BANK EFFICIENCY AND THE EFFICIENT MARKET HYPOTHESIS: THE CASE FOR BANK STOCK PRICES IN KLSE

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1. Introduction

A study on the efficient market hypothesis (EMH) for the Malaysia's Kuala Lumpur Stock Exchange (KLSE) or recently known as the Bursa Malaysia are quite numerous. In a series of papers Habibullah and his associates have investigated the EMH of the stock prices at the KLSE with respect to several key macroeconomics variables. For instance, Habibullah (1998a; 1998b), Habibullah and Baharumshah (1993a; 1996a; 1996b; 1998), Azali, Habibullah and Baharumshah (1999), Habibullah, Baharumshah and Tan (1998), Habibullah, Azali, Azman-Saini and Baharumshah (2000), Habibullah, Baharumshah, Azali and Azman-Saini (2000), and Puah, Habibullah and Lim (2003) studied the impact of money supply and other macroeconomics variables on the Malaysia's stock market and they found out that the EMH can be rejected.

Using weighted monetary aggregates (divisia money) as an alternative to the traditional simple-sum monetary aggregates, Habibullah and Baharumshah (1993b; 1997; 1999), and Habibullah and Smith (1998) also found that divisia monetary aggregates Granger cause the stock market implying that the stock market is inefficient. In terms of the international transmission or inter-sectoral transmission of the stock market in Malaysia and with other foreign stock markets, studies by Annuar and Shamsher (1993: the studies therein), Baharumshah, Sarmidi and Tan (2003), Habibullah (1998), Habibullah and Baharumshah (1995a; 1995b), Habibullah, Baharumshah and Azali (2000), Azman-Saini, Azali, Habibullah and Matthews (2002), Azman-Saini, Habibullah and Azali (2003) and Lim, Habibullah and Lee (2003) came to the same conclusion that Malaysia's stock market is not efficient.

The above results have important implications from the view point of the market participants as well as the monetary authority. From the view point of the market participants, an inefficient market will suggest that investors will be able to predict stock prices in the KLSE using information on the growth of the macroeconomic variables involved as the trading rule and consistently earn excess returns. As for the respective authority, money supply (simple-sum or divisia measures), economic growth, inflation, exchange and others can be used as instruments in affecting the stock market when the need arises.

The purpose of the present study is to investigate the informationally efficient market hypothesis of the bank stock prices listed at the KLSE with respect to bank's operating efficiency. According to Chu and Lim (1998), an informationally efficient stock market would have taken information on the efficiency scores into consideration in the price discovery process. Since bank's efficiency scores are published accounting numbers which are public information, stock prices should reflect this information. In their study, Chu and Lim (1998) investigate the influence of two bank efficiency measures on the bank's share prices. Using data envelopment analysis technique, they compute the relative cost efficiency (X-efficiency) and profit efficiency (P-efficiency) of a panel of six Singapore-listed banks during the period 1992-1996. They found out that the percentage changes in the prices of the bank shares reflect percentage changes in profit rather than cost efficiencies. They therefore conclude that the Singapore stock market is price efficient in the semi-strong form sense.

Other study that relate efficiency score with bank stock performance include Beccalli, Casu and Girardone (2002), and Eisenbeis, Ferrier and Kwan (1999). Eisenbeis et al. (1999) examine the X-inefficiencies of U.S. bank holding companies from both the stochastic and linear programming frontiers. They hypothesised that if financial markets are efficient we would expect a negative relationship between X-inefficiency and the bank stock returns. They found out that the level of firm-specific inefficiency for the stochastic frontier estimates is negatively correlated with bank stock returns and thus suggest that stocks of inefficient banks tend to underperform their more efficient counterparts. However, results from the linear programming are insignificant and Eisenbeis et al. (1999) conclude that the stochastic frontier produces relatively more informative performance measures than does the programming frontier.

On the other hand, Beccalli et al. (2002) investigate a group of bank for five countries, namely; France (22 banks), Germany (17 banks), Italy (29 banks), Spain (11 banks) and United Kingdom (11 banks). Employing the Data Envelopment Analysis (DEA) and Stochastic Frontier Approach (SFA), they estimate measures of bank cost efficiency for the year 1999/2000. Contrary to earlier finding by Eisenbeis et al. (1999), they found out that the percentage change in stock prices reflect percentage change in cost efficiency, particularly those derived from DEA. The relationship between cost efficiency score and stock prices show significantly positive sign, thus suggesting that stocks of efficient banks tend to outperform their inefficient counterparts. The results indicate that changes in the prices of bank shares reflect percentage changes in cost efficiency.

Our present study differs from the above studies in three respects. First, we estimate four efficiency scores with respect to commercial banks in Malaysia, namely; the overall technical, pure technical, scale and congestion efficiencies. Second, although only eight banks are listed in the KLSE during the period under study (1988-1993), the efficiency scores were calculated using all 37 commercial banks operated in Malaysia. And finally, we test bank stock price efficiency (EMH) using the method of Granger causality as in Li and Xu (2002) and Niarchos and Alexakis (1998).

The rest of the paper is organised as follows. Section 2 discusses a brief literature on measuring efficiency in several types of firms. Section 3 describes the data and the test framework. Section 4 presents and discusses empirical results. Section 5 concludes.

2. Review of Related Literature

2.1 Measuring Bank Efficiency Scores

Efficiency of a firm can be evaluated using financial ratios, parametric approach and non-parametric approach. Financial ratios like return on assets or cost-revenue ratios from accounting statements are commonly used by financial institutions, managers, regulators and consultants to measure efficiency of a firm (Chen and Yeh, 1997; Bauer, Berger, Ferrier and Humphrey, 1998). Frontier efficiency, on the other hand, measures deviations in performance from that of firms with best performance on the efficient frontier, holding constant a number of exogenous market factors like prices in local markets. It measures how well a firm performs relative to the predicted performance of the best firm in the industry, facing similar market conditions. Bauer et al. (1998) stress that frontier efficiency is a more superior measurement than financial ratios because it uses statistical technique to remove the effect of differences in prices and other exogenous market factors affecting the standard performance ratio in order to obtain better estimates. Two approaches could be used in the frontier efficiency evaluation, namely, the parametric or non-parametric approach. The parametric approach applies three different techniques, namely the stochastic econometric frontier approach, the thick frontier approach and the distribution-free approach.

