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Drivers of technical efficiency in Malaysian banking: a new empirical insight

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Restructuring and rationalisation of Malaysian banking in 2000 and the subsequent policy of deregulation and liberalisation adopted by Bank Negara Malaysia (BNM) have resulted in a significant transformation of Malaysian banking. Banks are now poised to play a pivotal role in the economic transformation of the economy as envisaged in the Financial Sector Blue Print 2011–20 of BNM. Using the data envelopment analysis technique, the technical efficiency of 19 commercial banks (8 domestic banks and 11 foreign banks) operating in Malaysia during 2005–12 is evaluated. Then, using bootstrap-corrected efficiency scores, the drivers of bank efficiency were estimated using the Tobit regression approach. Results clearly show that three large domestic banks are not only more efficient than their counterparts, but are also more efficient than the foreign banks. Bank size and return on assets are found to be the significant drivers of technical efficiency of Malaysian banks. Capital adequacy and the advances to deposit ratio also have a role in driving technical efficiency. The results also indicate that banks that are more effective in managing credit risk, as reflected in a lower level of non-performing assets as a percentage of total assets, and have lower levels of personnel expenses to total assets, are more efficient. The findings have significant implications at the individual bank level and also at the policy level.

Introduction

Prior to the Asian financial crisis (1997), the Malaysian banking system was fragmented, with 77 domestic banking institutions, including 22 domestic and 16 foreign commercial banks. The banking system underwent restructuring, consolidation, and rationalisation during 2000, under the initiative of the central bank, Bank Negara Malaysia (BNM), to achieve 'a more effective and competitive banking system' (BNM 2000). Today, there are 34 banking institutions, including 8 domestic and 19 foreign commercial banks. Over the course of implementation of the first Financial Sector Master Plan (FSMP) since 2001, the financial sector has expanded at an average annual rate of 7.3 per cent; to account for 11.7 per cent of real GDP in 2010 compared with 9.7 per cent in 2001. Domestic banks have accumulated strong capital and loan loss buffers, with improvements in underwriting and risk management practices, as well as strengthened governance structures and discipline. During this period, the Malaysian financial system became

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increasingly more diversified and competitive. The risk-weighted capital ratio (RWCR), the return on assets (ROA), and the return on equity (ROE) of the domestic commercial banks rose from 4.2 to 11.7 per cent, from 1.1 to 1.6 per cent, and from 13.7 to 16.7 per cent, respectively, between 2000 and 2010.

As the country aspires to transform into a developed and more competitive economy by 2020 under the government's Economic Transformation Plan, the financial sector is expected to play a crucial role based on innovation and productivity gains as envisioned in the Blue Print of the Financial Sector 2011–20 Financial Sector Blue Print (FSB) released by the BNM in 2012. According to the projections in this document, the total assets of the banking sector are projected to grow to nearly three times the size of GDP by 2020, up from 2.4 times in 2010. Well-functioning and efficient financial institutions and markets, with built-in flexibility to adapt to market needs and opportunities, are central to the optimal allocation of capital to new areas of growth. There is a considerable expectation of the Malaysian government from this sector to the effect that: 'a strong, comprehensive and progressive financial system underpins Malaysia's vision to become a developed nation by 2020' (Najib 2011).

Given the government's expectations of the banking system in ensuring the goal of economic transformation, this paper evaluated the drivers of technical efficiency in Malaysian banking. The approach used is to estimate bootstrapped-corrected efficiency scores before carrying out Tobit regressions to estimate the drivers of the banks' technical efficiency.

Relevance of evaluating bank efficiency

The performance of organisations is often evaluated in terms of their efficiency in the use of resources (Saha and Ravisankar 2000). The concept of efficiency is primarily an engineering concept, concerned at the basic stage with measuring the value of (a single) output for a given level of input. In a wider context, efficiency management is concerned with fuller utilisation of available inputs to achieve an optimal mix of outputs within the boundaries of feasibility in operations. Both capacity utilisation and quality of output are relevant parameters in the measurement of productivity of any decision-making unit (DMU). This concept of productivity/efficiency is also meaningful in the case of banking operations. In the literature pertaining to the performance evaluation of banks, various measures of efficiency have been proposed, such as scale efficiency, scope efficiency, allocative efficiency, productive efficiency, and technical efficiency (Berger et al. 1993). The present paper mainly deals with technical efficiency and total factor productivity (TFP) of banks based on input–output combinations. In the context of a service industry such as banking, technical inefficiency reflects the degree of slack in the utilisation of the physical, financial, and human resources.

