0.25
Total Efficiency Model 3	125	112	125	78	125	-0.26	-0.15	0.34	-0.05	-0.01	-0.19	-0.27	0.19	-0.12	-0.10
Home Investment (PC)	119	107	119	81	119	126	0.33	0.01	-0.03	0.21	0.59	0.19	-0.21	0.16	0.13
Parent Profits (PC)	116	105	116	78	116	116	121	-0.41	-0.47	-0.22	0.19	0.23	-0.33	0.26	0.13
Parent Size (PC)	120	107	120	83	120	121	116	127	0.59	0.53	0.04	-0.15	0.33	-0.18	-0.20
Home Trade	122	109	122	82	122	126	118	124	129	0.56	-0.02	0.08	0.01	-0.04	0.07
Home GDP per capita	125	112	125	85	125	126	121	127	129	132	0.36	0.19	0.11	0.10	-0.25
Competitor Market Share	125	112	125	85	125	126	121	127	129	132	132	0.06	-0.15	0.20	0.02
Operations Before 1985	125	112	125	85	125	126	121	127	129	132	132	132	-0.40	0.33	0.15
Parent Credit Rating (High)	102	95	102	72	102	106	103	104	107	109	109	109	109	-0.71	-0.54
Parent Credit Rating (Mid)	102	95	102	72	102	106	103	104	107	109	109	109	109	109	-0.18
Parent Credit Rating (Low)	102	95	102	72	102	106	103	104	107	109	109	109	109	109	109

Notes: Above the diagonal correlation coefficients are reported. The numbers of observations used to calculate these correlation coefficients are below the diagonal. On the diagonal we report the number of observations available for each variable.

Table 7: Regression results for Model 1

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observations	90	90	90	90	90	90	90	90	90
adjusted R^2	0.80	0.80	0.80	0.80	0.80	0.82	0.80	0.82	0.83
F-test	8.78	7.29	8.27	6.81	8.36	8.88	7.71	9.37	10.56
p-value	0.12	0.20	0.14	0.23	0.14	0.11	0.17	0.10	0.06
ΔUnited Kingdom	0.13	0.17	0.19	0.22	0.22	0.05	0.16	0.12	0.01
	(1.55)	(2.03)	(2.18)	(1.44)	(1.75)	(0.53)	(1.95)	(0.72)	(0.14)
ΔUnited States	-0.10	-0.07	-0.06	-0.11	-0.05	-0.18	-0.09	-0.15	-0.24
	(-1.29)	(-0.86)	(-0.74)	(-1.04)	(-0.56)	(-2.13)	(-0.96)	(-1.23)	(-2.68)
ΔJapan	0.08	0.09	0.12	0.07	0.15	0.00	0.13	0.02	-0.06
	(0.84)	(0.94)	(1.39)	(0.40)	(1.52)	(0.02)	(1.43)	(0.09)	(-0.53)
ΔNetherlands	-0.15	-0.11	-0.08	0.00	-0.03	-0.28	-0.09	-0.28	-0.36
	(-0.74)	(-0.56)	(-0.39)	(0.02)	(-0.12)	(-1.36)	(-0.43)	(-0.95)	(-1.72)
ΔGermany	0.12	0.17	0.19	0.23	0.21	0.05	0.18	0.05	-0.02
	(0.69)	(0.96)	(1.09)	(1.00)	(1.13)	(0.28)	(0.98)	(0.18)	(-0.11)
ΔSingapore	-0.25	-0.15	-0.14	-0.11	-0.12	-0.31	-0.17	-0.27	-0.40
	(-1.24)	(-0.80)	(-0.71)	(-0.45)	(-0.58)	(-1.59)	(-0.82)	(-1.00)	(-1.99)
Time Trend	-0.01	-0.01	-0.01	-0.01	-0.02	0.01	-0.01	0.00	0.01
	(-1.02)	(-2.45)	(-2.68)	(-2.64)	(-1.67)	(0.88)	(-2.61)	(0.00)	(1.56)
Home Investment (PC)	-0.02							-0.02	-0.03
	(-1.16)							(-1.08)	(-1.71)
Parent Profits (PC)		-0.03						-0.02	
		(-1.45)						(-0.94)	
Parent Size (PC)			0.02					0.01	
			(0.97)					(0.23)	
Home Trade				0.05				-0.03	
				(0.47)				(-0.27)	
Home GDP per capita					0.02			0.04	
					(0.63)			(0.94)	
Competitor Market Share						-0.06		-0.06	-0.06
						(-2.87)		(-2.98)	(-3.15)
Operations Before 1985							0.02	0.00	
							(0.13)	(0.03)	
Parent Credit Rating (Mid)								0.04	
								(1.01)	
Parent Credit Rating (Low)								0.09	0.07
								(1.81)	(1.67)

Notes: t-statistics are reported in parentheses. All equations are estimated using bank-specific random effects. The country dummies report the difference of the country-specific technical efficiency from the total sample of foreign banks. The F-statistics (and associated p-values) tests whether all country dummies are equal to zero. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Column (8) includes all possible available variables at once and the final column shows the results of the general to specific modelling.

