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# DOES COMPETITION FOSTER EFFICIENCY? EMPIRICAL EVIDENCE FROM MALAYSIAN COMMERCIAL BANKS

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## ABSTRACT

*This study focuses on technical efficiency measures and its decompositions as well as the relationship between efficiency and banking competition of Malaysian commercial banks. This study employs Data Envelopment Analysis to assess efficiency performance of Malaysian commercial banks during 1996–2011 while to estimate banking competition; Lerner index approach is utilised. Next, Granger causality tests between competition indexes and various measures of efficiency are undertaken to investigate "Does competition foster efficiency?" The evidence suggests that Malaysian commercial banks experienced increased concentration coupled with lower competition. The results of causality tests support a positive effect of competition on technical efficiency in Malaysian banking.*

**Keywords:** super-efficiency, foreign banks, domestic banks, Malaysian banking

## INTRODUCTION

Malaysian financial industry can be divided into banking industry, non-banking financial intermediaries and financial markets. The Central Bank of Malaysia (Bank Negara Malaysia, BNM) constitutes the apex of the banking industry, comprising commercial banks, investment banks, foreign bank representative offices and offshore banks in the International Offshore Financial Centre in Labuan as well as Islamic banks. The Malaysian banking sector has always presented the most important financial intermediaries and acts as the primary source of financing of an economy. The Malaysian Seventh Plan for 1996–2000 was set out to strengthen and modernise the banking industry so as to provide new instruments of funding and at the same time, to promote savings (Economic Planning Unit, 1996). In addition, the Eighth Plan 2001–2005 outlined the thrust of the financial sector lay in creating a strong, competitive and resilient domestic financial system to meet the challenges of globalisation (Economic Planning

Unit, 2001). The restructuring of the financial institutions through consolidation would facilitate the development of an efficient and competitive banking system to support the growth of the economy. Next, the phased implementation of the 10-year Financial Sector Master Plan and Capital Market Master Plan during the Ninth Plan period (2006–2010) strengthened the resilience and competitiveness of the banking system and the capital market in a more globalised operating environment (Economic Planning Unit, 2006). At the same time, domestic financial institutions were encouraged to expand abroad whilst the Islamic financial system continued to be further developed to tap its potential and serve as a new source of growth. The importance of the role of financial intermediaries is kept recognised by Malaysian government throughout its long-term policy in Tenth Malaysian Plan 2011–2015 (Economic Planning Unit, 2011). The second thrust of Tenth Malaysian Plan stated the urgency to create conducive environment to unleash economic growth, by emphasising on 12 sectors of National Key Economic Areas (NKEAs); and financial services sector is listed as one of the NKEAs to be exploited. The New Economic Model of Malaysia highlighted that the growth in financial development is needed in order to stimulate private investment (Economic Planning Unit, 2011).

Commercial banks in Malaysia are licensed under the Banking and Financial Institutions Act 1989 (BAFIA) by BNM. The roles of commercial banks include raising funds by collecting checkable deposits, savings deposits and time deposits from businesses and individuals; then, the banks give out loans to both customers and other business as defined by BNM (Institute of Banker Malaysia, 2013). The commercial banks are the largest component of the Malaysian banking system, comprise of 25 commercial banks (excluding Islamic banks) of which 17 are locally incorporated foreign banks (Central Bank of Malaysia, 2011). In year 2011, the share of commercial banks with respect to total assets is RM1,713 ('000 million), total loans (RM798,359 million) and total deposits is RM699,421 million (The Association of Banks in Malaysia, 2012).

The economic malaise in the end of 1990s has triggered the banking reform and has changed the Malaysian banking sector landscape profoundly. The enforcement of Malaysia's bank mergers in 1999 resulted in the mergers of all domestic commercial banks into several merged entities. Prior to bank mergers, there were 38 commercial banks of which 22 were domestic banks while 16 banks were foreign-controlled banks in Malaysian banking system in year 1998. In Malaysian banking industry, mergers and acquisitions can be traced to the historical reluctance of local banks to merge. The policy had always been to allow for market forces to dictate the pace of mergers. Even with the government's efforts, the shareholders of banking institutions were more interested in protecting their interests than paying heed to national considerations (Central Bank of Malaysia, 1999). Nevertheless, the currency and financial crisis in July 1997 sharply impacted on the Malaysian economy. Banking institutions were badly hit by the crisis as they were burdened with high levels of non-performing loans arising from over-lending to the property industry and over-exposure to share-based lending in the 1980s. Due to the losses, BNM came up with a rescue scheme to protect the integrity of public savings and stabilise the financial system. The rescue scheme involved the establishment of asset management companies to persuade and encourage local market participants to voluntarily merge. However, the banks remained reluctant to merge. Hence, the government proceeded to set in motion the consolidation process with BNM and expressed its intention to consolidate the local banks in April 1999.

The impact of bank mergers had created concerns among policy makers and researchers in terms of potential anticompetitive conducts of banks. Structurally speaking, bank mergers generate more concentrated systems and as a result, worsen bank competition. The preponderance of mergers has raised concerns that increased concentration is likely to intensify market power and therefore, hinder the realisation of competition. Additionally, restructuring in the banking industry would stimulate those firms operating inefficiently to shift to the frontier. Banks not allocating their resources efficiently would be liquidated or would merged with more efficient banks; unless they could become more like their efficient competitors by producing more outputs with existing inputs. Therefore, it is important to have a better understanding of the potential consequences of bank reform on banking competition as well as banking efficiency. A strong and resilient banking system should support economic efficiency and stability, where efficiency is closely related to the optimal competitive structure (Northcott, 2004).