The need to study bank efficiency arises for a variety of reasons. First, a measure of (relative) efficiency provides a good indicator of the success or otherwise of a bank in a competitive market; it also reflects the potential for failure of a banking institution. Studies reveal that banks that operate efficiently have a better chance of sustaining their business. Berger and Humphrey (1992) found that during the 1980s, high-cost banks experienced a higher rate of failure than more efficient banks. Similarly, in a study of banks during the 1920s, Wheelock and Wilson (1995) found that the less technically efficient a bank was, the greater its likelihood of failure. Efficiency indices could also be used to evaluate the impact of changes in regulation and in market conditions on the performance of banks. Further, such evaluations will also help a bank in identifying its areas of inefficiency and formulating suitable strategies to improve its position in the market. They can also provide a framework for regulators in which to assess the health of banks and to work out appropriate interventions to prevent systemic failures (Lacasta 1988).

The findings from banking efficiency analyses have been classified into three broad groups according to their contribution: (1) to inform government policy by assessing the effects of deregulation, mergers, or market structure on efficiency; (2) to address research issues by describing the efficiency of an industry, ranking its firms, or checking how measured efficiency may be related to the different efficiency techniques employed; or (3) to improve managerial performance (Berger and Humphrey 1997). So far, there are four survey papers on the analysis of banking efficiency. Berger and Humphrey (1997) reviewed 130 studies and found that 42 of them have used the data envelopment analysis (DEA) approach. Berger (2007) reviewed 100 papers on the application of frontier techniques in assessing the performance of banks. Fethi and Pasiouras (2010) reviewed 196 studies and found that 151 of them have used a DEA-like approach in measuring efficiency, productivity, and growth in banking. Finally, the survey by Paradi and Zhu (2013) is focused on the application of DEA in analysing bank branch efficiency.

Some of the parameters that determine the competitive strength of a bank have been identified as Capital Adequacy, Asset Quality, Human Resources Information, Financial Innovation, Technology, and Brand Equity—not all of which are directly measurable. Fethi and Pasiouras (2010) have noted that commonly used factors in determining bank efficiency are size, profitability, capitalisation, and loans to assets ratio. A single index that can be used to assess the relative strength of a bank is the capital adequacy ratio. Lessons from the recent global financial crisis and the International Regulatory Framework for Banks (Basel-III) developed by the Basel Committee on Banking Supervision suggest the need for a significant increase in the minimum level of capital requirements of banks to improve the banking sector's ability to absorb shocks arising from financial and economic stress. Well-capitalised banks are in a better position to expand their balance sheets, take legitimate risks (and receive higher returns), and undertake such auxiliary services as guarantees/underwriting with credibility; inadequate capital can constrain all of these activities.

The effects of mergers and acquisitions have remained an area of interest for researchers. Contrary to the popular belief that mergers result in improved cost ratios and cost efficiency, this is generally not supported by academic studies. This holds true whether simple accounting ratios are compared pre-merger and post-merger, holding industry effects constant, or in more sophisticated econometric analyses using frontier cost functions (Berger and Humphrey 1992; Rhoades 1993; Peristiani 1997; DeYoung 1997). The effects of mergers on profits have also been investigated. Initial results suggest that profit improves significantly from mergers of large banks (Akhavein et al. 1997). It is argued that merging banks tend to shift their output mix away from securities and toward loans, which raises profit because issuing loans creates more value (and usually more risk) than purchasing securities. This shift in mix may occur because merging banks are better able to diversify these risks, allowing a higher loan/asset ratio to be held with the same amount of capital (see also Benston et al. 1995; Hughes et al. 1996).

Another important issue for bank efficiency is to evaluate whether banks experience increasing returns to scale, constant returns to scale (CRS), or decreasing returns to scale after mergers. Following Zhu and Shen's (1995) returns to scale classification, Lou (2003) supported the findings of earlier studies that decreasing returns to scale oftentimes occurs among larger banks, whereas increasing returns to scale occurs among smaller banks (see, for example, McAllister and McManus 1993; Miller and Noulas 1996; Seiford and Zhu 1999).