For the purpose of this study, a non-parametric estimation is used to estimate the scale and technical efficiency of the commercial banks as compared to the parametric approach due to several reasons. Firstly, the input-output regression of ordinary least square model resulted in average or expected level of outcome given certain inputs, instead of the desired maximum achievable outcome (Soteriou, Karahanna, Papanastasiou and Diakourakis 1998). Moreover, econometric approach used in evaluating efficiency is based on the assumption that all decision making units are operating efficiently and would not be appropriate if technical efficiency assumption is dropped (Fukuyama, 1993).

Secondly, non-parametric analysis does not require a priori functional specification of the unknown technology or distribution assumptions about the error term that may cause potential specification error. The multiple outputs and variable return to scale of production provide meaningful technical and scale efficiency measures for each decision making units without having data on input price or costs. Thirdly, non-parametric approach also identifies sources of production growth, hence provides recommendation for performance improvement (Fukuyama, 1993; Grabowski, Rangan and Rezvanian, 1994). Non-parametric analysis also avoids the problem arising from multicollinearity among variables (Elyasiani and Mehdian, 1993; Chen and Yeh, 1997).

Basically, a non-parametric approach uses linear programming techniques to measure efficiency of operating units with the same objective. It measures efficiency based on technical efficiency, where efficient firms are those that use less of every inputs to produce the given amount of output or produces much more of every output given the amount of inputs as compared to other firms or linear combination of firms. Non-parametric analysis is commonly employed to evaluate the efficiency of firms or decision units like schools, universities, banks, hospitals, government departments and agencies. Some of these researches include those conducted by Elyasiani and Mehdian (1993), Miller and Noulas (1996), Chen and Yeh (1997), Al-Shammari (1999), Cummins, Tennyson and Weiss (1999), Avkiran (1999), Jorge-Moreno and Garcia-Cebrian (1999).

Elyasiani and Mehdian (1993) studied on the technical and scale inefficiencies in the United States beer industry for the period 1950 to 1986, using both parametric and non-parametric estimates. Employing the data envelopment analysis model by Färe, Grasskoff and Lovell (1985), Elyasiani and Mehdian derived the maximum potential output for each period by designing and solving a host of linear programming problems under alternative conditions. These maximum output values delineated the best practice frontiers which were piecewise linear. Subsequently, efficiency indexes were derived from the ratios of actual output to the potential output values under appropriate conditions. As a comparison, a translog form of ray-homothetic production function was applied to measure pure technical, overall technical and finally scales efficiencies. Generally, throughout the sample period, Elyasiani and Mehdian found that the beer industry in US was operating at a rather high level of pure technical efficiency relative to a production frontier with variable returns to scale.

In the United States, Miller and Noulas (1996) measured the relative technical efficiency of 201 large banks for the period between 1984 and 1990. By employing the non-parametric approach, they concluded that average inefficiency, both pure technical and scale efficiency, of banks under study was small, approximately 5%, much lower than those of previous findings. They justified that the difference due to different sample of banks used, different time frame, stiffer competition faced by banks in 1980s could have forced banks to operate efficiently or face the possibility of winding up their businesses. Another study on efficiency of banks was conducted by Chen and Yeh (1997). They studied the efficiency of Taiwanese banks and found that publicly owned bank managers managed their resources more poorly than that of privately owned. Based on intermediary approach, 15 out of the 34 commercial banks under study were found to be relatively effective, with a rather high overall efficiency rate.

Al-Shammari (1999) studied on the productive efficiency of public or government owned hospitals in Jordan for the period between 1991 and 1993. Al-Shammari discovered many public hospitals in Jordan appeared to be relatively efficient and for those not on the efficient frontier was close to it. However, services provided by these public hospitals were found to be under-utilised by the general public. It was suggested that deployment of staff, equipment, beds and medical supplies could improve efficiency by obtaining first hand information on current provision of services required by the people in Jordan. Also, the results from this study can be used to update information on hospital needs and guide future medical resources distribution and planning.

As for the insurance industry, Cummins et al. (1999) investigated the relationship between mergers and acquisitions, efficiency and scale economy in the United States life insurance industry for the period between 1988 and 1995. They found that United States insurance companies gain greater technical, cost and revenue efficiency than non-merging companies. They supported that restructuring life insurance industry in United States produced significant efficiency gains and improved profitability for target companies. Cummins et al. also maintained that constant or increasing return to scale insurance companies were more likely to become acquisition targets than firms operating with decreasing returns to scale.

From down under, Avkiran (1999) investigated on the efficiency gained by Australian trading banks during deregulated period mergers as well as to what extent operating efficiency gained benefited the public. Inputs identified were the number of staff, deposits, interest expense and non-interest expense, while outputs were net loans, net interest income and non-interest income. Avkiran evaluated the operation efficiency, employee productivity, profitability performance and average relative efficiency of Australian trading banks between 1986 and 1995 and found that though efficiency increased with mergers, acquiring banks did not always maintained their level of efficiency after merging with target banks. Moreover, whether gains in operating efficiency would benefit the public was uncertain.

Jorge-Moreno and Garcia-Cebrian (1999) studied on the production efficiency of European Railways for the timeframe of 1984 to 1995 via non-parametric analysis to estimate technical efficiency, purely technical efficiency and scale efficiency of companies under study. They used annual published data derived from the International Union of Railways of 21 companies, observed over the period of 12 years. Jorge-Moreno and Garcia-Cebrian found that a major part of technical efficiency of European railway companies were scale inefficient due to error made in size selection. As such, they recommended that those European railway companies to be downsized in order to improve their technical efficiency.

The efficiency of non-banking financial institutions is examined by Fukuyama, Guerra and Weber (1999), as well as Chang and Hsieh (1998). Fukuyama et al. (1999) estimated the overall efficiency and productivity growth of credit co-operatives in Japan for the period between 1992 and 1996. Credit co-operatives in Japan were organised under the Law for Small Business Corporation of Japan to accept deposit and savings from members of corporation, government municipals, public firms and non-profit organisations. With these deposits, they gave out loans and discounted bills to members and certain creditable non-members, as well as made payments associated with security transactions.