Table 8: Regression results for Model 1a

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observations	84	84	84	84	84	84	84	84	84
adjusted R^2	0.43	0.48	0.43	0.42	0.43	0.50	0.43	0.53	0.53
F-test	8.00	6.70	7.19	5.58	5.47	8.19	6.56	2.49	7.12
p-value	0.16	0.24	0.21	0.35	0.36	0.15	0.26	0.78	0.21
ΔUnited Kingdom	0.14	0.12	0.11	0.16	0.04	0.00	0.11	0.03	0.01
	(2.25)	(2.04)	(1.90)	(1.40)	(0.34)	(-0.01)	(2.27)	(0.21)	(0.09)
ΔUnited States	0.00	0.00	-0.01	-0.03	-0.05	-0.11	0.00	-0.08	-0.10
	(0.09)	(-0.01)	(-0.27)	(-0.52)	(-0.80)	(-2.00)	(-0.04)	(-0.72)	(-1.58)
ΔJapan	0.06	-0.04	0.02	-0.04	0.00	-0.10	0.02	-0.06	-0.15
	(0.77)	(-0.65)	(0.43)	(-0.27)	(0.02)	(-1.56)	(0.37)	(-0.36)	(-2.02)
ΔNetherlands	0.07	-0.04	0.02	0.10	-0.05	-0.17	0.03	-0.11	-0.22
	(0.47)	(-0.28)	(0.16)	(0.47)	(-0.34)	(-1.21)	(0.22)	(-0.46)	(-1.39)
ΔGermany	0.17	0.13	0.14	0.19	0.09	0.01	0.13	0.04	0.01
	(1.73)	(1.20)	(1.59)	(1.36)	(0.95)	(0.15)	(1.40)	(0.20)	(0.08)
ΔSingapore	0.02	-0.01	-0.03	0.03	-0.09	-0.16	-0.04	-0.10	-0.14
	(0.16)	(-0.07)	(-0.24)	(0.18)	(-0.67)	(-1.27)	(-0.30)	(-0.45)	(-1.00)
Time Trend	-0.01	-0.01	-0.01	-0.01	0.00	0.01	-0.01	0.00	0.01
	(-1.60)	(-1.15)	(-1.40)	(-1.74)	(-0.03)	(1.29)	(-1.68)	(0.37)	(1.49)
Home Investment (PC)	0.01							0.02	
	(0.67)							(1.00)	
Parent Profits (PC)		-0.04						-0.04	-0.03
		(-2.09)						(-2.09)	(-1.84)
Parent Size (PC)			0.00					-0.03	
			(-0.12)					(-1.27)	
Home Trade				0.05				-0.02	
				(0.46)				(-0.21)	
Home GDP per capita					-0.03			0.02	
					(-0.85)			(0.50)	
Competitor Market Share						-0.05		-0.06	-0.05
						(-2.94)		(-3.06)	(-2.84)
Operations Before 1985							-0.02	-0.03	
							(-0.39)	(-0.42)	
Parent Credit Rating (Mid)								0.03	
								(0.71)	
Parent Credit Rating (Low)								0.06	
								(1.17)	

Notes: t-statistics are reported in parentheses. All equations are estimated using bank-specific random effects. The country dummies report the difference of the country-specific technical efficiency from the total sample of foreign banks. The F-statistics (and associated p-values) tests whether all country dummies are equal to zero. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Column (8) includes all possible available variables at once and the final column shows the results of the general to specific modelling.