Review of studies on efficiency and productivity in Malaysian banking

In their study on the impact of deregulation and technological change in Malaysian banks over the period 1989–98, Dogun and Fausten (2003) computed Malmquist productivity indices using non-parametric DEA. The researchers reported an erosion of banking productivity and concluded that regulatory reform and liberalisation are not sufficient conditions for productivity improvement. Abdul-Majid et al. (2008) used stochastic frontier analysis to evaluate the productivity performance of Malaysian banks during 1996–2002 and reported that banks had experienced mildly decreasing returns to scale and annual productivity growth of 2.37 per cent, driven primarily by technical change. Merged banks were found to have higher input use and lower productivity change, implying that bank mergers had not contributed positively to bank performance. Sufian (2005) estimated productivity changes in Malaysian banks during the post-crisis period of 1998–2003. The results suggested that a productivity decline of 6.3 per cent was recorded during the study period. Matthews and Ismail (2006) examined the technical efficiency and productivity of domestic and foreign banks operating in Malaysia during the period 1994–2000. They concluded that foreign banks had a higher level of efficiency than domestic banks and that efficient banks were characterised by size and not loan quality or profitability. The main source of productivity growth was found to be technological change rather than improvement in efficiency. Using DEA, Marimuthu and Aroklasamy (2011) studied the productivity of 20 domestic and foreign banks operating in Malaysia during the period 1998–2007. Productivity indices were calculated based on the assumption of varying returns to scale. The authors concluded that conventional banks in Malaysia had shown some improvement in their productivity and that the FSMP of BNM was somewhat effective in ensuring an increase in the overall efficiency level.

In her study on the post-merger productivity of 10 Malaysian banks over the period 2000–01 using Malmquist productivity indices, Krishnasamy et al. (2003) found an increase in TFP in eight banks and that the growth in productivity could be attributed to technological change rather than efficiency change. The study estimated that post-merger Malaysian banks had achieved TFP growth of 5.1 per cent. Omar et al. (2006), studying the change in the productivity of the Malaysian banking industry during 2000–04, reported a slight increase in TFP, driven more by scale efficiencies than pure efficiency components. They concluded that there is great potential for the industry to increase productivity through higher utilisation of technology as well as technological knowledge dispersion.

Njie (2007) used DEA-type Malmquist indices on a panel of 15 banks to estimate productivity and efficiency changes in Malaysian banks between 1999 and 2005 and reported that technical efficiency, pure technical efficiency, and TFP had increased by 3.8, 1.1, and 3.7 per cent, respectively, and argued that periodic government intervention in a country's banking industry can be justified on efficiency grounds. Sufian and Ibrahim (2005) also applied Malmquist productivity indices to a sample of post-merger Malaysian banks during 2001–03 to investigate the extent the inclusion of off balance sheet (OBS) items in the output definition of banks affect the estimated change in TFP. These researchers found that inclusion of OBS items results in an increase in estimated productivity levels for all of the banks studied and that the impact seems to be larger on technological change than on efficiency change.

Ismail and Rahim (2009), in their study on the impact of mergers on efficiency and productivity in Malaysian commercial banks covering the period 1995–2005, reported that domestic banks improved their productivity scores more than foreign banks after the merger and the main source of productivity change was technical change. The study also reported that foreign banks are more efficient than local banks. Sufian (2010) examined the impact of mergers and acquisitions on the TFP of the Malaysian banking sector. The findings suggest that the TFP level in the Malaysian banking sector was higher during the post-merger period due to technological progress. In their study on the effect of mergers on the revenue efficiency of Malaysian banks using DEA, Sufian et al. (2012) concluded that the revenue efficiency of Malaysian banks did not significantly improve during the post-merger period.

Methodology

Various techniques have been used to study the efficiency of commercial banks and it has been found that estimates of efficiency are sensitive to the choice of technique, even often reaching contradictory findings. These contradictions may be due to the differences in the manner in which banking institutions are modelled. As Brown and Gardener (1995) noted, the choice of input and output variables in a banking context is crucial. Some researchers view banks as producers of loans and deposit accounts (for example, Sherman and Gold 1985) and measure output either by the number of transactions or by the number of accounts serviced (the production function approach). Others have argued that the output of banks should be measured in terms of the value of loans, with the inputs the costs of labour, capital, operations, deposits, and other resources (for example, Piyu 1992) (the intermediation approach). Unlike the production function approach, which focuses on operating costs and ignores the interest expense, in the intermediation approach, both operating and interest expenses are included in the analysis (Berger et al. 1987). Humphrey (1991) concluded: '. . . the five appropriate inputs are labour, capital, demand deposits, small time and savings deposits, and purchased funds'. There is the additional consideration of whether these input/output parameters should be treated as 'stock' or 'flow' variables (Resti 1997). In practice, researchers have generally been forced to rely on stock measures of output/inputs for most purposes because of the unavailability of data.

