Cardiff Economics Working Papers





Working Paper No. E2006/2

Efficiency and Productivity Growth of Domestic and Foreign Commercial Banks in Malaysia

Kent Matthews and Mahadzir Ismail

January 2006

Cardiff Business School
Aberconway Building
Colum Drive
Cardiff CF10 3EU
United Kingdom
t: +44 (0)29 2087 4000
f: +44 (0)29 2087 4419
business.cardiff.ac.uk

This paper can be downloaded from econpapers.repec.org/RePEc:cdf:wpaper:2006/2

This working paper is produced for discussion purpose only. These working papers are expected to be published in due course, in revised form, and should not be quoted or cited without the author's written permission.

Cardiff Economics Working Papers are available online from: econpapers.repec.org/paper/cdfwpaper/ and business.cardiff.ac.uk/research/academic-sections/economics/working-papers

Enquiries: EconWP@cardiff.ac.uk

Efficiency and Productivity Growth of Domestic and Foreign Commercial Banks in Malaysia

Kent Matthews[a] and Mahadzir Ismail[b,*]

[a] Cardiff Business School, Aberconway Building, Cardiff University, Colum Road, Cardiff CF10 3EU, United Kingdom

[b] MARA University of Technology, Kedah Branch, PO Box 187, 08400 Merbok, Malaysia

February 2005.

Abstract

This study examines the technical efficiency and productivity of domestic and foreign commercial banks in Malaysia 1994-2000. We find that foreign banks have a higher efficiency level than domestic banks, and that efficient banks are characterised by size but not profitability or loan quality. The main source of productivity growth is technical change rather than improvement in efficiency. The productivity of domestic banks is more susceptible to macroeconomic shocks than foreign banks but over the medium term foreign banks are only marginally superior to domestic banks.

Keywords: domestic and foreign banks; technical efficiency; Malmquist productivity index

JEL codes: D2, G2

Corresponding author: K Matthews Tel.: 44(0)292087 5855
[*] E-mail address: MatthewsK@cf.ac.uk

1.0 Introduction

There are number reasons as to why the performance of banks in developing countries in general and Malaysia in particular should receive greater attention. Firstly, since capital and debt markets are not well developed, the principal conduit for economy wide investment and saving is through the banking system. The risks of channelling loanable funds primarily through the banking system have been evident in the role of the banks in the Asian financial crisis[1]. The measure of efficiency of banks is an indicator of success. Cost and technical efficiency is therefore the main interest of the researchers and policy makers.

Secondly, the banking sector of the developing economies is beginning to face stronger competition due to globalisation of the financial system. For example, as a member of the World Trade Organisation (WTO), Malaysia has had to liberalise her domestic banking sector by removing a number of barriers like equity ownership and to allow a greater number of the foreign-owned banks to operate and directly compete with existing domestic-owned banks. This leads to the need to understand the current position of the domestic banks in term of their performance and efficiency.

Thirdly, the pass-through of central bank policy will depend on the competitive structure and efficiency of the banking system in this relatively small but open economy. Furthermore, they are also keen to know the potential impact of government policies on efficiency.

Most studies of banking efficiency have focussed on the developed economies[2]. While the developing and Far East economies have not been ignored[3], the number of the studies related to this region is small in comparison. Berger and

[1] In their analysis of the Asian financial crisis, Chin and Jomo (2003) find that the Malaysian banking system was the principal source of funds for the private sector.

[2] Drake and Hall (2003), Cavallo and Rossi (2002), Elyasiani and Rezvanian (2002), Maudos et al. (2002), Drake (2001) Altunbas and Molyneux (1996) and Molyneux and Forbes (1993)

Humphrey (1997) survey 130 studies that have employed frontier analysis in 21 countries. Of these studies, only 8 were of developing and Asian countries (including 2 in Japan). Studies on US financial institutions were the most common, accounting for 66 out of 116 single country studies.

There remains room for further exploration and analysis. In their study of Malaysian banks, Katib and Matthews (1999) exclude foreign banks. As a consequence, the relative position of domestic banks as compared to foreign banks is unknown in term of efficiency and performance. Elyasiani and Rezvanian (2002) argue that the distinction between local and foreign banks should not be ignored, particularly when the presence of foreign banks is significant. Furthermore there is a need for robustness studies that employ different sets of bank input and output or alternative techniques comparing the parametric against the non-parametric approach. For example, Karim (2001), Hashim (2001) and Edwards (1999) all use parametric techniques to estimate the cost efficiency and the economies of scale of the banks. However, they do not relate the efficiency measures to bank profitability[4].