Competition and efficiency are closely entwined in banking system; however, majority of past efficiency studies on banking industry have tended to neglect the nexus between competition and efficiency. Few attempts have been undertaken to investigate the relationship between bank competition and efficiency of banks, however they rely on structural measure of competition by taking concentration per se as a proxy for competition; whilst with respect to efficiency, only cost efficiency is estimated. Apart from that, the link between market structure and competition is not investigated. By addressing the above discussion as the gap in the literature, this study contributes to the existing literature by utilising Data Envelopment Analysis (DEA) to compute technical efficiency scores and its decompositions, which are pure technical efficiency and scale efficiency. While Lerner Index model is utilised to estimate competitiveness in the banking industry, market concentration is used to measure market structure.

Finally, Granger causality tests between competition indexes and measures of efficiency are undertaken to test the relationship between competition and efficiency in Malaysian banking market during 1996–2011. The rest of this article is organised as follows. Next section provides a brief discussion on the literature review of the nexus between concentration, competition and efficiency in banking sector, and it is followed by a description of data and the methodology in subsequent section. Next section presents the results of the market structure and competition as well as the nexus between various measures of efficiency and banking competition; this article ends with conclusions in the last section.

## PREVIOUS STUDIES

The theoretical foundation for the relationship between competition and efficiency in the banking market are emanated from theories on market structure and efficiency. The rationale behind the link between market structure and efficiency originates from the 'quiet life' hypothesis. Hicks (1935, p. 35) states that "The best of all monopoly profits is a quiet life". The quotation suggests that in concentrated markets, there is less pressure to compete, which results in reduced efforts by managers to operate efficiently. Therefore, increased market concentration weakens market competition which will halts productive efficiency. The 'quiet life' hypothesis also constitutes the 'structure conduct performance' hypothesis as proposed by Bain (1951), which postulates that banks in a concentrated market can charge higher loan rates and pay lower deposit rates, generating more profits and lower collusion costs; as a result, competition will decline. Thus, both hypotheses propose for the positive link of 'competition-efficiency'; increased concentration results in lowered competition which leads to a decrease in efficiency.

In a view of industrial organisation theory, the level of concentration in a market will determine the competitiveness level among firms in the market. Basically, the 'structure-conduct-performance' paradigm views that markets which are dominated by few large firms (highly concentrated) are less competitive than markets which are low concentrated (Mason, 1939; Bain, 1951). The hypothesis contends that the higher the concentration, the lower the competition; increased market concentration is associated with higher prices and greater profits (Bain, 1951). Nevertheless, the 'efficient-structure' hypothesis infers that the degree of concentration is determined by the superior performance of the efficient banks. 'Efficient-structure' hypothesis postulates that firms with superior efficiency become more profitable, the firms will increase their market share; as a result, the competition declines. (Demsetz, 1973; Peltzman, 1977). Both 'structure-conduct-performance' and 'efficient-structure' theories which are known as structural approach postulate that market concentration determine the competitive conduct of firms in a market. On contrary, the non-structural approach suggests that there is no clear evidence that in more concentrated markets, the market power is higher and that competition is lower. The contestable market theory emphasises that a high concentration market can be highly competitive even if it is dominated by few firms only (Baumol, 1982).

In addition, Leibenstein (1966) argues that competition can reduce 'x-inefficiencies' or inefficiencies inside firms. The existence of imperfections in the internal organisation of firms which affect the level of information asymmetries between owners and managers will results in x-inefficiencies. Eventually, the flaw in the labour contract will lessen the effort of managers and as the owners are unable to check the level of effort exerted by the managers, Liebenstein suggests two reasons to explain how competition can reduce 'x-inefficiencies'. Firstly, managers are aware that the only way to sustain performance in a competitive market is to cut cost and produce more, which means that managers must increase their work efforts. Managers are motivated to avoid the personal costs of firms' bankruptcy. Secondly, when competition is running high; shareholders of firms tend to compare the firms' performance relative to their rivals. The owners have the authority to change the management if necessary; thus, managers see this as a drive to increase their efforts and to reduce 'x-inefficiencies'. In this context, the relationship of 'competition-efficiency' is asserted.

On the other hand, 'efficient-structure' hypothesis posits a reverse causality between competition and efficiency (Demsetz, 1973). It is contended that relatively, more efficient firms possess more superior products, advancement in technology or better management. Firms may be exploiting greater x-efficiency (efficiency hypothesis) or greater scale efficiency, which is known as scale efficiency hypothesis (Berger, 1995). Therefore, more efficient firms mean that the firms have lower costs, which enable them to capture larger market shares, resulting in higher market concentration. As concentration is considered as an inverse measure of competition, it is suggested that there is a negative link between competition and efficiency.

The preceding discussion gives some highlight on the theoretical references about the nexus between competition and efficiency. The empirical evidences which directly addressed the relationship between competition and banking efficiency appear to be limited. Most of the existing studies on the nexus of competition and efficiency regressing efficiency scores on a set of variables for market structure. Studies such as Berger (1995) and Berger and Hannan (1998) confine their analysis on the United States of America (US) banking market while Goldberg and Rai (1996) and Punt and van Rooij (1999) focus on

European banks. The studies support a positive relationship between efficiency and market concentration, in favour of the ‘efficient structure’ hypothesis. The mentioned studies measure cost efficiency by employing stochastic frontier approach while market structure is measured with market concentration indices.