This study adopts the DEA approach in evaluating the productivity performance of Malaysian banks. DEA, which was introduced by Charnes et al. (1978), is a non-parametric technique for evaluating the relative efficiency of DMUs, using multiple inputs to produce multiple outputs. It is formed as the piece-wise linear combinations that connect the set of best-practice observations, yielding a convex production possibility. Then it identifies the relatively 'best practice' decisions of DMUs on the efficient frontier (Siems 1992) and determines the inefficiency of the others in the sample accordingly. Therefore, DEA does not require the explicit specification of the form of the underlying production relationships (Bauer et al. 1998). The most efficient banks are rated to have an efficiency score of one, while the less efficient banks score between zero and one. DEA does not give a measure of optimal efficiency; it differentiates DMUs on the basis of relative efficiency.

DEA can be implemented using an output or input orientation. In the output orientation, one measures the extent to which output may have been raised for the given level of inputs used by the DMU. Under the input-orientation approach, the objective is to estimate the degree of potential input savings for a given realised output level (Bougnol et al. 2010). In this paper, the variable returns to scale (VRS) DEA model has been adopted for two reasons. First, the CRS assumption is only valid when all DMUs are operating at optimal scale (Banker et al. 1984). Second, Malaysia's financial markets are not fully developed and therefore perfect competition is unlikely. Moreover, the output-oriented model was adopted in view of the fact that the focus of BNM is primarily on consolidation and expansion through mergers rather than on cost cutting.

The choice of input and output variables necessarily depend upon the nature and the focus areas of banking in the country, as the roles played by the banking system are dictated by the needs of society, the state of the economy, and the expectations of government. Banks in emerging market economies such as Malaysia are primarily in the business of intermediation: they mobilise household savings and deploy them in their lending and investment portfolio. Although technology is one of the key enablers of the banking business, manpower continues to be one of the key inputs of banks. Interest expenditure and Personnel (Establishment) expenditure are therefore two key input variables in the business of banking, and they have direct bearing on the profit position of banks. As banks deploy their resources in their lending and investment portfolio, they earn interest income and also non-interest income through fees and service charges. The efficiency of individual banks is therefore dependent upon their efficiency in combining the inputs to produce the outputs.

Malaysian banks are not entirely free in setting interest rates, either on deposits or loans. Similarly, banks are not entirely free to set recruitment and retention policies: interactions with the heads of human resources in Malaysian banks revealed that Malaysian banks, especially the largest two, are saddled with a good number of aged operational staff; moreover, staff are highly unionised and are not open to adapting to new challenges in the business environment. Aging and legacy issues therefore continue to prove a drag on the efficiency level of domestic banks.

Against this background, therefore, the input variables used in the DEA analysis are Interest Expenditure and Personnel Expenditure; the output variables are Interest Income and Non-interest Income.

Analysis and Findings

Stage 1

We chose the output-orientation model because the emphasis of bank managers is primarily output and market consolidation rather than cost control. We assume that there is data on K inputs and M outputs for each of the n banks. For the ith bank, these variables are represented by the vectors xi and yi, respectively. The output-oriented measure of the efficiency score of a bank $\hat{\theta}_k$ can be obtained by solving the following linear program equation (1):

$$\hat{\theta}_k = \max_{\hat{\theta}_k,\gamma}\Big(\theta > 0 \mid \theta y \le \textstyle\sum_1^n \gamma_i y_i\,;\, x \ge \sum_1^n \gamma_i x_i\,;\, \gamma_i \ge 0; \sum_1^n \gamma_i = 1, i = 1 \dots n\Big) \quad (1)$$

Equation (1) forms a convexity constraint, which ensures that inefficient banks are compared against banks of similar size; the formulation also allows for VRS. In this context, unlike the input-oriented DEA formulation, output orientation solves for the inverse of the efficiency measure to maintain the linear programming problem (Forsund 2001). This implies that the higher the efficiency score, the more inefficient the DMU will be.

Although the basic DEA models (CRS and VRS) have been improved in a number of ways in recent years (see Lovell 1993 and Seiford 1996), one of the main problems faced by researchers using non-parametric methods is the difficulty of drawing statistical inferences. Simar and Wilson (1998, 1999, and 2000) have shown that it is possible to obtain statistical properties via the use of the ‘bootstrap’ approach. According to Dyson and Shale (2010), bootstrap procedures produce confidence limits on the efficiencies of the DMUs, capturing the true efficient frontier within the specified interval. Briefly, bootstrapping efficiency scores involve replicating the data-generating process, generating an appropriately large number of pseudo-samples and then applying the original estimator to these pseudo-samples. The difference between the estimated value and the actual value of the parameter is called the ‘bias’, which arises out of random sampling during the bootstrapping process (Panagiotis 2012). In the case of DEA, the general aim of the bootstrap approach is to simulate the original sample B times, each time recalculating the parameter of interest, which is the DEA efficiency score. This allows B estimates of the parameter, thus making it possible to generate an empirical distribution for the parameter of interest. The empirical distribution can then be used to construct confidence intervals for the DEA efficiency scores, and also obtain other statistical properties. Hence, we adopt the smoothed bootstrap DEA procedure proposed by Simar and Wilson (2007).