This study aims to investigate the performance of domestic and foreign commercial banks in Malaysia. Firstly, we measure and decompose the efficiency of the commercial banks in Malaysia by using a non-parametric approach popularly known as Data Envelopment analysis. Secondly, we examine the efficiency score across the banks based on their ownership (domestic and foreign ownership). We also seek to identify the main characteristics of the so-called efficient or inefficient banks. Among other things, the characteristics cover the rate of return, market power, size

[3]See Rezvanian and Mehdian (2002), Hardy and di Patti (2001), Karim (2001), Hashim (2001), Edwards (1999), Laevan (1999), Katib and Matthews (1999), Chu and Lim (1998), Bhattacharyya et al. (1997) and Fukuyama (1995)

[4] Tahir (1999) studied the relationship between market structure and banking performance and in particular the role of efficiency in influencing banking performance. This efficiency measure is calculated using a stochastic approach.

and asset quality. Finally, we construct the Malmquist productivity index and identify the sources of productivity growth.

This paper is structured as follows. The next section discusses the development of banking in Malaysia. Section 3 details the methodology of efficiency measurement. Section 4 details the Malmquist productivity measurement. Section 5 discusses the data sample and the empirical results. Section 6 concludes.

2.0 Efficiency and the Banking industry in Malaysia

While banking existed in colonial Malaysia it can be said that the Malaysian banking system began in 1959 with the establishment of the Central Bank or Bank Negara Malaysia- two years after gaining independence from Great Britain in 1957. The system has 2 broad institutions, namely monetary institutions (the Central Bank and the commercial banks) and non-monetary institutions (finance companies, merchant banks and discount houses). By the end of 1959, there were already 26 commercial banks but only 8 were Malaysian. The rest were foreign owned. This reflected the dominance of overseas banks (mainly British), which specialised in foreign exchange business, the finance of foreign trade and of the development of rubber plantations and tin mines (Lin, 1977).

Since the early 1960s, the main priority of the Central Bank has been to develop a truly Malaysian-oriented banking system. This led to expansion of the domestic banking network and reorientation of operation of the foreign banks toward meeting and catering for domestic needs. By 1993, the number of domestic banks had increased to a peak of 23. However, since 1997, the number of domestic banks had declined as a result of consolidation and merger. By the end of 2001, there were only

10 domestic banks. While it can be argued that the merged banks are now better capitalised, as well as being able to undertake higher levels of risk, the merger exercise has also led to the closure of 187 bank branches, relocation of bank branches and redundancy. Similarly, the number of foreign banks had declined to 14 by 1994 and 13 by the end of 2003. 2 Singaporean-based banks merged in 2002.

Consolidation aside, another important step taken by the financial authority was the launch of the Financial Sector Master Plan (FSMP) in March 2001. A key objective of the plans is to enhance domestic capacity. This objective requires the local banks to benchmark their position vis-à-vis their peers within the domestic banking sector as well as the foreign banks operating in Malaysia. In other words, the domestic banks have to develop a competitive edge in term of efficiency in order to set realistic targets for improvement.

3.0 Methodology of Efficiency Measurement

Charnes et al. (1978) extended the single input-output model of Farrell (1957) to a multiple input-output generalisation. The technical efficiency is measured as ratio of virtual output produced to virtual input used. Known as the CCR model (after their names) Charnes et al. (1978) popularised the application of Data Envelopment Analysis (DEA)[5]. There are a number of papers that describe the methodology of DEA as applied to banking[6], what follows is a brief description.

Let us say that there are N banks. Let x_i represent the input matrix of the i^{th} bank, and y_i represent its output matrix. Let the KxN input matrix be denoted X and the MxN output matrix be denoted Y. The efficiency measure of each of the N banks is maximised by the DEA searching for the ratio of all weighted outputs over all

[5] Tavares (2002) produces a bibliography of DEA (1978-2001). There are 3203 DEA authors whose studies cover a wide range of fields. Banxia.com also compiles DEA papers from 1978 until present.

weighted inputs, where the weights are selected from the dual of the linear programming problem specified as:

$$\min_{\theta,\lambda} \theta$$

subject to

$$\begin{aligned} & -y_i + Y\lambda \geq 0 \\ & \theta x_i - X\lambda \geq 0 \\ & \lambda \geq 0 \end{aligned} \qquad (1)$$

where λ is a Nx1 vector of constants θ is a scalar and is the economic efficiency score of the ith bank.

However, the CCR model under the assumption of constant returns to scale (CRS) is only appropriate when all banks are at the optimal scale. This requires the Decision Making Units (DMUs) to operate on the flat portion of the long run average cost (LRAC) curve. In practice, some factors may prevent a bank from operating at optimal scale, such as financial and legal constraints or imperfect information. To overcome this problem, Banker et al. (1984) (known as the BCR model) introduce a variable that represents the returns to scale. The BCR model will allow the calculation of technical efficiency that is free from the scale efficiency effects. In addition, Coelli (1996) highlights that the use of the CRS specification when some of the banks are not operating at the optimal scale will result in measures of technical efficiency that are mixed up with scale efficiency.