Fukuyama et al. (1999) used data documented by Kin-yutosko (i.e. Financial Library consultant) and the annual yearbook of credit co-operatives in their study and discovered that pure technical inefficiency dominated scale inefficiency of Japanese credit co-operatives. They also found that foreign owned credit co-operatives in Japan were more overall efficient. In order to improve efficiency, they recommended reallocation of input, either by producing more output at the same cost or produce the same amount of output at a lower cost.

Chang and Hsieh (1998) investigated on the economic efficiency of Credit Department of Farmers' Associations (CDFA) in Taiwan, an organisation responsible for providing more than 50% of Taiwan's total agricultural loans. Using data from the Farmers' Association Yearbook in Taiwan Province and the financial report compiled by the Taiwan Co-operative Bank for the year 1994, a total of 283 CDFAs in various towns in Taiwan were examined. Chang and Hsieh used the intermediation approach to determine the inputs and outputs of CDFAs. They discovered that CDFAs were highly scale efficient, but the performance on technical and allocative efficiencies was not satisfactory. Their findings indicated that the increased competition caused by financial deregulation could improve CDFA performance through changes in portfolio management decision making, while the risk-efficiency trade-off could be used by regulatory agencies to monitor the performance of CDFAs.

Ong, Habibullah, Azali and Radam (2003) and Ong, Habibullah, Radam and Azali (2003) evaluated the efficiency of the Credit Guarantee Corporation (CGC) in providing credit guarantee schemes to small and medium enterprises, SMEs in Malaysia. The efficiency evaluation of CGC is conducted for single, two outputs and three outputs. The results suggest that CGC is most efficient in granting credit guarantees to three sectors of the economy than one and two sectors. The findings also suggest that both pure technical and scale inefficiencies contributed to the inefficiency of CGC and pure technical inefficiency contributed slightly more than scale inefficiency. As such, CGC should consider reallocating its existing inputs as well as increasing the amount of credit guarantees granted to general business, manufacturing and agriculture sectors in order to achieve a reasonable level of efficiency.

3. Methodology

Technical efficiency, also known as overall technical efficiency (OTE) can be decomposed into scale efficiency (SE) and pure technical efficiency (PTE). The estimation of OTE, SE, and PTE in this study is done through non-parametric approach. To illustrate our measures of efficiency, consider an industry which uses a single input and where one unit of the input can be converted to at most one unit output. Overall technical efficiency is the ratio of the quantity an efficient firm would have used to produce a unit of output to the quantity used by the firm being evaluated. For example, a firm using two units of the input to produce two units of the output has an overall technical efficiency score of 1 (2/2) or is 100 percent. Firms may be inefficient simply by making poor use of inputs or by failing to operate at the optimal scale. To determine the source of inefficiency, two other measures of efficiency are calculated. Scale efficiency measures the output loss due to operating at an inefficient scale, while pure technical efficiency measures efficiency at the firm's current scale. These measures are most easily explained in the context of the method of measuring efficiency, data envelopment analysis (DEA).

Measuring efficiency using a non-parametric approach began essentially with Farrell (1957). His estimation was based on linear programming techniques where a convex disposal hull was constructed based on observed input-output combinations. The efficiency measure developed were used to measure efficiency of decision making units as in Charnes, Cooper and Rhodes (1978), Byrnes, Fare and Grasskopf (1984, 1987), Brynes, Fare, Grasskopf and Lovell (1988), Grabowski and Pasurka (1988), Weersink, Turvey and Gondah (1990), among others. Non-parametric procedures for frontier estimation possess a number of attractive properties: (a) they do not impose any ad hoc functional form on the production frontier such as those dictated by parametric procedures, (b) they do not necessitate any distributional assumptions on efficiency, (c) they allow estimation of frontiers with multiple outputs and multiple inputs without resorting to restrictive aggregation assumption, and (d) simulation evidence has shown that production frontier estimated outperformed translog deterministic statistical frontiers in approximating the true production frontier, even when the true frontier was of the translog variety (Banker, Charner, Cooper and Maindiratta, 1988).

Fare et al. (1985) begin by specifying a transformation function, T, which satisfy constant returns to scale and strong input disposability:

$$T = \{(x,y) : y \geq Yz,\ Xz \geq x, z \in R_k^+\} \tag{1}$$

where x equals (nx1) vector of inputs, y equals (mx1) vector of output, k equals the number of firms, X is the (nxm) matrix of observed inputs, Y is the corresponding (mxk) matrix of outputs, and z is the intensity with which any activity (x, y) is utilised.

The overall measure of technical efficiency for an individual observation i, TE, can be expressed as

$$TE(x_i, y_i) = \max \{(x_i, \Theta_i\ y_i) \in T\} \tag{2}$$

and can be calculated through solution of the following linear programming problem:

$$TE(x,y) = \max \Theta \tag{3}$$

$$\text{st} \qquad \sum_{i=1}^{k} x_{ij} z_i \geq x_i \qquad j = 1,2,\ldots\ldots,6$$

$$\sum_{i=1}^{k} y_i z_i - y_i \Theta \geq 0$$

$$x_i, y_i \geq 0$$

The first constraint is the input constraint. The left hand side of the constraint constitutes the theoretical efficient firm against which the i-th firm is compared. The last constraint is the output constraint which consists of two parts. The component $\Sigma\, y_i\, z_i$, represents the maximum output of hypothetically efficient firm. The component $(-y_i \Theta)$ is the actual level of output of the i-th firm, y_i, multiplied by the level of inefficiency, Θ. If the firm is overall technically efficient, then $\Theta = 1$. As a result, the component $\Sigma\, y_i\, z_i$, is exactly offset by $(-y_i \Theta)$. Hence, the level of output of the i-th firm is the same as the theoretically efficient firm. If the firm is technically inefficient, then $\Theta > 1$, which indicates that the theoretical maximum output $\left[\Sigma\, y_i\, z_i\right]$ is greater than the actual output of the i-th firm, y_i.