The process followed can be summarised as follows:

- Compute the efficiency scores $\hat{\theta}_k$ for each bank $i = 1, \dots, n$, by solving the linear programming model in Equation (1).
- Use the kernel density estimation and the reflection method to generate a random sample of size n from $\{\hat{\theta}_i;\ i = 1, \dots, n\}$ providing $\left\{\hat{\theta}^*_{1b}, \hat{\theta}^*_{2b} \dots\dots, \hat{\theta}^*_{nb}\right\}$

- Obtain the corrected smoothed bootstrap sample (pseudo efficiencies θ_k^* for i = 1, . . . , n);
- Compute a pseudo data set $\{(x, y_{ib}^*; i = 1, ..., n\}$ n to form the reference bootstrap technology using the ratio $y_{ib}^* = \left(\dfrac{\hat{\theta}_i}{\theta_{ib}^*}\right) y_i$.
- Use this pseudo data to compute the bootstrap estimate of efficiency $\hat{\theta}_{nb}^*$ of $\hat{\theta}_i^*$ for each i = 1, . . . , n
- Repeat steps 2–4 a large number, B, of times in order to obtain a set of estimates $\left\{\hat{\theta}_{ib}^*; b = 1, ..., B\right\}$.
- Calculate the bias-corrected estimator of original efficiency scores $\hat{\theta}_i$ for every bank as follows: $\hat{\theta}_i^* = 2\theta_i - B^{-1}\left(\sum_{b=0}^{B} \hat{\theta}_{ib}^*\right)$

These re-sampled estimates may also be used to construct confidence intervals.

The study employed (B = 2,000) bootstrap replications to construct 95 per cent confidence intervals.

Stage 2

The bootstrap-corrected DEA scores obtained in Stage 1 of the analysis were used to investigate the possible drivers of efficiency in Malaysian banking. Mester (1996) used logistic regression to identify the characteristics of efficient banks. The present study investigated the determinants of bank efficiency following a two-step approach, as suggested by Coelli et al. (1998). In most cases, the Tobit approach is appropriate in representing second-stage DEA models (Hoff 2007). The efficiency scores calculated from DEA take values between 0 and 1, making the dependent variable in the second stage censored by nature. Hence, a simple application of Ordinary Least Square (OLS) may produce biased estimates if a significant proportion of the observations are equal to one (Maddala 1983). Tobit regression is appropriate when the dependent variable is bounded, with a positive probability of pile-up at the interval ends either from being censored or from being corner solutions (Wooldridge 2002) and hence is used in the present study.

To determine the influence of bank characteristics on efficiency, the study used the following independent variables in the Tobit regression: log of total assets, other income, advance deposit ratio, operating expenses to total assets ratio, business per employee, return on investment, Capital to Risk (Weighted) Assets Ratio - CRAR, and net Non-performing Asset - NPA ratio, as detailed in Equation (2).

$$\begin{aligned} \hat{\theta}_{bc}^* = \beta_1 + \beta_2(\log TA) + \beta_3 OI + \beta_4 ADR \\ + \beta_5 EOTAR + \beta_6 BPE + \beta_7 ROA \\ + \beta_8 CRAR + \beta_9 NNPARB + \varepsilon \end{aligned} \tag{2}$$

The profile of the technical efficiency scores of the selected banks computed for the sample of 11 foreign banks and eight domestic taken together in Stage 1 of the analysis are presented in Tables 1 and 2, respectively.

The average profile of efficiency scores of banks as presented in Tables 1 and 2 indicate that in general, banks were more efficient between the years 2008 and 2010, but the efficiency level declined in the subsequent 2 years: the average scores of the domestic banks rose from 1.19 in 2010 to 1.25 in 2012, whereas in the case of foreign banks, the average score rose from 1.20 to 1.34. In the case of domestic banks, the fall in the average level of efficiency is mainly contributed by RHB Bank Berhad - RHB followed by Public Bank Berhad - PUB. Incidentally, RHB is likely to be merged with the CIMB Group Holldings Berhad Group in the very near future and PUB made a large capital infusion in 2014 through a rights issue to stave-off any threats of a takeover. The sharper fall in the efficiency level of foreign banks might be a hangover of the global financial crisis in their parent institutions. As per the assessment of BNM, the health of domestic banks in Malaysia remained largely intact during and after the crisis.