As outlined by McKillop et al. (2002), the usual DEA procedure in measuring efficiency begins with collecting the data on input and output quantities. These data are then used to construct a non-parametric frontier of the best practices amongst the decision-making units (DMUs). An efficiency score for each DMU is measured in relation to this frontier. Under the DEA, there are two basic models. The models are

[6] The most recent being Drake (2004)

based on the assumption of constant returns to scale (CRS) and variable returns to scale (VRS).

The set of input-output is run under both assumptions, CRS and VRS. If the efficiency score of each bank produced by these models varies, then the banks are said to experience variable returns to scale (Avkiran, 1999). In addition, under the VRS, a model can be orientated either by using input minimisation or output maximisation. This orientation is important in order to seek any potential improvement areas. By input minimisation, we mean is how to seek potential improvement expressed in terms of how the input or resource level could decrease while maintaining the current production level. On the other hand, output maximisation means that we seek potential improvement in terms of how production could increase, given the current input level. This is crucial when a firm is facing a question of how much output quantities can be proportionally expanded without altering the input quantities employed.

Amongst the strengths of the DEA is that there is no need for a preconceived structure or specific functional form to be imposed on the data in identifying and determining the efficient DMUs[7] (Hababou, 2002; Favero and Papi, 1995 and Banker et al.,1984). Hababou (2002) adds that it is better to adopt the DEA technique when it has been shown that a commonly agreed functional form relating inputs to outputs is difficult to prove or find. Such specific functional form is truly difficult to show for financial services entities. Avkiran (1999) acknowledges the edge of the DEA by stating that this technique allows the researchers to choose any kind of input and

[7] Hababou (2002) and Avkiran (1999) provide a relatively thorough discussion of the merits and limits of the DEA.

output of managerial interest, regardless of different measurement units. There is no need for standardisation[8].

Three useful features of DEA are first, each DMU is assigned a single efficiency score, hence allowing ranking amongst the DMUs in the sample. Second, it highlights the areas of improvement for each single DMU. For example, since a DMU is compared to a set of efficient DMUs with similar input-output configurations, the DMU in question is able to identify whether it has used input excessively or its output has been under-produced. Finally, there is possibility of making inferences on the DMU's general profile. We should be aware that the technique used here is a comparison between the production performances of each DMU to a set of efficient DMUs. The set of efficient DMUs is called the reference set. The owners of the DMUs may be interested to know which DMU frequently appears in this set. A DMU that appears more than others in this set is called the global leader. Clearly, this information gives huge benefits to the DMU owner, especially in positioning its entity in the market.

The main weakness of the DEA is that it assumes data are free from measurement errors. Furthermore, since efficiency is measured in a relative way, its analysis is confined to the sample used. This means that an efficient DMU found in the analysis cannot be compared with other DMUs outside of the sample. The reason is simple. Each sample, separated, let us say, by year, represents a single frontier, which is constructed on the assumption of same technology. Therefore, comparing the efficiency measures of a DMU across time cannot be interpreted as technical progress but rather has to be taken as changes in efficiency (Canhoto and Dermine, 2003).

[8] An additional advantage according to Canhoto and Dermine (2003) is that the DEA technique is preferred to parametric

4.0 Productivity measurement

The major drawback of the DEA approach is that the efficiency scores obtained from a particular sample are confined to that particular sample and cannot be compared with another sample in a different time period. This limitation does not allow the measurement of productivity growth, which allows for improvement in efficiency as well as technical progress.

The idea of comparing the input of a decision making unit over two periods of time (period 1 and period 2) by which the input in period 1 could be decreased holding the same level of output in period 2 is the basis of the Malmquist Index[9]. Färe et al. (1994) developed a Malmquist productivity measures using the DEA approach based on constant returns to scale[10]. The Malmquist productivity index (M) enables productivity growth to be decomposed into changes in efficiency (catch-up) and to changes in technology (innovation).

We follow the method of Caves et al. (1982) and Zhu (2003) in calculating the Malmquist productivity index. Both studies employ the technology in period 2 as the reference technology. Alternatively, the technology in period 1 (base period) can also be used as reference technology[11]. This is the approach taken by Casu et al. (2004), Canhoto and Dermine (2003), Wheelock and Wilson (1999) and Färe et al. (1994). The difference in the reference technology used affects the magnitude in interpreting the index. When the reference technology is based on period 2, then $M > 1$ implies a deterioration in productivity over the period under study. Alternatively, when the

---

methods when the sample size is small.