Empirical studies that test the running causality between efficiency and competition are scant. The most notable’s study is Casu and Girardone (2009); the study reveals the causality relationship by employing Granger-causality tests. The study finds the negative magnitude between efficiency and competition in selected EU countries (France, Germany, Italy, Spain and the United Kingdom) over 2000–2005 periods. The authors find that there is a positive causation between market power and efficiency; whereas, the causality running from efficiency to competition is weak. Next, Pruteanu-Podpiera, Weill and Schobert (2008) investigate the effects of banking competition on efficiency measures in the Czech Republic between 1994 and 2005. The study rules out the competition improvement over the study period. The results offer support to the negative relationship between cost efficiency scores and the banking competition; thus, the ‘quiet life’ hypothesis is rejected. Maudos and Fernández de Guevara (2007) analyses the relationship between market power and efficiency in the EU countries over 1993–2002. Regressing market power variables which are represented by Lerner index and Hirschman-Herfindahl index (HHI) and other explanatory variables (size of banks and types of banking specialisation) on the dependent variable which is the cost efficiency variable, the results of the study reject the 'quiet life' hypothesis in the European banking system. Schaeck and Čihák (2008) offers support to the pro-competition policies in European and U.S. markets by suggesting that competitive banks are able to allocate resources more efficiently to bank customers. The testimony is confirmed further in Koetter, Kolari and Spierdijk (2008) study of U.S. banking market between 1986 and 2005.

No known studies have investigated the relationship between competition and efficiency in the context of the Malaysian banking industry. Attempts to measure competition and efficiency of Malaysian banks have been carried out on separate basis. For instance, Abdul-Majid and Sufian (2006) examine the competitive conditions of Malaysian banking industry; the results imply that Malaysian banks are operating in monopolistic competition market structure. Other studies such as Omar, Abdul-Rahman, Mohd.-Yusof, Abd.-Majid and Mohd.-Rasid (2006), Sufian (2007), Ahmad-Mokhtar, Abdullah, and M-Alhabshi (2008), Yeoh and Hooy (2011), Ab-Rahim, Md-Nor, and Ramlee (2012), and Ab-Rahim (2015), amongst all; confine their studies to assess the efficiency performance of the Malaysian financial institutions. Employing data envelopment analysis, Yeoh and Hooy (2011) and Ab-Rahim (2015) find that there is a declining trend in mean technical efficiency across all Malaysian banks around the period from 2000 to 2011. The results of earlier studies such as Sufian (2007) also show the declining trend of technical efficiency scores among merchant banks and the finance companies. In order to improve their productivity, Omar et al. (2006) add Malaysian banks should utilised advanced technology and acquire more technological knowledge in banking system.

Hence, this study contributes to the literature by extending the analysis of the relationship between efficiency and competition to developing countries, specifically Malaysian banking market. As far as this study is concerned, this is the first empirical study on testing the relationship between efficiency and competition in Malaysian banking industry.

## DATA AND METHODOLOGY

### Input and Output Variables

This study covers the period from 1996 to 2011, consists of nine domestic anchor banks created due to the merger policy. The commercial banks include Affin Bank, Alliance Bank, AMBank, CIMB Bank, EON Bank, Hong Leong Bank, Maybank, Public Bank and RHB Bank.[1] The bank level data used are taken from (2000) spreadsheets published by Bureau Van Dijk (BVD). All financial variables reported are in nominal values (Ringgit Malaysia), so to facilitate comparison over time; all the variables are deflated by the consumer price index (hereafter denoted as CPI) to obtain real values in 2000 price constant.[2]

As the purpose of this study is to evaluate the efficiency of banks with banks acting as financial intermediaries, this study employs the intermediation approach like many studies on banking efficiency. Mlima and Hjalmarsson (2002) suggested that intermediation roles include mobilising and distributing resources efficiently in order to smoothen investment activities. The approach views financial institutions as mediators between the depositor (supply) and the borrower (demand) of funds at the lowest cost. The approach is also superior in evaluating the importance of frontier efficiency as the minimisation of total cost (besides production cost) is needed to maximise profits. The input variables chosen in this study are personnel expenses, fixed assets, deposits and short term funding (deposits) whereas the output variables are represented by total loans, total securities and off-balance sheet items. Subsequently, the intermediation approach is maintained in the estimation of competition in the Malaysian banking sector. Input prices employed are calculated as price of labour (total expenditure on employees such as salaries, employee benefits and reserves for retirement pay, divided by total assets); price of capital (the ratio of non-interest expenses to the book value of premises and fixed assets) and price of deposits (total interest expenses divided by total deposits and short-term funding).

## Methodology

### *Data envelopment analysis*

The main non-parametric method, DEA, was introduced by Charnes, Cooper and Rhoades (1978) and is an analytical tool used to measure relative efficiency of firms throughout the process of transforming inputs into outputs. The following presents two types of envelopment surfaces, referred to as the constant returns to scale and variable returns to scale models. The DEA procedures are adopted from Coelli, Rao and Battese (2000). The constant returns to scale model measures efficiency in terms of overall technical efficiency (Charnes et al., 1978) assuming firms are operating at the optimal scale; however, firms in practice may face either economies or diseconomies of scale.

Subsequently, Banker, Charnes and Cooper (1984) extend the constant returns to scale model, by incorporating the variable returns to scale assumption, the model is used to assess the efficiency of decision-making units characterised by the variable returns to scale model. The variable returns to scale model provides the measurement of pure technical efficiency, which is the measurement of technical efficiency devoid of the scale efficiency effects. Next, scale efficiency is determined by taking the ratio of constant returns to scale efficiency scores over variable returns to scale efficiency. In other words, technical efficiency can be decomposed into pure technical efficiency and scale efficiency. Technical efficiency represents the deviation from the efficient frontier due to the inefficient use of resources; hence, the failure of the firm to extract the maximum output from its adopted input levels may be thought of as measuring the unproductive use of resources. While pure technical efficiency measures the proportional reduction in input usage that can be attained if the firm operates on the optimal frontier, scale efficiency refers to the proportional reduction if the bank achieves optimum production level.

