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Full Length Research Paper

Conventional banks and productivity level: The Malaysian perspective

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Data Envelopment Analysis (DEA) is specially adopted to assess the efficiency of conventional banks in Malaysia. Specifically, this paper investigates the productivity level of the conventional banks in Malaysia. The analysis is based on a data set of 20 banks over the period of 1998-2007. Results indicate that the conventional banks exhibit an improvement in their productivity index. While 14 banks register improvement in their productivity levels, 5 banks register deterioration in their productivity levels during the same period. This reveals that there is a minimal input waste. The results also suggest that the implementation of the Financial Sector Master Plan (FSMP) is somewhat effective as the overall efficiency level improves.

Key words: Banks, productivity, efficiency.

INTRODUCTION

The globalisation and liberalisation in banking industry was initiated to create a more competitive environment. This has aimed to result in an increase in efficiency and productivity of the industry. Due to the radical change of policy in the banking industry since the 1997 financial crisis, constant evaluation of its efficiency will be a valuable input for both practitioners and academics as well. On the other hand, the measure of efficiency of banks is an indicator of success and productivity improvement has been seen as key measures to control the operating cost of financial institutions. This leads to the need to understand the current position of the banks in term of their efficiency and productivity. Since 1997, the number of domestic banks has declined as a result of consolidation and merger. 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 bank branches, relocation of bank branches and redundancy. Similarly, the number of foreign banks has declined.

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The urgency to consolidate the banking sector was apparent during the Asian financial crisis that struck the region in 1997-1998, which exposed the vulnerabilities of the small banking institutions and the need for these institutions to maintain a high level of capital.

Furthermore, given the fact that much of the required financing in Malaysia was intermediated through the banking system, the risk associated with cyclical downturn in the economy would be much concentrated in the banking system. In order to minimize the potential impact of systemic risks on the banking sector as a whole, following the deepening of the financial crisis, the Government took stronger measures to promote merging of banking institutions.

There are two important development plans in place – the Financial Sector Master Plan (FSMP) launched on March 2001 and the Capital Markets Master Plan (CMMP). CMMP is a comprehensive plan to develop the capital market and guide it in the direction of greater deregulation and liberalisation in the future. FSMP sets out a ten year plan 'to develop a more resilient, competitive and dynamic financial system with better practices, that supports and contributes positively to the growth of the economy throughout the economic cycle

and has a core of strong and forward looking domestic financial institutions that are more technology driven and ready to face the challenges of liberalisation and globalisation'. The development of domestic institutions that form the core of an efficient, effective and stable financial sector is an important part of this process (Bank Negara Malaysia, 2001).

Objectives of the study

The objectives of the paper are constructed to reflect the empirical work of this paper. Hence, this study investigates the productivity level of conventional banks in Malaysia. This objective requires the calculations of efficiency scores of each bank over the period 1998 to 2007 using the DEA approach.

Literature review

Bank efficiency and productivity

Farell (1957) is the first to discuss concept of measuring efficiency empirically. Njie (2007) found that technical efficiency and pure technical efficiency ranged from 97.7-100%. Matthews and Mahadzir (2006) found that average pure technical efficiency is 83.21% and foreign banks have a higher efficiency level than domestic banks. Average efficiency for domestic banks is 76%, while foreign banks register 95.07%. Katib (1999) found that technical efficiency ranged from 68- 80% but there was a waste of resources Some findings showed that the efficiency of Malaysian banks before and after the crisis was not significantly different (Majid et al., 2003). In the mean time, Malaysian banks exhibited a commendable overall efficiency level of 95.9% during 1998-2003, hence suggesting minimal input waste of 4.1% (Sufian, 2004).