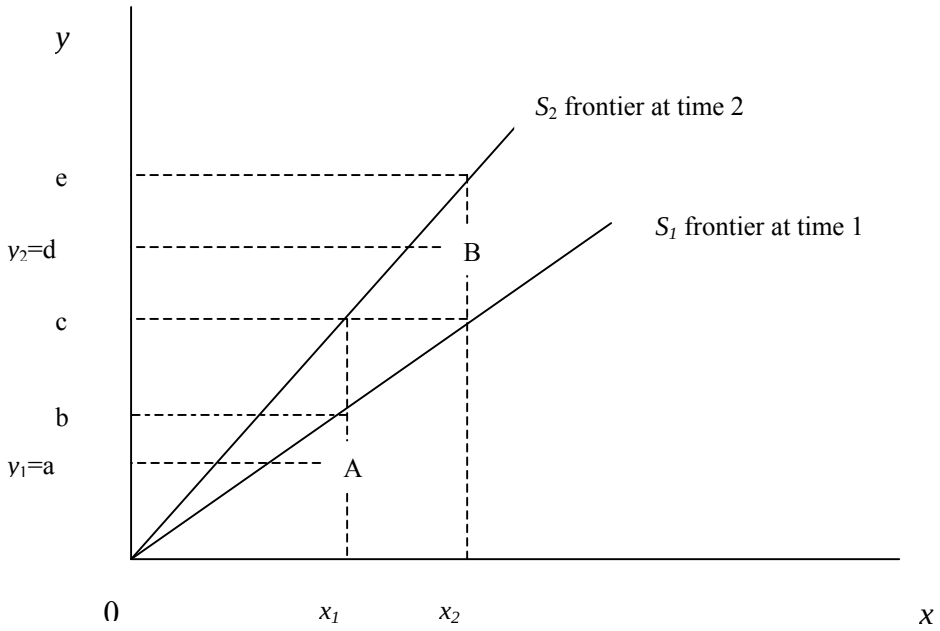
[9] Grosskopf (2003) provides a brief history of the Malmquist productivity index and discusses the theoretical and empirical issues related to the index. For the decomposition of Malmquist productivity index, see Lovell (2003).

[10] Ray and Desli (1997) proposed the decomposition of the same Malmquist index using a variable returns to scale frontier as the benchmark, which may lead to different conclusions concerning the sources of productivity growth.

[11] Casu et al. (2004), Canhoto and Dermine (2003), Wheelock and Wilson (1999) and Färe et al. (1994)

reference technology is based on period 1, then M > 1 implies an improvement in productivity. An illustration using the one input one output case is shown in Figure 1 below.

Figure 1



Points A and B represent observations in periods 1 and 2 respectively. The rays from the origin S_1 and S_2 represent frontiers of production for periods 1 and 2 respectively. Relative efficiency is measure in one of two ways. The relative efficiency of production at A compared to the frontier S_1 is $d_1(y_1,x_1)$ = 0a/0b. But compared with the period 2 frontier S_2 it is $d_2(y_1,x_1)$ = 0a/0c. The relative efficiency of production at B compared to the period 2 frontier S_2 is $d_2(y_2,x_2)$ = 0d/0e. Compared with the period 1 frontier S_1, the relative efficiency is $d_1(y_2,x_2)$ = 0d/0c. The Malmquist index (M) of

total factor productivity change is the geometric mean of the two indices based on the technology for periods 1 and 2 respectively. In other words:

$$M = \left[\frac{d_1(y_1, x_1)}{d_1(y_2, x_2)} \frac{d_2(y_1, x_1)}{d_1(y_1, x_1)} \right]^{\frac{1}{2}} \qquad (2)$$

An equivalent way of writing (2) is:

$$M = \frac{d_1(y_1, x_1)}{d_2(y_2, x_2)} \left[\frac{d_2(y_2, x_2)}{d_1(y_2, x_2)} \frac{d_2(y_1, x_1)}{d_1(y_1, x_1)} \right]^{\frac{1}{2}} \qquad (3)$$

or $M = ET$

where

M = the Malmquist productivity index

E = a change in efficiency over the period t and t+1 (the term outside the square bracket)

T = a measure of technical progress measured by shifts in the frontier from period 1 and 2 (the two ratios in the square bracket).

When the reference technology is based in period 2 as in (3), then $M < 1$ means that there has been a positive total factor productivity change between periods 1 and 2.

5.0 Data and empirical results

Two approaches are normally taken in determining what constitutes bank input and output. Under the intermediation approach, bank assets measure outputs and liabilities

measure inputs. In contrast, inputs in the production approach are physical entities such as labour and capital. Deposits are a measure of output. In this study, we use three inputs and three outputs selected under the intermediate approach. Inputs are the number of employees (LAB), fixed assets (FA) and total deposits (TD). Outputs are total loans (LOANS), other earning assets (OEA), and other operating income (OOY). The OOY variable is selected to reflect the growing contribution of non-interest income to banks' total income[12].