DEA efficiency score is obtained by taking the maximum ratio of weighted outputs to weighted inputs. This measurement allows multiple outputs and inputs to be reduced to single "virtual" input (*xi*) and single "virtual" output (*yi*) by optimal weighs.

$$\begin{aligned} &\text{Max}_{u,v}\ (u'y_t / v'x_t) \\ &\text{subject to (s.t.)} \quad u'y_j / v'x_j \le 1 \\ &\qquad j = 1, 2, \ldots, n \\ &\qquad u, v \ge 0, \end{aligned} \tag{1}$$

The vectors $xi$ and $yi$ indicate the $K \times N$ inputs matrix and $K \times M$ outputs matrix for $i$th decision making units (DMUs) respectively. In addition, the vector $(u'y_t/v'x_t)$represents the ratio of all outputs over all inputs where $u$ is an $M \times 1$ vector of output weighs and $v$ is a $K \times 1$ vector of input weighs. The efficiency for the $i$th DMU is maximised by finding values for $u$ and $v$; next, a constant constraint $\rho' x_t = 1$ is imposed to Equation (1).

$$\text{Max}_{u,v}\ (\mu' y_t)$$

$$\begin{aligned} \text{s.t.}\quad & \rho' x_t = 1 \\ & \mu' y_j - \rho' x_j \leq 0 \\ & j = 1, 2, \ldots, n \\ & \mu, \rho \geq 0, \end{aligned} \qquad (2)$$

The efficiency measure is then a function of multipliers of the "virtual" input-output combination, as in Equation (2). The notations $\mu$ and $\rho$ indicate the transformation of $u$ and $v$. The envelopment form is seen below as:

$$\begin{aligned} & \text{Min}_{\theta, \lambda}\ \theta \\ \text{s.t.}\quad & -y_t + Y\lambda \geq 0, \\ & \theta x_t - X\lambda \geq 0 \\ & \lambda \geq 0, \end{aligned} \qquad (3)$$

where $\theta$ is a scalar and $\lambda$ is an $N \times 1$ vector of constants. The value of $\theta$ is the efficiency score for the $i$th DMU and it should be solved $n$ times. If the value is equal to 1, the particular DMU is technically efficient. By relaxing the constant returns to scale assumption (Banker et al., 1984), the efficiency is assessed on the assumption of variable returns to scale; the convexity constraint $N1'\lambda=1$ is applied to Equation (3).

$$\begin{aligned} & \text{Min}_{\theta, \lambda}\ \theta, \\ \text{s.t.}\quad & -y_t + Y\lambda \geq 0, \\ & \theta x_t - X\lambda \geq 0 \\ & N1'\lambda = 1 \\ & \lambda \geq 0 \end{aligned} \qquad (4)$$

***Measuring market structure***

To measure market share in an industry, a market concentration ratio is used. Specifically, this study employs a bank concentration index of the highest two ($CR_2$), three ($CR_3$) and four ($CR_4$) banks' total assets, total deposits and total loans. CR*k* is computed as the sum of the *k* largest firms' market shares in the market, which takes the form:

$$CR_k = \sum_i^k S_i \quad (5)$$

Next, HHI is utilised to capture the general features of market structure. HHI includes information of the distribution of market shares as well as the number of firms in the industry.[3] HHI refers to the sum of the squared market shares of all banks in the market, where the market shares are considered weights. The formula is given as follows:

$$HHI = \sum_i^n S_t^2 \quad (6)$$

where $S_t^2$ is the sum of squared market shares of the *i*-th is firm and *n* is the number of firms in the market.

***Measuring market competition***

The Lerner index of monopoly power is a non-structural indicator of the degree of market competition developed in the context of the new economics industrial organization. The computation of the index, which provides measures of competition at the firm level, allows the investigation of the causality between efficiency and competition at the firm level to be carried out. The Lerner index has been computed in several empirical studies on banking competition (e.g. Angelini and Cetorelli, 2003; Maudos and Fernández de Guevara, 2007; Fernández de Guevara, Maudos and Perez, 2005). Basically, it is defined as the difference between price (calculated as the ratio of total costs to total assets) and marginal cost (expressed as a percentage of prices) divided by price.

The Lerner index measures the degree to which firms can mark-up output prices over the marginal cost of production. It can be approximated empirically using the translog functional form with three inputs and a single bank output (following Shaffer, 1993; and Berg and Kim, 1994). It is assumed that the flow of goods and services by banks is proportional to its assets; the price of assets is computed as total interest income divided by total assets. To derive marginal cost, a translog cost function with one output and three input prices was estimated. The econometric model is applied to a pooled sample of banks to evaluate the competitive structure, as the heterogeneity is controlled in the domestic banking industry. Standard symmetry restrictions of linear homogeneity in input prices are imposed by normalising total costs and input prices by one input price (PD) to correct for heteroskedasticity and scale biases. The cost function adopted from Pruteanu-Podpiera, et al. (2008) is specified as follows.