Overall technical efficiency can be disaggregated into two components: scale and pure technical. In order to distinguish between these two components the original transformation set T specified in equation (2) is modified to allow for increasing and decreasing returns to scale. Afriat (1972) has shown that restricting the intensity vector to sum to one permits increasing, constant and decreasing returns to scale. A new transformation set incorporating this non-constant returns to scale technology can be expressed as:

$$T' = \{(x,y) : y \geq Yz,\ Xz \geq x, z \in R_k^+,\ \sum z_i = 1\} \tag{4}$$

Another efficiency measure, termed pure technical efficiency (PE), can now be defined relative to the frontier. For any particular observations (x_i, y_i), pure technical efficiency can be expressed as:

$$PE(x_i, y_i) = \max\{\Theta_i : (x_i, y_i) \in T'\} \tag{5}$$

Thus, PE equals one for all observations, since the observations are on the technology frontier. To calculate this value numerically, the linear programming problem given by equation (3) is solved with the additional constraint that the elements of the intensity vector sum to one:

$$\sum_{i=1}^{k} z_i = 1 \tag{3a}$$

By taking the ratio TE to PE for an observation, one can determine if the firm operates under constant or non-constant returns to scale, and expressed as:

$$SE(x_i, y_i) = TE(x_i, y_i) / PE(x_i, y_i) \tag{6}$$

If the technology exhibits constant returns to scale at the observed input and output combination, the scale efficiency measure equals to one. Non-constant returns to scale occur when $SE(x_i, y_i) > 1$ and constant returns to scale occur when $SE(x_i, y_i) = 1$. To determine the direction of non-constant returns to scale, a third transformation set, T*, which imposes non-increasing returns to scale, is defined. This is done by restricting the intensity variables so that $\sum z_i \geq 1$. The new transformation set is:

$$T = \{(x,y) : y \geq Yz,\ Xz \geq x, z \in R_k^+,\ \sum z_i \geq 1\} \tag{7}$$

Given the above transformation set, a new measure of efficiency relative to this set is written for observation (x_i, y_i), as:

$$WE^{*}(x_i, y_i) = \max \{\Theta_i : (x_i, \Theta y_i) \in T^{*}\} \tag{8}$$

The definition differs from the pure technical efficiency measure PE only in the equality restriction on summation constraint for the intensity variable elements. Consequently, it is calculated by solving a third linear programming problem given by equation (3) and the following constraint replaces equation (3a):

$$\sum_{i=1}^{k} z_i \geq 1 \tag{3b}$$

There are two possible cases when $SE \neq 1$. If TE=WE*, increasing returns to scale exist and if TE $\neq$ WE*, then decreasing returns to scale exist.

The next component of overall technical efficiency is congestion, that is, over-utilisation of some input(s) to the point that output falls. Under strong disposability of inputs, congestion cannot occur. Thus, in order to model the possibility that some inputs may have an adverse effect on output (if they are used in too high proportion) we change the technology and impose only weak rather than strong disposability of input. According to Fare et al. (1985), this can be accomplished by changing the constraint $Xz \geq x$ into $Xz = \lambda x$, where $0<\lambda\geq1$. The technology

$$T^{**} = \{(x_i, y_i) : y \geq Yz,\ Xz = \lambda x, 0 < \lambda \geq 1, z \in R_k^{+},\ \Sigma z_i = 1\} \tag{9}$$

where λ permits the over-utilisation of inputs by relaxing the strong disposability assumption. Another measure of pure technical efficiency, PE*, can now be derived relative to the frontier of this weakly disposable technology:

$$PE^{*}(x_i, y_i) = \max \{\Theta_i, (x_i, \Theta y_i) \in T^{**}\} \tag{10}$$

The measure is calculated by solving the following linear programming problem:

$$PE^{*}(x_i, y_i) = \max \Theta \qquad (3c)$$

$$\text{st} \qquad \sum_{i=1}^{k} x_i z_i = \lambda x_i \qquad j = 1,2,\ldots\ldots,6$$

$$\sum_{i=1}^{k} y_i z_i - y_i \Theta \geq 0$$

$$\sum_{i=1}^{k} z_i \geq 0$$

$$0 < \lambda \geq 1$$

The effect of congestion or over-utilisation, $CE^{*}(x_i, y_i)$, of a particular input can then be determined by

$$CE(x_i, y_i) = PE(x_i, y_i) / PE^{*}(x_i, y_i) \qquad (11)$$

Congestion is evident for an individual firm if CE>1. Over-utilisation of inputs is not present if the pure technical efficiency measures defined under weak (PE*) and strong (PE) input disposability assumptions are equal.

From the above discussion, it is clear that if one assumes that the technology obeys strong disposability of inputs and constant returns to scale, $TE(x_i, y_i) = PE^{*}(x_i, y_i)$. Thus, $TE(x_i, y_i)$ can be regarded as the 'strong disposable constant returns to scale' Farrell measure and hence we have the following disaggregation:

$$TE(x_i, y_i) = SE(x_i, y_i).CE(x_i, y_i).PE^{*}(x_i, y_i) \qquad (12)$$

To sum up, equation (12) gives us a decomposition of Farrell's measure of technical efficiency into (a) scale efficiency which measures output loss due to deviations from constant returns to scale, (b) congestion which measures output loss due to over-utilisation of inputs, and (c) pure technical efficiency which measures output loss due to technical inefficiency. For all measures, production is efficient in the relevant sense if the measure is equal to unity. If there is inefficiency due to scale, congestion or pure technical, the corresponding measure will be more than unity. Thus, the difference between unity and the observed measure yields the percentage of potential output loss due to a particular type of inefficiency.

3.1 Sources of Data Used

In this study, we employed financial data of 37 commercial banks over the period 1988-1993. Data for the analysis were taken from the financial statements of the respective banks (see Table 1 for a list of commercial banks in Malaysia). This study implements a variant of intermediation approach. Three banks outputs, namely interest income (Q1), non-interest income (Q2) and total loans (Q3) are used.

Interest income include interest and fee income on loans, income from lease financing receivables, interest and dividend income on security and other income. Non-interest income includes service charges on deposit account, income from fiduciary activities and other non-interest income. Total loans consist of loans and lease net of unearned income. These output that are being used in this study represent the banks' revenue and major business activity.