Table 1 provides a snapshot of the data. Except for LAB, other variables are measured in real terms (1994 = 100). The total number of bank-year observations is 193. Most of the data for the foreign banks are not available for 1994 since not all of them had been locally incorporated by this date. After 1997, some data are not included due to the increase in merger activity that took place after the Asian financial crisis. Because of the unavailability of data and the merger activities, the number of observations in 1994 and 2000 is only 20. The average number of observation for other years (1995 to 1999) is 30.

Table 1: Descriptive Statistics of Bank Inputs and Outputs 1994-200

Variable	Mean	Std. deviation	Minimum	Maximum
LAB	1903.3	2384.8	70	12200
TD	7423.3	9629.0	131.4	60260.4
FA	110.4	153.6	1.7	792.2
LOANS	6620.3	8907.3	146.3	61003.9
OEA	4164.9	5822.8	76	32091.0
OOY	95.3	130.7	-4.6	800.7

Notes: LAB = number of bank employees; TD = total deposits; FA = fixed assets; OEA = other earning assets; and OOY = other operating income. c. Figures are in thousands of ringgit Malaysia (RM) except for the number of bank employees.

This study covers the period 1994 - 2000. The starting period was the first year all locally incorporated foreign banks, were required to publish their annual financial statements. Observations after 2000 are excluded because of the major

[12] In 1999, the OOY of the banks in the sample on average stood at 11.38%. Other studies that have used this measure include

consolidation that occurred in the years following. The data sample consists of 193 bank-years. Table 1 shows the wide differences in the raw variables used in the study. The larger banks have grown rapidly over this period with employment rising 70 per cent and loans by 355 per cent. In contrast small banks have contracted their workforce and seen loans shrink by 55 per cent. The growing influence of fee income on the revenue of the banks is seen in the operating income rising by an average of 175 per cent over the period.

Table 2 shows the structure of the commercial banks. It shows the dominance of domestic banks in the industry based on the selected input and outputs. With the exception of OOY, the market share of the foreign banks is around 20%.

Table 2: Structure of the banking industry in 1995 (share %)

	LAB	TD	FA	LOANS	OEA	OOY
Domestic banks (n=21)	81.6	78.6	77.9	76.0	79.6	65.5
Foreign banks (n=11)	18.4	21.4	22.1	24.0	20.4	34.5

Under the assumption of VRS, the average pure technical efficiency between 1994 and 2000 was 83.21%. This means that the commercial banks could have produced, on average, the same amount of outputs with approximately 16.79% fewer resources than they actually employed[13]. Under the CRS assumption, the average efficiency score was around 56.57%. If PTE is greater than SE as shown by the table below, then inefficiency is caused by scale inefficiency. Putting it in another way, if there is a large difference between the efficiency scores obtained under the CRS and VRS assumptions, then this is evidence of scale inefficiency. The results show that on

Maudos and Pastor (2003), Yildirim (2002) and Siems and Barr (1998).

average, the inefficiency that the banks have experienced is due to scale inefficiency. This implies that the banks have difficulty in finding an optimal combination between various inputs to produce the desired output[14].

Table 3: Summary of efficiency score by bank ownership (1994 – 2000)

Bank	1994	1998	2000	1994-2000
Average OTE				
All Banks	0.8941	0.6045	0.6237	0.5657
Domestic	0.8940	0.5308	0.5093	0.4768
Foreign	0.8944	0.7319	0.7174	0.7119
Average PTE				
All Banks	0.9356	0.7888	0.8895	0.8321
Domestic	0.9322	0.6979	0.7894	0.7600
Foreign	0.9421	0.9460	0.9714	0.9507
Average SE				
All Banks	0.9567	0.7691	0.6972	0.6744
Domestic	0.9610	0.7701	0.6486	0.6331
Foreign	0.9487	0.7675	0.7501	0.7422

Note:. Inputs are the number of labour (LAB), fixed asset (FA) and total deposits (TD). Outputs are total loans (LOANS), other earning assets (OEA) and other operating income (OOY).

The analysis of efficiency focuses on bank ownership. Domestic banks are classified as either state-owned banks or private-owned banks. A bank is categorised as state-owned if a substantial part of its shares is owned by the government-owned agencies or directly owned by the government via the Ministry of Finance. Out of 32 banks observed between 1994 and 2000, 21 are domestic and the remainder are foreign. Table 3 shows that, at the beginning of the period there was little difference in the average performance of domestic and foreign banks. In the depths of the Asian financial crisis, when loan losses were at their peak, on average, domestic banks had seen a dramatic decline in relative efficiency, while foreign banks, that were least exposed to the domestic market had a higher average score. By the end of the period,

[13] This finding is similar to Katib and Matthews (1999). Laeven (1999) also found an average efficiency of 70%.

foreign banks had maintained their efficiency lead. A Student 't' test is used to evaluate the differences in efficiency score of banks according to ownership. Table 4 shows that there are significant differences in the average scores of domestic and foreign banks.