$$\ln\left(\frac{TC}{PD}\right)=\alpha_0+\alpha_1\ln Q+\frac{1}{2}\alpha_2(\ln Q)^2+\alpha_3\ln\left(\frac{PL}{PD}\right)+\alpha_4\ln\left(\frac{PK}{PD}\right)+\alpha_5\ln\left(\frac{PL}{PD}\right)*\ln\left(\frac{PK}{PD}\right)+ \frac{1}{2}\alpha_6\left(\ln\left(\frac{PL}{PD}\right)\right)^2+\frac{1}{2}\alpha_7\left(\ln\left(\frac{PL}{PD}\right)\right)^2+\alpha_8\ln Q\ln\left(\frac{PK}{PD}\right)+\varepsilon \tag{7}$$

Bank costs (TC) are functioned to output or total assets (Q), the input prices which are PL as the price of labour, PK as the price of physical capital and PD as the price of borrowed funds; whilst $\alpha$ = 1, 2,…, 9 are parameters to be estimated and ε is the error term. Indices for each bank have been dropped in the presentation for simplicity. Once the parameters are estimated, the marginal cost of banking can be computed. The cost function is estimated using a common frontier and allows the derivation of marginal costs (MC) as in Equation (8) and the formula for Lerner index is as in Equation (9):

$$MC_{it}\frac{TC_{it}}{Q_{it}}\left(\alpha_1+\alpha_2\ln Q_{it}+\alpha_3\ln Q_{it}+\alpha_4\ln Q_{it}+\varepsilon_{it}\right) \tag{8}$$

$$LI\,\frac{P_i-MC_{it}}{P_i} \tag{9}$$

where $p_i$ is the price of production output $Q$ total assets and is calculated as total revenue (interest plus non-interest income) divided by total assets. LI stands for Lerner index, LI = 0 indicates perfect competition so firm has no market power while LI closer to 1 indicates relatively weak price competition thus, the firm has market power.

### *Testing the relationship*

This study attempts to employ fixed effects panel regression using Granger-causality test to assess the causality between bank competition and bank efficiency as the number of cross-sections, which are represented by the number of banks (approximately 9), is about the same as the number of regressors in the model (which is nine); thus, the random effects model could not be employed. Nevertheless, to confirm the procedures, the Hausman test will be held.[4] The fixed effects model assumes that all explanatory variables are correlated with the unobserved effects or the specific error term that eliminates this correlation within the transformation and "…the crucial distinction between fixed and random effects is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not" (Green, 2008, p.183).

The standard procedure for Granger causality test is as below:

$$y_{it} = \alpha_0 + \sum_{i=1}^{m} \alpha_1^y y_{it-1} + f_i^y + u_{it}^y \quad (10)$$

$$x_{it} = \beta_0 + \sum_{i=1}^{m} \alpha_1^x x_{it-1} + f_i^y \sum_{i=1}^{m} \delta_1^y y_{it-1} + f_i^x + u_{it}^y \quad (11)$$

where *y* represents efficiency, *x* represents the competition whilst *f* represents the bank's individual effect. *i* and *t* represent indices for the bank and the time period, respectively. The error terms in Equation (10) and Equation (11) are assumed to be normally distributed with mean zero and constant variance. Each dependent variable is regressed on its yearly lags and on those of the other variable.

The dependent variable in Equation (10) is the estimated efficiency scores which represents technical efficiency, pure technical efficiency and scale efficiency of bank *i* relative to its peers in year *t*. The second dependent variable in Equation (11) measures the competition indexes of the individual firms. The right-hand side variables include lagged values of the dependent variables *y* (efficiency) and *x* (competition) as a standard procedure for Granger-causality models. A significant relationship between current and past (lagged) efficiency would imply that the latter contains information that improves the prediction of current efficiency. Granger-causality gives historical associations in which a change in one variable precedes a change in the other, but does not necessarily imply economic causation.

## RESULTS AND DISCUSSION

This section presents the results of Granger causality test between bank efficiency and competition. The Lerner index is employed to compute the individual measures of competition for each sample in bank whilst DEA measured efficiency for each bank.

### Empirical Results of Competition

The Lerner index of monopoly power is a non-structural indicator of the degree of market competition. The computation of Lerner indices which provides measures of competition at the firm level, allows the investigation of the causality between efficiency and competition to be performed. The yearly Lerner indices are displayed in Table 1.

Table 1
*Lerner indices per year*

| Year | Median | Mean | s.d. |
|---|---|---|---|
| 1996 | 0.5808 | 0.6128 | 0.0726 |
| 1997 | 0.6050 | 0.6211 | 0.0725 |
| 1998 | 0.5674 | 0.6065 | 0.0881 |
| 1999 | 0.6253 | 0.6469 | 0.1075 |
| 2000 | 0.6572 | 0.6829 | 0.0973 |
| 2001 | 0.6243 | 0.6439 | 0.1176 |
| 2002 | 0.6139 | 0.6525 | 0.1200 |
| 2003 | 0.6274 | 0.6765 | 0.1268 |
| 2004 | 0.6382 | 0.6817 | 0.1345 |
| 2005 | 0.6648 | 0.6895 | 0.1378 |
| 2006 | 0.6501 | 0.7012 | 0.1340 |
| 2007 | 0.6627 | 0.7200 | 0.1336 |
| 2008 | 0.6340 | 0.6982 | 0.1360 |
| 2009 | 0.6311 | 0.7028 | 0.1408 |
| 2010 | 0.6260 | 0.6882 | 0.1379 |
| 2011 | 0.6190 | 0.6742 | 0.1336 |

Table 1 shows that the Lerner index jumps from 0.6065 in 1998 to 0.6829 in year 2000; this could be due to the immediate enforcement of merger policy effects, announced at the end of the 1990s. Generally, the main trend is decreased banking competition over the entire period. Following the mixed results of Lerner index between years 1996 to 2001; banking competition decreases considerably from year 2002 to year 2007. Thus, one fails to observe any evolution towards strong banking competition during the post-merger period. Thus, the enforcement of merger policy probably has favoured market power during the period. Nevertheless, the effects do not last long, as in 2007 onwards, the Lerner index drops considerably. In 2011, the banking competition is at its highest value, when the Lerner index is recorded lowest at 0.6742. It would be interesting to find out whether the market concentration is positively or negatively related to market competition. Table 3 shows an average concentration index based on $CR_2$ and the Lerner indices between 1996 and 2011.