A firm's productivity is the ratio of outputs to inputs and it depends on production, process technology, and differences in environments in which production occurs, among other variables. Over the last decade, there has been considerable amount of research performed to study the productivity changes in the commercial banking industry aimed at informing regulators and practitioners faced with a changing environment in the banking industry (Casu et al., 2004). Njie (2007) studied the impact of financial liberalisation of banking industry in Malaysia. He found that during the period of 1999 to 2005, Malaysian banks achieved a total factor productivity growth of 3.1%. The growth of productivity of these banks was attributed to technological change rather than technical efficiency change. Matthews and Mahadzir (2006) examined the productivity of domestic and foreign commercial banks in Malaysia from 1994-2000. The results showed that in the 1994/2000 period, productivity growth was on average between 20 and 25% and such growth was contributed by the improvement in technical change rather than improvement in technical efficiency.

Krishnasamy et al. (2004) investigated Malaysian banks post-merger productivity changes. They found that during the period of 2000-2001, post-merger Malaysian banks achieved a total factor productivity growth of 5.1%. However, eight banks posted a positive total productivity growth ranging from 1.3 - 19.7%. The results also suggested that there was indeed a rapid technological change of post-merger Malaysian banks ranging from 5.0- 16.8%. Sufian and Ibrahim (2005) applied the Malmquist Productivity Index method to investigate the extent of off-balance sheet (OBS) items in explaining Malaysian banks total factor productivity changes. They found that the inclusion of OBS items resulted in an increase in the estimated productivity levels. Krishnasamy (2003) used both DEA and Malmquist total factor productivity index (MPI) to evaluate bank efficiency and productivity changes in Malaysia over the period 2000–2001. The results indicated that total MPI increased in all the banks studied. The growth of productivity of these banks was again attributed to technological change rather than technical efficiency change. Dogan and Fausten (2003) examined the impact of deregulation and technological change on the productivity of Malaysian banks over the period 1989– 1998. The results suggested that productivity of Malaysian banks deteriorated during the decade 1989– 1998 and the decline range was between 3.3- 5.6%. The investigation suggested that regulatory reform and liberalisation were not sufficient conditions for productivity improvement.

Sufian (2005) presented the productivity changes of Malaysian banks during the post crisis period of 1998-2003. The results suggested that the productivity regress of 6.3% was recorded throughout the study period and it was indeed supported by technology. Some empirical findings suggest that Malaysian NCBFI have exhibited productivity regress due to efficiency decline rather than technological regress (Sufian, 2007). The main source of productivity growth is technical change and foreign banks have a higher efficiency than domestic banks (Matthew and Mahadzir, 2006). Meantime, Malaysian banks experience mild decreasing annual productivity change of 2.37%, driven primarily by technical change, which has declined over time (Majid et al., 2008). Some evidence shows that the domestic banks have recorded an increase in productivity during 1998-2006. The decomposition of the productivity change index indicates that the domestic banks' productivity progress is mainly attributable to technological change rather than technical efficiency change during the years before the financial crisis whilst in the latter years, recorded increase in productivity (Rahim and Hamdan, 2008). Some continuously support that banks experienced average productivity growth of 1.3% and in addition, the source of productivity improvement was attributed to efficiency

Table 1. List of banks sample.

Bank	Ownership	Abbreviation
Affin Bank	D	AFB
Alliance Bank Malaysia Berhad	D	ALB
AmBank/AMMB Holdings Berhad	D	AMB
EON Bank Berhad	D	EON
Hong Leong Bank Berhad	D	HLB
Malayan Banking Berhad - Maybank	D	MAY
Public Bank Berhad	D	PB
RHB Bank Berhad	D	RHB
Bangkok Bank Berhad	F	BB
Bank of America Malaysia Berhad	F	BA
Bank of Nova Scotia Berhad	F	BNS
Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad	F	BTM
Citibank Berhad	F	CITI
Deutsche Bank (Malaysia) Bhd	F	DB
HSBC Bank Malaysia Berhad	F	HSBC
JP Morgan Chase Bank Berhad	F	JPMC
Royal Bank of Scotland Berhad (The)	F	RBS
OCBC Bank (Malaysia) Berhad	F	OCBC
Standard Chartered Bank Malaysia Berhad	F	SCB
United Overseas Bank (Malaysia)	F	UOB

Note: D = Domestic; F = Foreign.

increase rather than technological change (Khong and Chan, 2008)

RESEARCH METHODS AND MEASUREMENT

Data collection

The study adopted a complete set of secondary data of each of the 20 banks selected. The data were mainly collected from Bankscope database, companies' annual reports and government's reports. Upon collecting the data, computational analysis was conducted using Data Envelopment Analysis Program (DEAP). 2.1 Software and DEA model were used to compute the productivity scores.