Table 4: Efficiency scores and bank ownership (1994 – 2000)

Efficiency	Domestic banks[a]	Foreign banks	t-statistics	Significance level
Mean OTE	0.4768	0.7119	-6.6758*	0.0000
Standard deviation	0.0251	0.0300		
No. of observations	120	73		
Mean PTE	0.7600	0.9507	-7.3834*	0.0000
Standard deviation	0.0189	0.0115		
No. of observations	120	73		
Mean PTE	0.6331	0.7422	-3.2142*	0.0015
Standard deviation	0.0203	0.0278		
No. of observations	120	73		

Note: [a] Local banks consist of both private banks and state-owned banks.
* significant at 1% level.
.

The results enable us to identify efficient from inefficient banks. Efficient banks have a score of 1 and inefficient banks have a score of less than 1. However, an important issue is the identification of the characteristics of banks that constitute efficiency. Table 5 summarises the results of Tobit regression where the dependent variable is pure technical efficiency (PTE).

Table 5

Tobit Regression, Dependant Variable PTE, Number of observations 193

Variable	Coefficient	P Value	Coefficient	P Value
Intercept	0.244	0.414	0.158	0.581
ROA	1.683	0.304	1.758	0.270
MSA	3.109	0.000***	3.142	0.000***
CR5	0.737	0.187	0.964	0.067*

[14] This is also confirmed by Yildirim (2002) and Katib and Matthews (1999).

RLLPL	0.434	0.707	0.979	0.388
OWNER	0.337	0.000***	0.337	0.000***
GRW	0.002	0.551	-	-
DCR	-	-	-0.092	0.025**
LR $\chi^2(6)$	96.7	0.000***	101.4	0.000***

Notes: ROA = percentage of pre-tax profit to total asset. MSA = ratio of bank assets to total. CR5 = Concentration ratio of 5 largest banks (measure of market power), RLLP = ratio of loan loss provision to total loans, OWNER = Ownership dummy (1 = foreign, 0 = domestic), GRW = real GDP growth, DCR = post Asian financial crisis dummy (0 = 1994-97, 1 = 1998 – 2000). *** = significant at 1% level. ** = significant at 5% level. * = significant at 10%

This result shows that ownership and size matter. The post crisis dummy also shows that on average bank efficiency worsened in the aftermath of the Asian financial crisis. Smaller, domestic banks saw a reduction in efficiency score relative to larger domestic or foreign banks. The worsening in score need not be interpreted as a weakening of technical efficiency but rather as an adjustment to balance sheets caused by loan losses. However, efficiency was unrelated to a measure of risk or loan quality (RLLPL). This is possibly because large domestic banks and foreign banks also made losses but to a lesser degree and all banks made appropriate provisions in the aftermath of the crisis.

Table 6 shows the Malmquist productivity index and the sources of productivity growth; efficiency change and frontier shift or catching-up effect and shifting-up effect. The table reports the changes in productivity during two consecutive years (taking the second year to construct the benchmark technology or reference technology) as well as changes between 1994 and 2000. The Malmquist productivity index (M) measures the change in productivity between two periods. Since technology in the second period is used as reference technology, then if $M < 1$, there is productivity growth. If $M > 1$, productivity deteriorates and if equal to one, productivity remains unchanged.

On average, productivity has increased over the 1994-2000 period for both domestic and foreign banks in our sample. The average change in the Malmquist

productivity index is about 20-25%. The main source of productivity growth comes from technical change or innovation. This implies that the frontier has shifted outward by 50.2%. On the other hand, technical efficiency has deteriorated. During the first period (1994/98), productivity improves, with foreign banks showing a much faster pace of productivity growth. Productivity declines during 1998/2000 for domestic banks caused mainly by the fall in technical innovation.

Table 6:
Malmquist productivity index and sources of productivity growth for Bank

Banks	1994-1998	1998-2000	1994-2000
Malmquist Index			
Domestic banks	0.919	1.021	0.806
Foreign Banks	0.740	0.899	0.740
Efficiency Change			
Domestic banks	1.644	1.103	1.600
Foreign Banks	1.310	1.021	1.515
Technical Change			
Domestic banks	0.554	0.960	0.503
Foreign Banks	0.542	0.905	0.499

Note: The calculation of productivity index is done based on the assumption of constant returns to scale and under input orientation. $M > 1$ means deterioration in productivity, $M=1$ means no change in productivity and $M < 1$ means improvement in productivity.