Table 2
*Concentration ratios and competition indices (1996–2011)*

| Year | Concentration Ratios ($CR_2$) | Lerner Index |
|---|---|---|
| 1996 | 0.48 | 0.6128 |
| 1997 | 0.51 | 0.6211 |
| 1998 | 0.43 | 0.6065 |
| 1999 | 0.42 | 0.6469 |
| 2000 | 0.41 | 0.6829 |
| 2001 | 0.40 | 0.6439 |
| 2002 | 0.40 | 0.6525 |
| 2003 | 0.37 | 0.6765 |
| 2004 | 0.37 | 0.6817 |
| 2005 | 0.36 | 0.6895 |
| 2006 | 0.37 | 0.7012 |
| 2007 | 0.38 | 0.7200 |
| 2008 | 0.39 | 0.6982 |
| 2009 | 0.39 | 0.7028 |
| 2010 | 0.37 | 0.6882 |
| 2011 | 0.41 | 0.6742 |

Basically, the results in Table 2 suggest that a higher concentration leads to a lower degree of market power; even though the banking market is highly concentrated, it does not lead to anti-competitive conduct as postulated by the traditional SCP hypothesis. It would be interesting to find out whether the market concentration is positively or negatively related to market competition, as illustrated in Figure 1. The figure shows a scatter diagram of concentration ratios $CR_2$ and Lerner indices. The slightly downward-sloping regression line denotes the negative link between market concentration and market power. Nevertheless, the linear regression in this figure does not yield any significant relationship between concentration and competition; thus, the link is further explored in the next section.

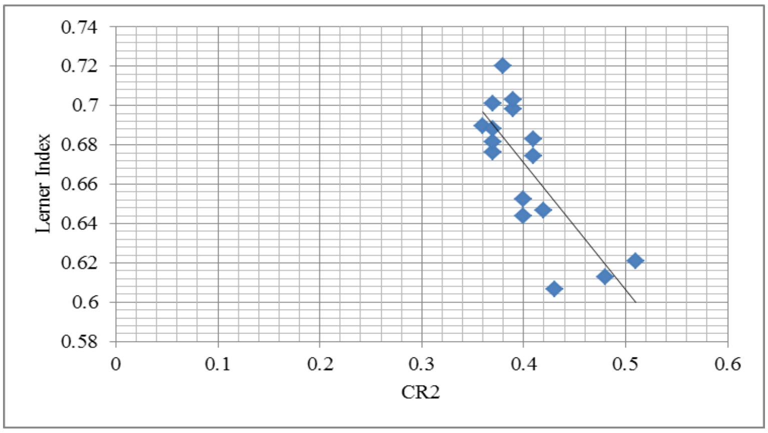


*Figure 1.* A scatter diagram of concentration ratios and competition indices

## Empirical Results of Efficiency

The results in Table 3 are generated from the DEA common frontier approach. The reported mean efficiency is based on the averaging of estimated efficiency scores by years of study period. Technical efficiency refers to the firm's ability to maximise output from a given set of input[5] and it can be decomposed into two components: pure technical efficiency and scale efficiency.

Table 3
*Efficiency scores of the common frontier (1996–2011)*

| Year | Technical Efficiency | Pure Technical Efficiency | Scale Efficiency |
|---|---|---|---|
| 1996 | 0.6403 | 0.7596 | 0.8541 |
| 1997 | 0.6008 | 0.7028 | 0.8679 |
| 1998 | 0.6440 | 0.7587 | 0.8596 |
| 1999 | 0.6129 | 0.7422 | 0.8431 |
| 2000 | 0.6034 | 0.7463 | 0.8257 |
| 2001 | 0.6264 | 0.7630 | 0.8361 |
| 2002 | 0.6464 | 0.8092 | 0.8172 |
| 2003 | 0.6089 | 0.7823 | 0.8030 |
| 2004 | 0.6164 | 0.7753 | 0.8138 |
| 2005 | 0.5910 | 0.7658 | 0.7898 |
| 2006 | 0.5893 | 0.7708 | 0.7816 |
| 2007 | 0.5619 | 0.7408 | 0.7710 |
| 2008 | 0.5879 | 0.7868 | 0.7684 |

(*continued on next page*)

Table 3: (*continued*)

| Year | Technical Efficiency | Pure Technical Efficiency | Scale Efficiency |
|---|---|---|---|
| 2009 | 0.5635 | 0.7718 | 0.7524 |
| 2010 | 0.5404 | 0.7519 | 0.7524 |
| 2011 | 0.5458 | 0.7652 | 0.7524 |
| Mean | 0.5987 | 0.7620 | 0.8055 |

Generally, the results suggest that throughout the study period, scale efficiency (81%) contributes more to technical efficiency than pure technical efficiency (76%). The banks performed relatively well with minimal input waste in scale efficiency (19%), followed by 34% and 40% in pure technical efficiency and technical efficiency, respectively.