Sampling design

This study used a sample size of 20 domestic and foreign banks and the data were collected based on their operations in Malaysia over the period 1998 to 2007. This period represented the post-period of the 1997 Asian financial crisis. In light of this, FSMP was introduced in 2001, and thus, this study analysed the extent to which, the conventional banks in Malaysia attained their productivity levels during this period. In terms of the sampling procedures, the sample was restricted to only conventional type commercial banks in Malaysia; hence, Malaysian Islamic Banks, Development Banks, Investment Banks, Export-Import Banks and Cooperative Banks were dropped or excluded in this study. And another requirement was that all the banks selected must have been operational from 1998 to 2007 for the purpose of consistency. It should be noted that Bank of China and CIMB Bank were also excluded (due to inconsistency of the period of operations and merger activities). Finally, only 20 banks of the conventional type were chosen for this study and the list of banks chosen is shown in Table 1.

Methods of analysis

DEA is a nonparametric estimation method which involves the application of mathematical programming to observed data in order to locate a frontier which can be used to evaluate the efficiency of each of the bank for the observed output and input quantities. The data that involve descriptive statistics analysis are the input and output selected in the DEA analysis. As for this type of study, researcher tends to adopt a non parametric approach. Under the non parametric approach, the researchers use Data Envelopment Analysis (DEA) model to analyse productivity or even efficiency level of banks as developed by Coelli (1996).

Banks' inputs and outputs are needed for computerising of efficiency and productivity scores. The output produced by banking institutions is unique as it is intangible. Two methods are available in defining bank's inputs and outputs, namely the production approach and intermediation approach. The main difference between these two approaches is how deposits are treated. Financial institutions produce services such as loans and deposits by using capital and labours as inputs (Benston, 1965). Meanwhile, banks transform deposits and borrow funds into loans and other assets. Under intermediation approach, financial institution's outputs are the value of revenue bearing assets such as loans and investment, while deposits, borrow funds as well as capital and labours are considered as inputs (Sealey and Lindley, 1977).

Moreover, results that border between zero and one score (0-1) with complete efficient bank has an efficiency score of one. This applies to both efficiency and productivity level. To find PTE, technical efficiency relative to a frontier exhibits variable returns to scale. The linear programming problem as presented below for each bank in the sample is solved using DEAP 2.1 Software.

Table 2. Productivity level.

Malmquist Productivity Index	Productivity level
M > 1	improvement in productivity
M = 1	no change in productivity
M < 1	deterioration in productivity

Adapted from: Färe et al. (1994). Productivity growth, technical progress and efficiency change in industrialised countries. The American Economic Review, 84, 66-83.

min PTE_k
$o_k \leq Z0$
$PTE_k i_k \geq ZI$
$\sum_k Z\, i = 1$
$Z \geq 0$
$K = 1, ..., K$

Where, given sample size of *K* banks;
o_k is a *m* x 1 vector of output produced by bank
k i_k is a *n* x 1 vector of inputs produced by bank *k*
O is a *K* x *m* matrix of outputs produced by K banks in the sample
I is a *K* x *n* matrix of inputs utilized by K banks in the sample
Z is a vector of *n* x 1 vector of intensity weights used to construct the frontier.

Rezvanian et al. (2008) studied the efficiency change, technological progress and productivity growth of private, public and foreign banks in India.

There are several established productivity indices developed by Fisher, Tornqvist, and Malmquist. Calculation of the Fisher and Tornqvist indices requires information about prices, whereas the Malmquist index is quantity based. This study follows Malmquist productivity index approach to measure the productivity change of banks. Total Factor Productivity (TFP) growth measures how much productivity grows or declines over time. When there are more outputs relative to the quantity of given inputs, then TFP has grown or increased. TFP can grow when adopting innovations such as electronics, improved design or what is called technological change. TFP can also grow when the industry uses their existing technology and economic inputs more efficiently; they can produce more while using the same capital, labour and technology or more generally by increase in technical efficiency. TFP change from one year to the next is therefore consisted of technological change and changes in technical efficiency. This study used the output-oriented model of DEA-Malmquist where it was calculated from efficiency scores based on DEA linear programming approach to put much weight on the expansion of output quantity out of a given amount of inputs.