It can also be seen that the larger domestic banks were more efficient than their smaller counterparts throughout the study period. This further justified our search for possible drivers of efficiency of Malaysian banks in the subsequent stage of the analysis. In order to gain further insights, the banks were then

Table 1
Profile of Efficiency Scores of Foreign Banks in Malaysia during 2005–12

	2005	2006	2007	2008	2009	2010	2011	2012	Average
Stanchart	1.27702	1.34430	1.36346	1.24595	1.32818	1.27787	1.22722	1.22251	1.28581
OCBC	1.33129	1.32554	1.38911	1.38606	1.55710	1.24343	1.30782	1.37648	1.36460
UOB	1.34680	1.37234	1.34904	1.33976	1.27018	1.21475	1.27438	1.35278	1.31500
RBS	1.51550	1.77448	1.99163	1.28229	1.61189	1.75183	1.11721	1.57365	1.57731
Novascotia			1.47443	1.40434	1.19408	1.01359	1.00000	1.05960	1.19101
Citi	1.30018	1.30302	1.30805	1.23392	1.00000	1.00000	1.07279	1.10415	1.16526
BOC	1.00000	1.20879	1.36480	1.33126	1.00000	1.10410	1.49812	1.51847	1.25319
HSBC	1.33094	1.33706	1.30107	1.27765	1.24162	1.16764	1.27969	1.15735	1.26163
Bangkok		1.00000	1.30298	1.37837	1.39565	1.36026	1.47399	1.53897	1.35003
Deutsche	1.40059	1.58765	1.57344	1.43513	1.00000	1.04044	1.48304	1.40799	1.36603
JPM		1.00000	1.12730	1.00000	1.00000	1.09812	1.05598	1.46215	1.10622
Average	1.31279	1.32532	1.41321	1.30134	1.23624	1.20655	1.25366	1.34310	1.29903

Table 2
Profile of Efficiency Scores of Domestic Banks in Malaysia during 2005–12

	2005	2006	2007	2008	2009	2010	2011	2012	Average
Affin	1.53498	1.65339	1.70927	1.53202	1.41211	1.46797	1.52795	1.56379	1.55018
Alliance	1.39332	1.7308	1.65318	1.51108	1.55461	1.51688	1.52043	1.54631	1.55332
AMB	1.21514	1.33339	1.43404	1.36391	1.30067	1.22535	1.20541	1.26402	1.29274
CIMB	1.18614	1.25828	1.20128	1.17544	1.02839	1.01621	1.00000	1.05935	1.11564
HongLeong	1.39783	1.41602	1.44754	1.35447	1.34723	1.2289	1.2508	1.24271	1.33569
MayBak	1.04581	1.12524	1.1757	1.17992	1.12444	1.00000	1.00000	1.00000	1.08139
PUB	1.11294	1.21083	1.25551	1.21959	1.04954	1.00521	1.0612	1.10007	1.12686
RHB	1.39145	1.37492	1.37853	1.27867	1.08238	1.09772	1.19907	1.23159	1.25429
Average	1.2847	1.38786	1.40688	1.32689	1.23742	1.19478	1.22061	1.25098	1.28876

ranked in terms of efficiency scores in each of the 8 years included in the study (see Table 3).

It can be seen from Table 3 that the technical efficiency scores of the three largest domestic Malaysian banks, viz., May Bank, CIMB, and Public Bank, were higher than that of other banks—not only the domestic banks, but also the foreign banks, except JPM. May Bank, CIMB, and Public Bank were among the top five banks on eight occasions compared with five times each by JPM and Citibank. By comparison, domestic banks, Affin Bank, and Alliance Bank were among the bottom three in all of the 8 years.

The profiles of the average and bootstrap-corrected efficiency scores of the banks in the sample are presented in Table 4. It can be seen from this table that the estimated biases are negative and in some cases quite large.

The profiles of the average and bootstrap-corrected efficiency scores of the banks in the sample are presented in Table 4. It can be seen from this table that the estimated biases, defined as the observed differences between the DEA scores and the mean of their bootstrap distribution, are negative as expected (Simar and Wilson 2000) and in some cases quite large. Larger biases indicate larger confidence intervals, suggesting that the same output could have been produced while scaling back inputs more than what the standard DEA score indicates.