The banks' input are interest expenses (X1), non-interest expenses (X2), transaction deposits (X3) and non-transaction deposit (X4). Interest expenses include the purchase and sale of securities and interest on demand notes and other borrowed money. Non-interest expenses include salaries, expenses associated with premises and fixed assets, taxes and other expenses. Bank deposit are then disaggregated into transaction and non-transaction deposits because they have different turnover and cost structure. Deposit and funds purchased are the source of loanable funds to be invested in assets. These inputs represent measures for the banks' labor, capital and operating costs. This selection of inputs and outputs is in accordance with the studies by Aly, Grabowski, Pasurka and Rangan (1990) and Hancock (1986).

Table 1: *List of Commercial Banks in Malaysia*

Abbreviations	Name of Banks
A. Domestic Commercial Banks	
BHL	Ban Hin Lee Bank Berhad
BBMB	Bank Bumiputera Malaysia Berhad
Buruh	Bank Buruh (Malaysia) Berhad
Utama	Bank Utama (Malaysia) Berhad
BOC	Bank of Commerce Berhad
DCB	Development and Commercial Bank Berhad
HHB	Hock Hua Bank Berhad
HHSB	Hock Hua Bank (Sabah) Berhad
KONG	Kong Ming Bank Berhad
KYB	Kwong Yik Bank Berhad
MBB	Malayan Banking Berhad
MUI	Malayan United Bank Berhad
MFB	Malaysian French Bank Berhad
OBB	Oriental Bank Berhad
PACB	Pacific Bank Berhad
HABIB	Perwira Habib Bank Malaysia Berhad
PBB	Public Bank Berhad
SABAH	Sabah Bank Berhad
SBB	Southern Bank Berhad
UMBC	United Malaysian Banking Corporation
WAH	Wah Tat Bank Berhad
B. Foreign Commercial Banks	
ALG	Algemene Bank Nederland NV
BKOK	Bangkok Bank Limited
AMER	Bank of America NT & SA
NOVA	Bank of Nova Scotia
TOKYO	Bank of Tokyo
CHASE	The Chase Manhattan Bank, NA
CKBL	Chung Kiaw Bank Limited
CITI	Citibank, NA
DEUT	Deutshe Bank
HSBC	The Hongkong and Sanghai Banking Corporation
LEE	Lee Wah Bank Limited
OCBC	Overseas Chinese Bank Corporation
OUBL	Overseas Union Bank Limited
STD	Standard Chartered Bank
SECPAC	Security Pacific Asian Bank
UOBL	United Overseas Bank Limited

4. Empirical Results

Since the purpose of the DEA analysis is to compute the efficiency scores for each bank, here we discuss only briefly the results of the linear programming estimations. In Table 2 we presented the average of the efficiency scores for each bank for the period 1988 to 1993. The average figure show that banks in Malaysia is inefficient, and the main source of inefficiencies comes from pure technical efficiency follow by the scale efficiency. Looking at the individual banks, for the period of six years, on average, Southern Bank Berhad (domestic) and Bank of America (foreign) are efficient while others are inefficient. Again Southern Bank Berhad and Bank of America are scale efficient. With respect to PTE, Bank Bumiputra Malaysia Berhad, Bank Buruh, Malayan Banking Berhad, Southern Bank Berhad, Bank of America, Bank of Nova Scotia, The Chase Manhattan Bank, Citibank, Hongkong and Shanghai Bank, and United Overseas Bank Limited are said to be pure technical efficient. In terms of efficiency in input usage, our results show that Bank Bumiputra Malaysia Berhad, Malayan Banking Berhad, and Hongkong and Shanghai Bank show this characteristic.

Table 3 show the average performance of the commercial banks, both domestic and foreign banks for each year with respect to the efficiency scores. For example, in all cases, foreign banks are more efficient in terms of the overall technical, scale, and pure technical efficiencies compared to the domestic banks. In all these cases, the efficiency scores are closer to one. However, in terms of input usage, the domestic banks are more efficient than the foreign banks except for the year 1991 and 1993. Earlier study by Ghaffar and Habibullah (1990), using data for 1985 and 1986 and estimating the statistical cost functions, found out that foreign banks are more efficient than the domestic commercial banks in Malaysia. On the contrary, further analysis by Habibullah (1991, 1995) and Habibullah and Tan (2001) found that domestic banks exhibit economies of scale compared to the foreign banks. In Habibullah's (1995) study, although banks in Malaysia exhibits economies of scope or interproduct complementarity among various outputs, the foreign banks do not experience scale economies. This result is further supported by Habibullah and Tan (2001). Using the translog cost function approach, they found out that the foreign banks exhibit diseconomies of scale while the domestic banks experience economies of scale in their operation.

Table 2: *Average Overall Technical (OTE), Scale (SE), Pure Technical (PTE) and Congestion (CE) Efficiencies of Malaysian Commercial Banks, 1988-1993*

Banks	OTE	SE	PTE	CE
BHL	1.1704	0.9736	1.2008	0.4090
BBMB	1.0358	1.0358	1.0000	1.0000
Buruh	1.0233	1.0233	1.0000	0.5169
Utama	1.1828	1.0029	1.1891	0.2644
BOC	1.1416	1.0362	1.1060	1.1060
DCB	1.1474	1.0261	1.1157	0.7519
HHB	1.2498	1.0803	1.1439	0.2869
HHSB	1.0907	1.0307	1.0575	0.3481
KONG	1.0226	1.0008	1.0241	0.0203
KYB	1.1075	1.0515	1.0675	0.6061
MBB	1.3101	1.3101	1.0000	1.0000
MUI	1.0272	0.9630	1.0851	0.7358
MFB	1.4297	0.9301	1.4838	0.6658
OBB	1.2912	1.0722	1.2128	0.2436
PACB	1.1963	1.0437	1.1472	0.3871
HABIB	1.0754	1.0258	1.0462	0.5600
PBB	1.1444	1.0648	1.0723	1.0723
SABAH	1.0496	1.0337	1.0132	0.1023
SBB	1.0000	1.0000	1.0000	0.8863
UMBC	1.2342	1.2110	1.0154	0.9197
WAH	1.2167	1.0689	1.1371	0.0153
ALG	1.3461	1.1214	1.2027	0.0275
BKOK	1.0782	0.9728	1.1128	0.0653
AMER	1.0000	1.0000	1.0000	0.3671
NOVA	1.0874	1.0874	1.0000	0.0240
TOKYO	1.0570	1.0381	1.0186	0.7211
CHASE	1.0143	1.0143	1.0000	0.6333
CKBL	1.2180	1.1313	1.0938	0.3722
CITI	1.0226	1.0226	1.0000	0.8592
DEUT	1.0549	0.9997	1.0546	0.2010
HSBC	1.0148	1.0148	1.0000	1.0000
LEE	1.1349	1.0828	1.0500	0.2727
OCBC	1.1583	1.0591	1.1087	0.9467
OUBL	1.1376	0.9694	1.1858	0.2937
STD	1.1250	1.1231	1.0019	0.9392
SECPAC	1.2244	1.1451	1.0702	0.0241
UOBL	1.1552	1.1552	1.0000	0.0049
AVERAGE	**1.1345**	**1.0519**	**1.0815**	**0.5041**