Therefore, TFP index is a ratio of the weighted aggregate outputs to weighted aggregate inputs, using multiple outputs and inputs. This index utilized the geometric mean of two-year efficiency measures.

Following Färe et al. (1994), the Malmquist productivity index for bank i between year t and t-1 can be defined as:

$$M = \frac{D^{t+1}\left(x^{i,t+1}, y^{i,t+1}\right)}{D^{t}\left(x^{i,t}, y^{i,t}\right)} \left[\frac{D^{t}\left(x^{i,t+1}, y^{i,t+1}\right)}{D^{t+1}\left(x^{i,t+1}, y^{i,t+1}\right)} \frac{D^{t}\left(x^{i,t}, y^{i,t}\right)}{D^{t+1}\left(x^{i,t}, y^{i,t}\right)} \right]^{1/2} = \Delta E \cdot \Delta T$$

Where x and y denote as input vector and output vector in year t respectively, and D is output distance function. The first term represents the change in technical efficiency (E) and the expression in square brackets represents technological change (T). M>1 means that period (t+1) productivity is greater than period t productivity, whilst M<1 means productivity decline and M=1 corresponds to stagnation. The same interpretation applies to the numerical values obtained for the efficiency and technology indices.

RESULTS

Descriptive statistics analysis

The inputs used are fixed assets and deposits. Fixed assets for banks include property, plant and equipment. On the other hand, deposits include demand deposits, saving deposits, fixed deposits as well as inter-bank deposits and borrowings. The two outputs chosen in this study were other earning assets and loan. Other earning assets consist of bank deposits, securities (government/ quasi-government, bank issued and others) and other investment. Loans included performing loans, non performing loans and loan loss reserves.

Productivity analysis

The calculation of productivity index was done based on the assumption of various returns to scale (VRS) and under output orientation. The first period is used as reference or base then the productivity level can be summarized in Table 2.

As given in Table 3, the Malmquist Productivity Index improved from year 1999 (1.022%) to 2000 (1.044%). The efficiency change in year 1999 was 1.069% and technological change was 0.955% in the same year. Hence, it seemed that the technical efficiency change could have contributed more proportion to productivity improvement in year 1999. As of year 2000, the productivity index was 1.044% and hence, it was indeed an improvement in productivity. The efficiency change was 0.956% and technological change was 1.092%. Hence, technological improvement contributed more proportion to productivity improvement rather than the efficiency factor. However, in year 2001, the Malmquist Productivity Index dropped to 1.028%. During this period, efficiency improvement contributed more towards productivity improvement.

As of 2002, the productivity index was 1.024 and thus, it was an improvement in productivity. Technological

Table 3. Malmquist productivity index: summary of annual means.

Year	Malmquist productivity index	Technological change	Efficiency change
1999	1.022	0.955	1.069
2000	1.044	1.092	0.956
2001	1.028	0.966	1.064
2002	1.024	1.098	0.932
2003	1.013	0.927	1.093
2004	0.989	1.015	0.974
2005	1.024	1.021	1.002
2006	1.018	1.065	0.956
2007	0.987	0.933	1.057
Mean	1.017	1.007	1.010

Notes. All the reported indices are relative to the previous year.

improvement contributed more than efficiency change to the productivity improvement. In 2003, the index was 1.013 and hence, an improvement in productivity was recorded. The efficiency change was 1.093 and technological change was 0.927. Hence, the efficiency improvement contributed to productivity improvement. In the year 2004, the Malmquist Productivity Index was 0.989. This showed that it was deterioration in productivity. However, technological improvement contributed more to productivity improvement. In the year 2005, the productivity index was 1.024 and an improvement in productivity was recorded. The efficiency change was 1.002 and technological change was 1.021. Hence, technological improvement contributed relatively more as compared to efficiency change.