Table 5 presents a description and the expected signs of the explanatory variables used in the analysis. The dominance of a bank is reflected by its size, which is measured as a natural logarithm of its total assets; larger banks are expected to be more efficient and

Table 3
Yearly Rank Based on Technical Efficiency Scores

2005	2006	2007	2008	2009	2010	2011	2012	Overall
BOC	Bangkok	JPM	JPM	Citi	Citi	Novascotia	MayBank	MayBank
MayBank	JPM	MayBank	CIMB	BOC	MayBank	CIMB	CIMB	JPM
PUB	MayBank	CIMB	MayBank	Deutschw	PUB	MayBank	Novascotia	CIMB
CIMB	BOC	PUB	PUB	JPM	Novascotia	JPM	PUB	PUB
AMB	PUB	HSBC	Citi	CIMB	CIMB	PUB	Citi	Citi
Stanchart	CIMB	Bangkok	Stanchart	PUB	Deutschw	Citi	HSBC	Novascotia
Citi	Citi	Citi	HSBC	RHB	RHB	RBS	Stanchart	BOC
HSBC	OCBC	UOB	RHB	MayBank	JPM	RHB	RHB	RHB
OCBC	AMB	Stanchart	RBS	Novascotia	BOC	AMB	HongLeong	HSBC
UOB	HSBC	BOC	BOC	HSBC	HSBC	Stanchart	AMB	Stanchart
RHB	Stanchart	RHB	UOB	UOB	UOB	HongLeong	UOB	AMB
Alliance	UOB	OCBC	HongLeong	AMB	AMB	UOB	OCBC	UOB
HongLeong	RHB	AMB	AMB	Stanchart	HongLeong	HSBC	Deutsche	HongLeong
Deutschw	HongLeong	HongLeong	Bangkok	HongLeong	OCBC	OCBC	JPM	Bangkok
RBS	Deutschw	Novascotia	OCBC	Bangkok	Stanchart	Bangkok	BOC	OCBC
Affin	Affin	Deutschw	Novascotia	Affin	Bangkok	Deutschw	Bangkok	Deutschw
Bangkok	Alliance	Alliance	Deutschw	Alliance	Affin	BOC	Alliance	Affin
—	RBS	Affin	Alliance	OCBC	Alliance	Alliance	Affin	Alliance
—	—	RBS	Affin	RBS	RBS	Affin	RBS	RBS

AMB = AmBank(M); BOC = Bank of China (Malysia); CIMB = Group Holldings Berhad; HSBC = HSBC Bank Malaysia; JPM = J.P. Morgan Chase Bank; OCBC = OCBC Bank (Malaysia); PUB = Public Bank Berhad; RBS = The Royal Bank of Scotland; RHB = RHB Bank Berhad; UOB = United Overseas Bank (Malysia).

Table 4
Profile of Average of Actual and Corrected Bank Scores

Bank	Tech Efficiency	Tech. Effic.B-S Corr.	Bias
Stanchart	1.285814	1.341763	–0.0559
OCBC	1.364603	1.412552	–0.0479
UOB	1.315004	1.361789	–0.0468
RBS	1.577309	1.709322	–0.132
Novascotia	1.191008	1.275342	–0.0843
Citi	1.165262	1.238073	–0.0728
BOC	1.253192	1.391518	–0.1383
HSBC	1.261628	1.343793	–0.0822
Bangkok	1.350032	1.450239	–0.1002
Deutsche	1.366035	1.472749	–0.1067
JPM	1.10622	1.246263	–0.14
Affin	1.550184	1.605241	–0.0551
Alliance	1.553325	1.636793	–0.0835
AMMB	1.292742	1.378492	–0.0857
CIMB	1.115635	1.198244	–0.0826
HongLeong	1.335687	1.386824	–0.0511
MayBank	1.081389	1.191107	–0.1097
PUB	1.126858	1.184661	–0.0578