Table 3: *Average Overall Technical (OTE), Scale (SE), Pure Technical (PTE) and Congestion (CE) Efficiencies of Malaysian Commercial Banks, 1988 to1993*

Banks	1988	1989	1990	1991	1992	1993
OTE:						
All	1.2207	1.2928	1.0762	1.0879	1.0783	1.0509
Domestic	1.2589	1.1457	1.0636	1.0711	1.0781	1.0140
Foreign	1.0308	1.0075	1.0098	1.0114	1.0116	1.0062
SE:						
All	1.0334	1.1563	1.0181	1.0438	1.0299	1.0301
Domestic	1.0557	1.0371	1.0051	1.0377	1.0343	1.0083
Foreign	1.0168	1.0065	1.0040	1.0100	1.0039	1.0049
PTE:						
All	1.1981	1.1132	1.0636	1.0445	1.0492	1.0206
Domestic	1.2158	1.1035	1.0637	1.0323	1.0421	1.0058
Foreign	1.0133	1.0009	1.0058	1.0015	1.0077	1.0012
CE:						
All	0.3744	0.5090	0.5398	0.4949	0.5443	0.5620
Domestic	0.5621	0.5909	0.6191	0.7006	0.6761	0.5115
Foreign	0.4547	0.4515	0.4430	0.7311	0.5556	0.6542

Table 4: *Percentage Number of Banks with Respect to Overall Technical (OTE), Scale (SE), Pure Technical (PTE) and Congestion (CE) Efficiencies, 1988 to1993*

Banks	1988	1989	1990	1991	1992	1993
OTE:						
All	18 [48.6]	11 [29.7]	19 [51.4]	17 [45.9]	15 [40.5]	18 [48.6]
Domestic	10 (47.6)	7 (33.3)	11 (52.4)	11 (52.4)	9 (42.9)	7 (33.3)
Foreign	8 {50.0}	4 {25.0}	8 {50.0}	6 {37.5}	6 {37.5}	11 {68.8}
SE:						
All	13 [35.1]	9 [24.3]	14 [37.8]	15 [40.5]	14 [37.8]	17 [45.9]
Domestic	6 (28.6)	6 (28.6)	8 (38.1)	9 (42.9)	8 (38.1)	7 (33.3)
Foreign	7 {43.8}	3 {18.8}	6 {37.5}	6 {37.5}	6 {37.5}	10 {62.5}
PTE:						
All	17 [45.9]	19 [51.4]	22 [59.5]	25 [67.6]	26 [70.3]	29 [78.4]
Domestic	7 (33.3)	10 (47.6)	11 (52.4)	15 (71.4)	14 (66.7)	15 (71.4)
Foreign	10 {62.5}	9 {56.3}	11 {68.8}	10 {62.5}	12 {75.0}	14 {87.5}
CE:						
All	6 [16.2]	11 [29.7]	10 [27.0]	12 [32.4]	14 [37.8]	16 [43.2]
Domestic	4 (19.0)	6 (28.6)	7 (33.3)	9 (42.9)	9 (42.9)	7 (33.3)
Foreign	2 {12.5}	5 {31.3}	3 {18.8}	3 {18.8}	5 {31.3}	9 {56.3}

Notes: Figures in square brackets [.] denote percentage to total commercial banks (37). Figures in round brackets (.) denote percentage to total domestic banks (21). Figures in curly brackets {.} denote percentage to total foreign banks (16).

In Table 4, we presented the number of banks that are efficient (value of one) with respect to the efficiency scores. For example, for the overall technical efficiency, the total number of banks that are efficient does not change much from 1988 to 1993. However, for the domestic banks, there is a decline in the number of banks that are efficient, that is, from 10 in 1988 to 7 in 1993, while efficient foreign banks increase from 8 in 1988 to 11 in 1993. On the other hand, for the other efficiency scores, efficiency level for all banks has improved from 1988 to 1993.

4.1 Bank Stock Price and the Efficient Market Hypothesis

Table 5 presents the efficiency scores and the year end stock prices of eight commercial banks listed in the Kuala Lumpur Stock Exchange for the period 1988 to 1993. We observed that the most efficient bank is Southern Bank Berhad, while fairly efficient banks are Ban Hin Lee Bank and Public Bank Berhad. However, for the period 1988 to 1993, the largest domestic bank, Malayan Banking Berhad are said to be inefficient but efficiency level improves from 1.65 in 1988 to 1.08 in 1993.

Our main purpose is to determine whether bank stock price is efficient with respect to information of the efficiency scores – the overall technical, scale, pure technical and congestion efficiencies. For this purpose, in this study we employ the standard Granger causality test to test the semi-strong efficient market hypothesis for bank stock price. According to the semi-strong EMH, neither stock price's own past returns nor other publicly available information can be used to predict the current return. We follow the work of Niarchos and Alexakis (1998) and Li and Xu (2002) by estimating the following equation:

$$\Delta\log \textit{stock price} = \alpha + \sum_{i=1}^{2} \beta_i \Delta\log \textit{stock price}\ (t\text{-}1) + \sum_{i=1}^{2} \theta_i \Delta\log \textit{efficiency}\ (t\text{-}1) \quad (13)$$

From equation (13), the test for the null hypothesis that $\beta_i = \theta_i = 0_i$ indicates Granger non-causality of the efficiency scores to bank stock price, and thus implies that semi-strong efficient market hypothesis holds.