The productivity index was 1.018 and there was an improvement in productivity in 2006. Technological improvement contributed more than efficiency change to the productivity improvement. Meanwhile, in the year 2007, the productivity index was 0.987 and thus there was deterioration in productivity compared to the previous year. The efficiency change was 1.057 and technological change was 0.933. Hence, the efficiency improvement contributed more to productivity improve-ment (as compared to the technological change). As presented in Table 4, there were 14 banks (AFB, AMB, EON, MAY, PB, BB, BA, BNS, DB, HSBC, JPMC, RBS, OCBC, UOB); this was registered as an improvement in productivity over the period 1998 to 2007 on average. On the other hand, HLB productivity index was at par (1.0) from 1998 to 2007. However, there were 5 banks (ALB, RHB, BTM, CITI and SCB); this was registered as deterioration in their productivity levels. More details of the productivity scores of each bank over the period 1999 to 2007 are given in Table 5. Table 6 on the other hand, presents the details of efficiency scores of each bank over the same period.

Conclusion

Overall, the productivity of conventional banks in Malaysia from 1998 to 2007 has shown some improve-ment. It seems that conventional banks on average have improved productivity level at 1.7 percent per annum. These findings are consistent with Njie (2007), Matthews and Mahadzir (2006), Krishnasamy et al. (2004), Krishnasamy (2003), Ab Rahim and Hamdan (2008) and Khong and Chan (2008). It can not be denied that improvement in productivity (as in the case of 1998 to 2007) is very much contributed by efficiency improvement rather than technological improvement. This argument seems to be consistent with Matthew and Mahadzir (2006) and Khong and Chan (2008).

The technological advancement plays a leading role in transforming banking services delivery system. Traditionally, banking activities were labour intensive. However, with the rapid development in information and communication technology and the rising labour costs, banks are able to take advantage of this cost-effective technology. Internet banking, telephone banking, cash and cheque deposit machines and electronic payment system are some of the examples. Indeed, banks have adapted well to this advancement and this contributes to the efficiency and effectiveness of banking operations that have helped banks increase their efficiency and productivity. This is also in line with the recommendation in the FSMP which requires management of banking institutions to accord greater attention to the development of information and communication technology (ICT).

In conclusion, the FSMP objective has been achieved and has proved that the productivity of conventional banks in Malaysia has improved after the implementation of FSMP. The researchers noted that the FSMP has actually stimulated efficiency growth in terms of technological innovation among the banks, but does not see

Table 4. Malmquist productivity index: summary of bank means.

Bank	Malmquist productivity index	Technological change	Efficiency change
AFB	1.008	1.001	1.008
ALB	0.988	0.972	1.017
AMB	1.009	0.976	1.033
EON	1.001	0.976	1.025
HLB	1.000	0.991	1.009
MAY	1.002	0.988	1.014
PB	1.011	0.993	1.017
RHB	0.996	0.981	1.015
BB	1.026	1.001	1.025
BA	1.150	1.144	1.006
BNS	1.024	1.024	1.000
BTM	0.978	0.983	0.994
CITI	0.992	0.991	1.001
DB	1.112	1.112	1.000
HSBC	1.012	0.992	1.021
JPMC	1.039	1.039	1.000
RBS	1.002	1.029	0.974
OCBC	1.004	0.984	1.020
SCB	0.986	0.984	1.002
UOB	1.002	0.981	1.021
Mean	1.017	1.007	1.010

Notes: All the reported indices are relative to the previous year.

Table 5. Productivity scores of conventional banks in Malaysia from 1998 to 2007.