## Empirical Results of Competition and Efficiency

This section reports the results of the causality tests between competition and efficiency. The Granger causality tests are performed for each type of efficiency, namely technical, pure technical, and scale efficiency in order to examine the relationship between efficiency and competition within the Malaysian banking industry. Whilst Panel A reports the causality running from efficiency to competition, the results of the causality running from competition to efficiency are reported in Panel B of the tables. Based on the Hausman test, the null hypothesis that random effect model is consistent and efficient is rejected; thus, this study reports the results from fixed effect panel model and are White corrected (White, 1980).[6] The results are presented in Tables 4 to Table 6.

Panel B in Table 4 shows that the Lerner index negatively Granger-causes the efficiency, thereby indicating that competition positively Granger-causes efficiency i.e., an increase in bank competition Granger-causes an increase in efficiency. This link is relatively significant at 1% significance level. Panel A shows the positive signs of the coefficients indicate a negative running causality between efficiency and competition.

Table 5 shows that the negative Granger coefficient demonstrates that the Lerner index negatively Granger-causes the efficiency index and thus, the competition positively Granger-causes efficiency with the summation of coefficients is 10.31. With respect to the Granger causality running from competition to efficiency, the link is significant at a 5% level. The negative sign of the summation of coefficients indicates the positive link between competition and efficiency. As the coefficients of the lags of Lerner index increase, the competition measures decrease and as a result, the pure technical efficiency scores decrease.

Table 4
*Granger-casuality – Lerner index (LI) and Technical Efficiency (TE)*

| Variables | PANEL A: Dependent – LI | | PANEL B: Dependent – TE | |
|---|---|---|---|---|
| | Coefficient | s.e. | Coefficient | s.e. |
| Intercept | 0.2872 | 0.0438* | 0.8073 | 0.1698* |
| $LI_{t-1}$ | 0.6153 | 0.0638* | –0.3413 | 0.1238* |
| $LI_{t-2}$ | –0.1738 | 0.0751** | 0.3190 | 0.1254** |
| $LI_{t-3}$ | 0.2120 | 0.0593* | –0.3499 | 0.1034* |
| $LI_{t-4}$ | –0.0862 | 0.0403** | –0.0250 | 0.1113 |
| $LI_{t-1} = LI_{t-2} = LI_{t-3} = LI_{t-4}=0$ | $\lambda^2$ (4) = 146.28* | | $\lambda^2$ (4) = 19.88* | |
| Σ coefficients: | 0.5625 | 0.0697 | –0.3973 | 0.4641 |
| $TE_{t-1}$ | 0.0024 | 0.0144 | 0.3453 | 0.0722* |
| $TE_{t-2}$ | –0.0186 | 0.0196 | 0.0827 | 0.0635 |
| $TE_{t-3}$ | 0.0306 | 0.0163*** | –0.1816 | 0.0581* |
| $TE_{t-4}$ | 0.0011 | 0.0194 | –0.1619 | 0.0835*** |
| $TE_{t-1} = TE_{t-2} = TE_{t-3} = TE_{t-4} = 0$ | $\lambda^2$ (4) = 2.57 | | $\lambda^2$ (4) = 39.10* | |
| Σ coefficients: | 0.0155 | 0.0697 | 0.0845 | 0.2774 |

*Note:* *, **, *** Significant at 1%, 5%, 10% significance level

Table 5
*Granger-causality – Lerner index (LI) and Pure Technical Efficiency (PTE)*

| Variables | PANEL A: Dependent – LI | | PANEL B: Dependent – PTE | |
|---|---|---|---|---|
| | Coefficient | s.e. | Coefficient | s.e. |
| Intercept | 0.2826 | 0.0424* | 0.7899 | 0.1792* |
| $LI_{t-1}$ | 0.6220 | 0.0696* | –0.3427 | 0.1658** |
| $LI_{t-2}$ | –0.1939 | 0.0585* | 0.2268 | 0.1257*** |
| $LI_{t-3}$ | 0.2261 | 0.0830* | –0.2258 | 0.1309*** |
| $LI_{t-4}$ | –0.0916 | 0.0337* | 0.0167 | 0.0990 |
| $LI_{t-1} = LI_{t-2} = LI_{t-3} = LI_{t-4}=0$ | $\lambda^2$ (4) = 155.62* | | $\lambda^2$ (4) = 10.31** | |
| Σ coefficients: | 0.5625 | 0.2448 | –0.3250 | 0.5214 |
| $PTE_{t-1}$ | 0.0114 | 0.0142 | 0.3161 | 0.1083* |
| $PTE_{t-2}$ | –0.0285 | 0.0163*** | 0.0537 | 0.0631 |

(*continued on next page*)

Table 5: (*continued*)

| Variables | PANEL A: Dependent – LI | | PANEL B: Dependent – PTE | |
|---|---|---|---|---|
| | Coefficient | s.e. | Coefficient | s.e. |
| $PTE_{t-3}$ | 0.0291 | 0.0196 | –0.0918 | 0.0899 |
| $PTE_{t-4}$ | 0.0106 | 0.0187 | –0.0254 | 0.0745 |
| $PTE_{t-1} = PTE_{t-2} = PTE_{t-3} = PTE_{t-4} = 0$ | $\lambda^2$ (4) = 6.96 | | $\lambda^2$ (4) = 23.03* | |
| Σ coefficients: | 0.0226 | 0.0687 | 0.2527 | 0.3358 |