Before estimating equation (13), all variables were transformed into natural logarithm and to render stationarity, the change in log of the variables were used in the estimation. In fact, numerous studies by Habibullah and associates found that stock returns

Table 5: *Data on Efficiency Scores and Bank Stock Prices 1988-1993*

Banks	1988	1989	1990	1991	1992	1993
Ban Hin Lee Bank Berhad						
OTE	nr	nr	nr	1.0000	1.0000	1.0000
PTE	nr	nr	nr	1.0000	1.0876	1.0000
SE	nr	nr	nr	1.0000	0.9195	1.0000
CE	nr	nr	nr	0.0679	1.0876	1.0000
SP	na	na	na	3.28	4.96	7.90
Development and Commerce Bank Berhad						
OTE	1.3323	1.4537	1.0686	1.0000	1.0297	1.0000
PTE	1.2628	1.2183	1.2029	1.0102	1.0000	1.0000
SE	1.0550	1.1932	0.8884	0.9899	1.0297	1.0000
CE	0.6856	0.4819	0.3340	1.0102	1.0000	1.0000
SP	1.06	1.40	1.83	1.92	2.08	6.40
Hock Hua Bank Berhad						
OTE	nr	nr	nr	1.1332	1.0007	1.0127
PTE	nr	nr	nr	1.0522	1.0457	1.0000
SE	nr	nr	nr	1.0769	0.9569	1.0127
CE	nr	nr	nr	0.0611	1.0457	0.2381
SP	na	na	na	2.90	2.98	7.75
Pacific Bank Berhad						
OTE	nr	nr	1.2385	1.0000	1.1991	1.1950
PTE	nr	nr	1.2299	1.0000	1.1558	1.1421
SE	nr	nr	1.0070	1.0000	1.0375	1.0463
CE	nr	nr	0.3432	1.0000	0.3509	0.1829
SP	na	na	2.74	2.72	2.60	7.80
Public Bank Berhad						
OTE	1.5968	1.0000	1.0000	1.2695	1.0000	1.0000
PTE	1.2080	1.1091	1.1168	1.0000	1.0000	1.0000
SE	1.3219	0.9017	0.8954	1.2695	1.0000	1.0000
CE	1.2080	1.1091	1.1168	1.0000	1.0000	1.0000
SP	1.58	2.06	1.32	1.40	1.54	5.10
Southern Bank Berhad						
OTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
SE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
CE	1.0000	1.0000	1.0000	1.0000	1.0000	0.3179
SP	2.85	4.70	4.54	3.82	4.54	7.85
Bank of Commerce Berhad						
OTE	1.3083	1.3152	1.0000	nr	nr	nr
PTE	1.3392	1.2969	1.0000	nr	nr	nr
SE	0.9769	1.0141	1.0000	nr	nr	nr
CE	1.3392	1.2969	1.0000	nr	nr	nr
SP	2.13	2.78	3.42	na	na	na
Malayan Banking Berhad						
OTE	1.6529	1.2707	1.4031	1.2680	1.1838	1.0819
PTE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
SE	1.6529	1.2707	1.4031	1.2680	1.1838	1.0819
CE	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
SP	6.70	8.75	12.7	7.10	8.20	11.8

Notes: na and nr denote not available and not relevant respectively. SP denotes bank stock price (year end).

are I(1) processes. We first estimate with one lag and then two lags. The results of estimating equation (13) using the Newey-West (1987) procedure to correct for heteroskedasticity and autocorrelation are presented in Table 6.

The results clearly indicate that bank stock price is efficient with respect to the overall technical efficiency for both one and two lags, and also to scale and congestion efficiency score for one lag. In all these cases, Granger causality ($\beta_i \neq \theta_i \neq 0_i$) can be rejected in favour of the null hypothesis that $\beta_i = \theta_i = 0_i$ at the 5 percent level of significance. However, as for the pure technical efficiency scores with respect to lag one and two, and scale and congestion efficiencies of two lags, our result suggests that these efficiency scores Granger causes bank stock price. This implies that bank stock price is not efficient and thus rejects the EMH with respect to these efficiency scores. In other words, investors will be able to beat the market using these efficiency scores to predict the bank stock price in the KLSE in the short-run.

In order to determine whether bank stock price is efficient to the efficiency scores in the long-run, we estimate the following error-correction equation:

$$\Delta \log \textit{stock price} = \alpha + \sum_{i=1}^{2} \beta_i \Delta \log \textit{stock price}\ (t\text{-}1) + \sum_{i=1}^{2} \theta_i \Delta \log \textit{efficiency}\ (t\text{-}1)$$

$$+ \gamma(\log \textit{stock price}\ (t\text{-}1) - \log \textit{efficiency}\ (t\text{-}1)) \qquad (14)$$

The significance of the parameter γ indicates cointegration between bank stock price and the efficiency scores and thus implies inconsistency with semi-strong efficient market hypothesis in the long-run. The results of the long-run semi-strong efficient market hypothesis are presented in Table 7. We can clearly observe that the results of the short-run semi-strong efficient market hypothesis are robust to the inclusion of the error-correction term. In fact the error-correction term is statistically insignificant in all cases. This implies that bank stock price at the KLSE is semi-strong efficient in the long-run with respect to the efficiency scores.