Table 9: Regression results for Model 1b

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observations	90	90	90	90	90	90	90	90	90
adjusted R^2	0.59	0.62	0.59	0.60	0.59	0.61	0.59	0.63	0.65
F-test	9.85	9.92	10.24	6.94	9.70	10.27	7.26	7.89	11.57
p-value	0.08	0.08	0.07	0.22	0.08	0.07	0.20	0.16	0.04
ΔUnited Kingdom	0.06	0.09	0.10	0.14	0.12	0.02	0.08	0.10	0.06
	(1.43)	(2.28)	(2.14)	(1.41)	(1.50)	(0.50)	(1.94)	(0.89)	(1.10)
ΔUnited States	-0.07	-0.04	-0.04	-0.08	-0.04	-0.10	-0.05	-0.08	-0.10
	(-1.63)	(-1.03)	(-1.02)	(-1.37)	(-0.68)	(-2.24)	(-1.02)	(-1.07)	(-2.09)
ΔJapan	0.03	0.01	0.05	-0.01	0.07	-0.01	0.05	-0.04	-0.02
	(0.56)	(0.14)	(1.20)	(-0.09)	(1.35)	(-0.11)	(1.19)	(-0.36)	(-0.42)
ΔNetherlands	-0.10	-0.10	-0.06	0.02	-0.03	-0.16	-0.05	-0.12	-0.16
	(-0.90)	(-0.99)	(-0.59)	(0.13)	(-0.22)	(-1.37)	(-0.50)	(-0.62)	(-1.35)
ΔGermany	0.04	0.07	0.08	0.14	0.10	0.01	0.06	0.04	0.03
	(0.52)	(0.91)	(1.04)	(1.01)	(1.07)	(0.15)	(0.72)	(0.27)	(0.34)
ΔSingapore	-0.08	-0.02	-0.02	0.02	-0.01	-0.10	-0.05	-0.04	-0.06
	(-0.73)	(-0.16)	(-0.18)	(0.15)	(-0.06)	(-1.00)	(-0.49)	(-0.25)	(-0.58)
Time Trend	0.00	0.00	-0.01	-0.01	-0.01	0.00	-0.01	0.00	0.00
	(-0.56)	(-1.42)	(-1.92)	(-1.77)	(-1.24)	(0.61)	(-1.72)	(-0.10)	(0.35)
Home Investment (PC)	-0.01							-0.01	
	(-0.90)							(-0.44)	
Parent Profits (PC)		-0.04						-0.03	-0.03
		(-2.65)						(-1.97)	(-2.20)
Parent Size (PC)			0.01					0.00	
			(0.87)					(0.11)	
Home Trade				0.06				0.01	
				(0.68)				(0.12)	
Home GDP per capita					0.01			0.02	
					(0.57)			(0.63)	
Competitor Market Share						-0.03		-0.03	-0.02
						(-1.89)		(-1.77)	(-1.66)
Operations Before 1985							-0.02	-0.02	
							(-0.41)	(-0.26)	
Parent Credit Rating (Mid)								0.00	
								(0.09)	
Parent Credit Rating (Low)								0.07	0.07
								(1.94)	(2.15)

Notes: t-statistics are reported in parentheses. All equations are estimated using bank-specific random effects. The country dummies report the difference of the country-specific technical efficiency from the total sample of foreign banks. The F-statistics (and associated p-values) tests whether all country dummies are equal to zero. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Column (8) includes all possible available variables at once and the final column shows the results of the general to specific modelling.

Table 10: Regression results for Model 2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observations	62	62	62	62	62	62	62	62	62
adjusted R^2	0.19	0.22	0.20	0.28	0.19	0.21	0.19	0.37	0.34
F-test	1.17	1.33	1.03	1.99	3.08	0.83	1.24	2.30	3.88
p-value	0.76	0.72	0.79	0.57	0.38	0.84	0.74	0.51	0.27
ΔUnited Kingdom	0.00	-0.02	-0.01	-0.28	-0.25	0.06	-0.01	-0.27	-0.02
	(0.01)	(-0.28)	(-0.16)	(-0.97)	(-1.43)	(0.63)	(-0.10)	(-0.70)	(-0.33)
ΔUnited States	-0.01	-0.03	-0.02	0.07	-0.14	0.05	0.00	0.18	0.03
	(-0.10)	(-0.41)	(-0.28)	(0.60)	(-1.38)	(0.58)	(-0.03)	(0.77)	(0.54)
ΔJapan	-0.02	0.02	-0.01	0.27	-0.11	0.06	-0.02	0.36	-0.06
	(-0.17)	(0.27)	(-0.11)	(1.24)	(-1.25)	(0.55)	(-0.27)	(1.20)	(-0.85)
ΔNetherlands	-0.18	-0.16	-0.17	-0.59	-0.41	-0.08	-0.18	-0.57	-0.23
	(-0.89)	(-0.90)	(-0.95)	(-1.25)	(-1.85)	(-0.38)	(-1.00)	(-1.02)	(-1.44)
Time Trend	0.00	0.00	0.00	0.00	0.02	-0.01	0.00	-0.01	0.00
	(0.13)	(0.19)	(0.27)	(-0.04)	(1.51)	(-0.66)	(0.23)	(-0.29)	(0.49)
Home Investment (PC)	0.00							-0.01	
	(-0.03)							(-0.24)	
Parent Profits (PC)		0.03						0.00	
		(1.10)						(0.04)	
Parent Size (PC)			-0.01					0.03	
			(-0.42)					(0.64)	
Home Trade				-0.25				-0.27	
				(-1.42)				(-1.54)	
Home GDP per capita					-0.08			-0.05	
					(-1.52)			(-0.63)	
Competitor Market Share						0.03		0.06	
						(0.94)		(1.60)	
Operations Before 1985							-0.02	0.00	
							(-0.30)	(0.01)	
Parent Credit Rating (Mid)								0.09	
								(1.32)	
Parent Credit Rating (Low)								-0.15	-0.20
								(-2.10)	(-3.71)