Bank	Productivity score								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
AFB	0.992	0.951	1.170	0.912	0.921	1.108	1.140	0.954	0.965
ALB	0.991	1.042	0.952	0.960	0.975	1.009	0.979	0.967	1.019
AMB	1.053	0.993	0.906	1.019	0.957	1.003	1.031	1.022	1.106
EON	0.990	1.026	1.057	0.908	1.021	1.070	0.952	0.983	1.016
HLB	1.011	0.986	1.023	0.999	0.998	0.963	1.003	1.016	1.004
MAY	1.004	0.978	1.040	1.020	1.001	0.963	1.026	0.995	0.994
PB	1.012	1.037	1.028	1.001	1.124	0.857	1.033	0.986	1.040
RHB	0.991	1.026	1.072	0.965	0.929	0.919	1.033	1.025	1.011
BB	0.997	0.992	1.151	1.034	1.174	1.063	1.015	1.102	0.769
BA	1.408	1.502	0.973	1.174	1.113	0.994	1.161	1.158	0.980
BNS	1.221	1.168	0.773	1.100	1.054	1.080	1.160	1.068	0.722
BTM	0.904	1.058	0.988	1.108	0.912	0.970	0.906	0.937	1.038
CITI	0.941	1.054	1.059	1.201	0.850	0.898	0.984	1.046	0.942
DB	1.180	1.245	1.061	0.907	1.123	1.037	1.082	1.078	1.358
HSBC	0.980	1.027	1.020	1.052	0.958	0.963	1.050	1.020	1.044
JPMC	1.092	1.060	1.004	1.079	1.004	1.071	1.122	0.932	1.003
RBS	0.873	0.946	1.123	1.098	1.305	0.911	0.896	1.110	0.848
OCBC	1.005	0.962	1.132	0.993	0.939	1.040	0.959	0.999	1.022
SCB	0.902	1.013	1.043	0.969	1.107	0.930	1.006	0.926	0.994
UOB	1.012	0.947	1.062	1.040	0.911	0.985	0.987	1.070	1.013
Mean	1.028	1.051	1.032	1.027	1.019	0.992	1.026	1.020	0.994

Table 5. Contd.

SD	0.122	0.129	0.089	0.082	0.110	0.069	0.076	0.064	0.126
Max	1.408	1.502	1.170	1.201	1.305	1.108	1.161	1.158	1.358
Min	0.873	0.946	0.773	0.907	0.850	0.857	0.896	0.926	0.722

Notes: All the reported indices are relative to the previous year.

Table 6. Efficiency scores of conventional banks in Malaysia from 1998 to 2007.

Bank	Efficiency score									
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
AFB	0.947	0.970	0.936	0.940	0.945	0.954	0.956	0.988	0.945	0.930
ALB	0.987	0.976	1.000	0.958	0.921	0.951	0.959	0.949	0.972	0.964
AMB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
EON	0.970	0.969	0.994	1.000	1.000	1.000	1.000	1.000	1.000	0.991
HLB	0.928	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
MAY	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
PB	1.000	1.000	1.000	1.000	1.000	1.000	0.952	0.965	0.977	1.000
RHB	1.000	1.000	1.000	1.000	0.979	0.970	1.000	0.871	1.000	1.000
BB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.923
BA	0.954	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
BNS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
BTM	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
CITI	1.000	0.998	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
DB	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
HSBC	0.915	0.949	1.000	0.895	0.900	0.904	0.906	0.932	0.945	0.981
JPMC	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
RBS	0.904	0.869	0.824	0.867	1.000	1.000	1.000	0.931	0.995	0.964
OCBC	0.984	0.998	0.963	1.000	0.999	0.995	1.000	0.981	0.970	0.978
SCB	1.000	0.976	0.992	1.000	1.000	1.000	1.000	1.000	1.000	1.000
UOB	0.967	0.996	0.973	1.000	1.000	1.000	1.000	0.998	1.000	1.000
Mean	0.978	0.985	0.984	0.983	0.987	0.989	0.989	0.981	0.990	0.987
SD	0.032	0.031	0.041	0.039	0.029	0.025	0.025	0.035	0.018	0.024
Max	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Min	0.904	0.869	0.824	0.867	0.900	0.904	0.906	0.871	0.945	0.923

to have much impact on the efficiency change or improvements in management. These findings suggest that there are still gaps to be filled by the inefficient banks in the sample in order to be competitive in the more liberalised and globalise environment of the future.

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