Our results suggest that while there was little difference in the average efficiency between domestic and foreign banks at the beginning of the period, it was the growth in productivity over the period that provided foreign banks with an efficiency advantage. In particular, the Asian financial crisis exposed domestic banks to greater financial stress. Table 6 shows that the differences in productivity are not related to differences in technical efficiency. We can interpret the results as differences caused by risk exposure. Malaysian domestic banks were more exposed to the Asian financial crisis than foreign banks operating in Malaysia.

Section 7 Conclusion

We have examined the technical efficiency of domestic and foreign banks in Malaysia using the DEA approach over the period 1994-2000. We use three inputs: the number of bank employees, fixed assets and total deposits. Outputs of the bank are also three: total loans, other earning assets, and other operating income. Our findings show that foreign banks on average were more efficient than domestic banks over this period. The results indicate that the main source of inefficiency in the Malaysian banking system is scale inefficiency (failure to find an optimal combination of inputs to produce the desired level of output). Based on pure technical efficiency, the performance of the Malaysian banks is relatively stable, with the score always above 80% except in 1998 and 1999. The same pattern applies to the overall technical efficiency and the scale efficiency, except that their scores are relatively lower. An examination of the characteristics of efficient banks showed that they were typically large and/or foreign. The Asian financial crisis saw a reduction in average efficiency allowing for size and ownership.

We constructed a Malmquist productivity index and identified the sources of productivity growth. The sample period is from 1994 until 2000 with a total of 193 observations. The study follows the approach taken by Cave et al. (1982) and Zhu (2003). The results show in the 1994/2000 period, productivity growth was on average between 20 and 25% and such growth has been contributed by improvement in technical change rather than improvement in technical efficiency. On balance foreign banks exhibited marginally greater productivity growth than domestic banks. However, this result should be interpreted with caution as the better productivity performance of foreign banks may have less to do with efficiency and more to do with

the exposure of their respective balance sheets to macroeconomic shocks and the environment of risk.

References

Altunbas, Y., and Molyneux, P., 1996, Cost economies in EU banking system, *Journal of Economics and Business*, Vol. 48, Issue 3, pp. 217-230.

Avkiran, N.K., 1999. An application reference for data envelopment analysis in branch banking: helping the novice researcher, *International Journal of Bank Marketing*, 17(5), pp. 206-220.

Banker, R.D., Charnes, A., and Cooper, A.A., 1984, Some models for estimating technical and scale inefficiencies in data envelopment analysis, *Management Science*, 9, pp. 1078-1092.

Berger, A.N., and Humphrey, D.B., 1997, Efficiency of financial institutions: international survey and directions for future research, *European Journal of Operational Research*, 98, pp. 175-212.

Bhattacharyya, A., Lovell, C.A.K., and Sahay, P., 1997, The impact of liberalization on the productive efficiency of Indian commercial banks, *European Journal of Operational Research*, 98, pp. 332-345.

Canhoto, A., and Dermine, J., 2003, A note on banking efficiency in Portugal, New vs. Old banks, *Journal of Banking & Finance*,27, pp. 2087-2098.

Casu, B., Girardone, C. and Molynuex, P., 2004, Productivity change in European banking: A comparison of parametric and non-parametric approaches, *Journal of Banking & Finance* (forth coming).

Cavallo, L., and Rossi, S.P.S., 2002, Do environmental variables affect the performance and technical efficiency of the European banking systems? A parametric analysis using the stochastic frontier approach, *The European Journal of Finance,* 8, pp. 123-126.

Caves, D.W., Christensen, L.R. and Diewert, W.E., 1982. The economic theory of index numbers and the measurement of input, output and productivity, *Econometrica* 50, pp. 1393-1414.

Charnes, A., Cooper, W.W., and Rhodes, E., 1978, Measuring the efficiency of decision making units, *European Journal of Operational Research*, 2, pp. 429-44.

Chin, K. F. and Jomo, K.S., 2003. From financial liberalisation to crisis in Malaysia, in Chung, H.L (eds), *Financial liberalisation and the economic crisis in Asia*, European Institute of Japanese Studies East Asian Economics and Business Studies, Routledge Curzon, London.

Chu, S.F., and Lim, G.H., 1998, Share performance and profit efficiency of banks in an oligopolistic market: evidence from Singapore, *Journal of Multinational Financial Management,* 8, pp. 155-168.

Coelli, T., 1996., A guide to DEAP Version 2.1: A Data Envelopment Analysis (Computer) Program, CEPA Working Paper 96/08, University of New England, Australia.

Drake L., 2004, Costs and Efficiency in Banking: A Survey of The Evidence from the US, the UK and Japan, in Mullineux A W and Murinde V (eds), *Handbook of International Banking*, Cheltenham: Edward Elgar

Drake, L., 2001, Efficiency and productivity change in UK banking, *Applied Financial Economics*, 11, pp. 557-571.