Notes: t-statistics are reported in parentheses. All equations are estimated using bank-specific random effects. The country dummies report the difference of the country-specific technical efficiency from the total sample of foreign banks. The F-statistics (and associated p-values) tests whether all country dummies are equal to zero. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Column (8) includes all possible available variables at once and the final column shows the results of the general to specific modelling.

Table 11: Regression results for Model 3

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Observations	90	90	90	90	90	90	90	90	90
adjusted R^2	0.78	0.78	0.76	0.76	0.77	0.78	0.76	0.82	0.82
F-test	4.33	4.76	6.45	5.26	7.32	5.52	5.88	3.67	4.47
p-value	0.50	0.45	0.26	0.39	0.20	0.36	0.32	0.60	0.48
ΔUnited Kingdom	0.01	0.13	0.13	0.21	0.35	-0.05	0.10	0.19	0.16
	(0.12)	(1.15)	(1.04)	(0.97)	(1.94)	(-0.39)	(0.91)	(0.79)	(0.83)
ΔUnited States	-0.21	-0.12	-0.13	-0.19	-0.02	-0.29	-0.16	-0.15	-0.18
	(-2.03)	(-1.09)	(-1.17)	(-1.32)	(-0.16)	(-2.41)	(-1.28)	(-0.86)	(-1.21)
ΔJapan	0.05	0.09	0.19	0.07	0.26	0.02	0.19	0.06	-0.10
	(0.37)	(0.73)	(1.54)	(0.31)	(1.92)	(0.16)	(1.57)	(0.26)	(-0.63)
ΔNetherlands	0.05	0.19	0.27	0.43	0.50	0.00	0.25	0.06	0.02
	(0.20)	(0.71)	(0.99)	(1.06)	(1.59)	(0.02)	(0.90)	(0.15)	(0.04)
ΔGermany	-0.13	0.03	0.05	0.15	0.19	-0.13	0.06	-0.10	-0.10
	(-0.56)	(0.12)	(0.20)	(0.46)	(0.71)	(-0.55)	(0.22)	(-0.29)	(-0.36)
ΔSingapore	0.05	0.32	0.30	0.39	0.48	0.09	0.29	0.22	0.20
	(0.19)	(1.25)	(1.11)	(1.09)	(1.60)	(0.36)	(1.04)	(0.59)	(0.60)
Time Trend	0.01	0.00	-0.01	-0.01	-0.03	0.02	0.00	0.00	0.01
	(1.24)	(-0.45)	(-0.91)	(-0.85)	(-1.98)	(1.73)	(-0.76)	(-0.06)	(0.43)
Home Investment (PC)	-0.07							-0.04	-0.05
	(-2.52)							(-1.43)	(-1.60)
Parent Profits (PC)		-0.08						-0.07	-0.06
		(-2.62)						(-2.41)	(-2.20)
Parent Size (PC)			0.02					-0.03	
			(0.49)					(-0.88)	
Home Trade				0.10				-0.08	
				(0.61)				(-0.52)	
Home GDP per capita					0.09			0.15	0.10
					(1.83)			(2.66)	(2.12)
Competitor Market Share						-0.08		-0.10	-0.09
						(-2.60)		(-3.58)	(-3.34)
Operations Before 1985							0.03	0.01	
							(0.22)	(0.05)	
Parent Credit Rating (Mid)								0.10	
								(1.70)	
Parent Credit Rating (Low)								0.09	
								(1.38)	

Notes: t-statistics are reported in parentheses. All equations are estimated using bank-specific random effects. The country dummies report the difference of the country-specific technical efficiency from the total sample of foreign banks. The F-statistics (and associated p-values) tests whether all country dummies are equal to zero. The first eight columns in each of the results tables report the results of including in turn each individual explanatory variable. Column (8) includes all possible available variables at once and the final column shows the results of the general to specific modelling.