Table 6: *Regression Results of the following equation:*

$$\Delta \log \textit{stock price} = \alpha + \sum_{i=1}^{2} \beta_i \Delta \log \textit{stock price} (t\text{-}i) + \sum_{i=1}^{2} \theta_i \Delta \log \textit{efficiency} (t\text{-}i)$$

Independent variables	Overall Technical Efficiency: Lag 1	Overall Technical Efficiency: Lag 2	Pure Technical Efficiency: Lag 1	Pure Technical Efficiency: Lag 2	Scale Efficiency: Lag 1	Scale Efficiency: Lag 2	Congestion Efficiency: Lag 1	Congestion Efficiency: Lag 2
Constant	0.3197	0.4051	0.3587	0.0692	0.2938	0.3962	0.2831	0.2798
	(2.8233)*	(2.2387)	(3.0598)*	(0.6112)	(2.8306)*	(2.7999)*	(2.4532)*	(2.3751)*
Stock Price (-1)	-0.1764	-0.2793	-0.2101	-0.1692	-0.2071	-0.3040	-0.2233	-0.1231
	(0.8188)	(0.8158)	(0.9059)	(0.3001)	(0.9790)	(0.9027)	(1.1272)	(0.2352)
Stock Price (-2)		-0.5958		-0.6354		-0.5671		-0.4170
		(1.5447)		(2.9565)*		(1.9292)		(1.1232)
Efficiency (-1)	0.3694	-0.2997	2.7331	-0.5095	-0.2040	-0.2918	0.0714	0.0458
	(0.4562)	(0.1968)	(4.4213)*	(0.5083)	(0.2771)	(0.2265)	(0.5991)	(0.4039)
Efficiency (-2)		0.6885		-5.9908		1.4540		0.7041
		(1.5603)		(4.9234)*		(2.4323)*		(4.8159)*
R-squared	0.027	0.194	0.193	0.728	0.015	0.441	0.030	0.439
SER	0.503	0.588	0.458	0.341	0.506	0.489	0.502	0.490
DW	1.88	1.23	1.26	1.89	1.68	1.29	1.97	1.94
F-statistics:								
$\beta_i = 0$	0.423	0.349	0.376	0.018*	0.340	0.203	0.274	0.307
$\theta_i = 0$	0.653	0.335	0.000*	0.001*	0.784	0.021*	0.556	0.000*
$\beta_i = \theta_i = 0$	0.617	0.239	0.001*	0.000*	0.615	0.029*	0.489	0.001*

Notes: Asterisk (*) denotes statistical significance at the five percent level.

Table 7: *Regression Results of the following equation:*

$$\Delta \log \textit{stock price} = \alpha + \sum_{i=1}^{2} \beta_i \Delta \log \textit{stock price}\ (t\text{-}i) + \sum_{i=1}^{2} \theta_i \Delta \log \textit{efficiency}\ (t\text{-}i) + \gamma(\log \textit{stock price}\ (t\text{-}1) - \log \textit{efficiency}\ (t\text{-}1))$$

Independent	Overall Technical Efficiency:		Pure Technical Efficiency:		Scale Efficiency:		Congestion Efficiency:	
variables	Lag 1	Lag 2	Lag 1	Lag 2	Lag 1	Lag 2	Lag 1	Lag 2
Constant	0.4705	0.7130	0.6320	0.0627	0.4943	0.6638	0.3719	0.6182
	(2.2843)*	(1.5514)	(2.8677)*	(0.2132)	(2.0026)	(2.6615)*	(1.2874)	(1.9446)
Stock Price (-1)	-0.1290	-0.1784	-0.1326	-0.1713	-0.1421	-0.2141	-0.1849	0.0940
	(0.6202)	(0.5054)	(0.5238)	(0.3152)	(0.6934)	(0.6514)	(0.8240)	(0.1584)
Stock Price (-2)		-0.5229		-0.6360		-0.5715		-0.2954
		(1.7352)		(2.9546)*		(2.5262)*		(0.6710)
Efficiency (-1)	0.3424	0.1695	3.3103	0.5380	-0.3474	-0.5738	0.0638	-0.1592
	(0.3920)	(0.1012)	(5.6196)*	(0.5269)	(0.3804)	(0.3945)	(0.5119)	(0.7934)
Efficiency (-2)		0.7642		-6.0252		1.2056		0.6512
		(1.0355)		(3.9285)*		(2.5104)*		(4.1809)*
ECM(-1)	-0.1476	-0.2884	-0.2418	0.0040	-0.1897	-0.2534	-0.0710	-0.2654
	(0.9694)	(1.1913)	(1.8179)	(0.0250)	(1.0192)	(1.7983)	(0.3542)	(1.4124)
R-squared	0.065	0.325	0.305	0.728	0.068	0.529	0.039	0.552
SER	0.507	0.575	0.437	0.365	0.506	0.480	0.514	0.468
DW	1.92	1.73	1.35	1.89	1.66	1.53	2.02	2.42
F-statistics:								
$\beta_i = 0$	0.543	0.277	0.607	0.029*	0.497	0.102	0.421	0.526
$\theta_i = 0$	0.699	0.467	0.000*	0.007*	0.708	0.004*	0.615	0.000*
$\beta_i = \theta_i = 0$	0.768	0.470	0.000*	0.000*	0.687	0.000*	0.648	0.002*

Notes: Asterisk (*) denotes statistical significance at the five percent level. ECM equals the difference between stock price and efficiency scores.

5. Conclusion

The purpose of the present study is to investigate the informationally efficient market hypothesis of the bank stock prices listed at the KLSE with respect to bank's operating efficiency. An informationally efficient security price would have taken information on the efficiency scores into consideration in the price discovery process. Since bank's efficiency scores are published accounting numbers which are public information, stock prices should reflect this information. In this study, using data envelopment analysis technique, we compute the overall technical efficiency and decomposed it into pure technical efficiency, scale efficiency and congestion efficiency. We found out that the percentage changes in the prices of the bank shares at the KLSE reflect percentage changes in the overall technical efficiency but not to the pure technical, scale and congestion efficiencies scores. We therefore conclude that the Malaysia's bank stock return is price inefficient in the semi-strong form sense.

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Abstract

The purpose of the present study is to investigate the informationally efficient market hypothesis of the bank stock prices listed at the KLSE with respect to bank's operating efficiency. In this study, using data envelopment analysis technique, we compute the overall technical efficiency and decomposed it into pure technical efficiency, scale efficiency and congestion efficiency. We found out that the percentage changes in the prices of the bank shares at the KLSE reflect percentage changes in the overall technical efficiency but not to the pure technical, scale and congestion efficiencies scores. We therefore, conclude that the Malaysia's bank stock return is price inefficient in the semi-strong form sense.