Drake, L., and Hall, M.J.B., 2003, Efficiency in Japanese banking: An empirical analysis, *Journal of Banking and Finance*, 27, pp. 891-917.

Edwards, S.J., 1999., Bank efficiency and performance: A study of developing countries, PhD Thesis, University of Wales, Cardiff.

Elyasiani, E., and Rezvanian, R., 2002. A comparative multiproduct cost study of foreign-owned bank and domestic-owned US banks, *Applied Financial Economics*, 12, pp. 271-284.

Färe, R., Grosskopf, S., Norris, M. and Zhang, Z., 1994., Productivity growth, technical progress and efficiency change in industrialised countries, *The American Economic Review,* Volume 84, pp. 66-83.

Farrell, M.J., 1957., The measurement of productive efficiency of production, *Journal of the Royal Statistical Society*, Series A, 120, pp. 253-281.

Favero, C., and Papi, L., 1995, Technical efficiency and scale efficiency in the Italian banking system: A non-parametric approach, *Applied Economics*, 27, pp. 385-395.

Fukuyama, H., 1995) Measuring efficiency and productivity growth in Japanese banking: A non-parametric frontier approach, ***Applied Financial Economics***, 5, pp. 95-117.

Grosskopf, S., 2003, Some remarks on Productivity and its decompositions, *Journal of Productivity Analysis*, 20, pp. 459-474.

Hababou, M., 2002 ."Tutorial in DEA". http.//members.tripod.com/moezh/DEAtutorial/DEAtutorial.html.

Hardy, D.C., and di Patti, B.E., 2001, Bank reform and bank efficiency in Pakistan, **IMF Working Paper**, WP/01/138.

Hashim, M.P., 2001, Economies of scale and economies of scope of Malaysian banks, PhD Thesis, Putra University of Malaysia.

Karim, M.Z.A., 2001, Comparative bank efficiency across select ASEAN countries, *ASEAN Economic Bulletin*, 18(3), pp. 289-304.

Katib, M.N., and Matthews, K., 1999, A non-parametric approach to efficiency measurement in the Malaysian banking system, *The Singapore Economic Review*, Vol. 44, No.2, pp. 89-114.

Laeven, L., 1999, Risk and efficiency in East Asian banks, *World Bank, Policy Research Working Papers* 2255.

Lin, S.Y., 1977, Malaysia: money and monetary management since independence 1957 1- 1976, PhD Thesis, Harvard University , Cambridge, Massachusetts.

Lovell, C.A.K., 2003, The decomposition of Malmquist productivity indexes *Journal of Productivity Analysis,* 20, pp. 437-458.

Maudos, J., Pastor, J.M., Perez, F. and Quesada, J., 2002, Cost and profit efficiency in European banks, *Journal of International Financial Markets, Institutions and Money*, 12, pp. 33-58.

Maudos, J., and Pastor, J.M., 2003, Cost and profit efficiency in the Spanish banking sector (1985-1996): a non-parametric approach, *Applied Financial Economics*, 13, pp. 1-12.

McKillop, D.G., Glass, J.C., and Ferguson, C., 2002, Investigating the cost performance of UK Credit Unions using the Radial and non-Radial Efficiency measures, *Journal of Banking and Finance*, 26, pp. 1563-1591.

Molyneux, P., and Forbes, W., 1993, Market structure and performance in European banking, Institute of European Finance, RP 93/5.

Ray, S.C. and Desli, E., 1997, Productivity growth, technical progress and efficiency change in industrialised countries: Comment, *The American Economic Review*, 87, pp. 1033-1039.

Rezvanian, R., and Mehdian, S., 2002, An examination of cost structure and production performance of conventional banks in Singapore, *Journal of Banking and Finance*, 26, pp. 79-98.

Siems, T.F. and Barr, R.S., 1998, Benchmarking the productive efficiency of U.S. banks,. *Financial Industry Studies*, Federal Reserve Bank of Dallas.

Tahir, I.M., 1999, Market structure and efficiency in ASEAN banking, PhD Thesis, University of Wales, Bangor.

Tavares, G., 2002, *A bibliography of data envelopment analysis (1978-2001)*, Rutcor Research Report, Rutgers University, USA.

Wheelock, D.C. and Wilson, P.W. (1999), Technical progress, inefficiency and productivity change in U.S. banking, 1984-1993, *Journal of Money, Credit and Banking* 31, pp. 212-234.

Yildirim, C., 2002, Evolution of banking efficiency within an unstable macroeconomics environment: the case of Turkish commercial banks, *Applied Economics*, 34(18), pp. 2289-2302.

Zhu, J., 2003, *Quantitative models for performance evaluation and benchmarking*, Kluwer Academic Publishers.