Table 5
Profile of Explanatory Variables used in Tobit Analysis

Explanatory variable	Symbol	Variable description	Expected sign
Size	logTA	Log of total assets	+ve
Other income/total assets	OI/TA	Other income/total assets	+ve
Advances/deposits	ADR	Loans and advances/deposits	+ve
Operating expenses/total assets	EOTAR	Operating expenses/total assets	−ve
Personnel expenses/total assets	BPE	Staff expenses/total assets	−ve
Return on assets	ROA	Net profit/total assets	+ve
Capital adequacy ratio	CRAR	(Tier-I + Tier-II capital)/risk-adjusted assets	+ve
Net NPA ratio	NNPARB	Net non-performing assets/net loans and advances	−ve

hence the sign on the size variable is expected to be positive. Diversification in the sources of income is computed as the ratio of other income to total assets; banks with diversified sources of income are expected to be more efficient and hence the expected sign on the coefficient of this variable is positive. The lending orientation of a bank is measured as the ratio of advances to deposits; banks with larger loan to deposit ratios are expected to be more efficient in an emerging market economy like Malaysia. Therefore, the expected sign of the coefficient is positive. Operating expenses are computed as the ratio of operating expenses to total assets. More efficient banks are expected to be more agile in controlling their level of operating expenses; hence, a negative sign is expected. Staff costs is measured in terms of the ratio of personnel expenses to total assets and is expected to have negative sign with the level of bank efficiency. Profitability is measured in terms of the net profit to total assets ratio; more efficient banks are expected to be more profitable, and therefore, the sign on this coefficient is expected to be positive. The capital strength of a bank is measured in terms of its Tier-I and Tier-II capital as a percentage of risk-adjusted assets; banks that are more strongly capitalised are expected to be more efficient and hence the sign of this coefficient is expected to be positive. Credit quality is measured in terms of the ratio of net non-performing assets to net loans and advances; banks with poorer quality assets are expected to be more inefficient and the coefficient is expected to have a negative sign.

Table 6
Results of Tobit Regression Analysis

Independent variables	Coefficient	*t*-stat
Constant	2.741076	14.17
LTA	−0.1528066***	−5.83
Other income/total assets	−1.36881	−0.51
ADR	−0.0841765**	−3.01
EOTAR	−3.079589	−1.15
BPE	16.28787**	2.20
Return on assets	−16.70025***	−5.23
CRAR	−.3087742**	−3.15
NNPARB	0.687439**	2.05
Number of obs = 148; Log likelihood = 77.45		
Prob > chi^2 = 0.0		

***, ** Statistical significance at one per cent, and five per cent.

In the formulation of the Tobit model, the dependent variable is the inverse of the efficiency scores. It can be seen from Table 6 that the effects of bank size and ROAs on technical efficiency are negative and highly significant at the one per cent level, suggesting that bank size and profitability are two significant drivers of technical efficiency of banks. Similarly, the capital adequacy ratio and the advances to deposits ratio appear to be key drivers of the efficiency of Malaysian banks. Other income to total asset has a negative relationship with the level of efficiency, although not a significant one, implying thereby that traditional banking is still a driver of efficiency in the Malaysian banking domain. It is also found that higher personal expenses to total assets and a higher level of non-performing assets drive down the technical efficiency of banks and hence need close monitoring by Malaysian banks.

Conclusion

The Malaysian economy is moving into a new phase of growth in the present decade, and there is an increasing expectation that the banking system should play a pivotal role in facilitating the transformation process. The banking sector is projected to grow its asset base to nearly three times GDP by 2020, up from 2.4 times in 2010. As BNM nudges banks to graduate to the Basel-II era, the strengths of individual institutions will be ultimately determined by their capital efficiency. Malaysian banks will therefore have to identify and capitalise on their sources of efficiency to sustain their competitive edge in the highly competitive market place.

This paper provides a comprehensive analytical view of the drivers of efficiency in Malaysian banking. The big three Malaysian domestic banks, viz., May Bank, CIMB, and Public Bank are found to be more technically efficient not only among the banks in the same group, but also in comparison with the foreign banks operating in the country. Bank size and ROAs are found to be significant drivers of banking efficiency. Banks with higher capital adequacy, aggressive but well-managed credit portfolios, and the more agile in managing their personnel expenses in relation to total assets are also found to be more efficient.

Therefore, it will not be surprising if domestic Malaysian banks continue to expand their asset base by exploiting new opportunities arising out of the ongoing Economic Transformation Programme 2020 of the Government. However, their success will be dependent upon their ability to strengthen their capital base: internal accrual will play a crucial role in this regard. Cost efficiencies, likely involving IT technology, will therefore continue to be one of the key drivers of strength of the domestic banks.

These findings strengthen the argument in favour of further financial market liberalisation initiatives by BNM, as is contemplated in its Financial Sector Blueprint 2011–20. The findings should also encourage banks to plan appropriate strategies to drive their efficiency. Before concluding, it is worth mentioning that the International Monetary Fund has raised a red flag in its Financial Sector Report (International Monetary Fund 2014) about banking concentration; it observed that five banking groups in Malaysia account for 70 per cent of the total assets in the banking system, and hence, there is a need to preserve the competitive landscape.

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