*Note:* *, **, *** Significant at 1%, 5%, 10% significance level

Table 6
*Granger-causality – Lerner index (LI) and Scale Efficiency (SE)*

| Variables | PANEL A: Dependent – LI | | PANEL B: Dependent – SE | |
|---|---|---|---|---|
| | Coefficient | s.e. | Coefficient | s.e. |
| Intercept | 0.3457 | 0.0657* | 0.1409 | 0.0308* |
| $LI_{t-1}$ | 0.5693 | 0.0638* | –0.0247 | 0.0078* |
| $LI_{t-2}$ | –0.0894 | 0.0696 | 0.0333 | 0.0178*** |
| $LI_{t-3}$ | 0.1467 | 0.0688** | 0.0025 | 0.0178 |
| $LI_{t-4}$ | –0.0771 | 0.0572 | –0.0085 | 0.0146 |
| $LI_{t-1} = LI_{t-2} = LI_{t-3} = LI_{t-4}=0$ | $\lambda^2$ (4) = 129.27* | | $\lambda^2$ (4) = 13.08** | |
| Σ coefficients: | 0.5495 | 0.2594 | 0.0025 | 0.0581 |
| $SE_{t-1}$ | –0.1209 | 0.0535** | 0.6879 | 0.0700* |
| $SE_{t-2}$ | 0.0737 | 0.0608 | 0.0810 | 0.0700 |
| $SE_{t-3}$ | 0.0996 | 0.0511*** | 0.0154 | 0.0487 |
| $SE_{t-4}$ | –0.0990 | 0.0460** | 0.0251 | 0.0381 |
| $SE_{t-1} = SE_{t-2} = SE_{t-3} = SE_{t-4} =0$ | $\lambda^2$ (4) = 12.19** | | $\lambda^2$ (4) = 504.73* | |
| Σ coefficients: | –0.0466 | 0.2113 | 0.8095 | 0.2267 |

*Note:* *, **, *** Significant at 1%, 5%, 10% significance level

Based on the results in Table 6, it can be concluded that the Lerner index positively Granger-causes the scale efficiency index, which means that competition negatively Granger-causes efficiency. The joint test is significant at a 5% significance level and the null hypothesis that efficiency does not Granger-cause competition, is rejected. The Granger coefficient is reported positive in Panel B and therefore, as the competition measures decrease, the scale efficiency scores increase.

## CONCLUSION

In the case of causality running from banking competition to efficiency, the results reveal that there are positive effects of banking competition on technical and pure technical efficiencies. Yet, the sign is reversed in the context of scale efficiency. The positive sign of 'competition-efficiency' link, affirmed the quiet-life hypothesis. "The best of all monopoly profits is a quiet life" (Hicks, 1935, p. 9), this suggests that banks with more market power are not exposed to competition and therefore, they are not able to reduce costs and attain higher efficiency. This preposition is supported in previous studies, for instance Berger and Hannan (1998) discovered that the quiet-life hypothesis prevailed in the U.S. banking sector. The authors added that in a highly concentrated market, bank managers do not work hard to control costs and managers pursue other objectives other than profit maximisation. In this kind of environment, managers are able to exercise market power by setting prices above marginal costs. As a result, costs of production increases, the social welfare is hampered and eventually, it halters cost efficiency.

From a policy perspective, the results are of interest to authorities which are seeking for assessment of the trade-off between banking efficiency and competition. As quoted in Central Bank of Malaysia's Governor Speech (Central Bank of Malaysia, 2000), "The merger and consolidation program is a necessary pre-condition to create strong, efficient and competitive domestic banking institutions". Both elements are desirable to policymaker's point of view because a competitive banking environment allocates resources more efficient to the society and eventually, it enhances the financial stability of a nation.

This study found that, a heightened banking competition had resulted in a higher technical efficiency of banks. On contrary, an intensified banking competition yielded a lower scale efficiency of banks. The results of this study offer cautions to the authorities; it shows that efficiency and competition cannot be achieved with a single directive policy. This study recommends that the authorities should tackle the issue by addressing policies based on continual basis. In this vein, it is important for the government to make continuous effort, persistently towards promoting competition in banking industry; the competitiveness of banking industry will results in higher efficiency and better innovation that eventually, lead to a greater variety of products, lower prices, higher consumer welfare, lower market power and better access to financial products and services. Adding to that, a heightened competition also would encourage banks to identify new lending opportunities while expanding their customer base in order to generate income.

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## NOTES

1. With regard to the Malaysian banking sector, because of the consolidation process undertaken in the aftermath of the 1997 crisis, the number of domestic commercial banks was reduced from 24 to only 10 banks; however, Southern Bank merged voluntarily with CIMB bank in May 2007.
2. CPI is preferred for use as the deflator in many studies such as Dogan and Fausten (2003) and Detragiache and Gupta (2004). Okuda and Hashimoto (2004) stated that when using panel data, it is necessary to use a deflator in order to keep outputs from various years comparable.
3. Interested readers are referred to Bikker and Haaf (2002) for comprehensive merits and demerits of both $CR_k$ and HHI.
4. To decide between fixed or random effects, Hausman (1978) suggested a test to check whether the individual effects are correlated with the explanatory variables. The null hypothesis of the test is no correlation between individual effects and the regressors; while the alternative hypothesis implies that the individual effects are correlated with the explanatory variables, thus the fixed effects approach is consistent and efficient.
5. Berger and Humphrey (1992) define technical inefficiency as the cost related to allocating more input than the minimum level, or producing less than the efficient level of production.
6. The White's (1980) heteroscedasticity consistent statistics and the Wald test which follows an F-distribution are used throughout this study.

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