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I. ARTICLES

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BANK EFFICIENCY AND STOCK RETURNS IN SELECTED ASEAN COUNTRIES

This paper examines the relationship between bank efficiency and stock returns in selected ASEAN countries for the period 1987-2007.We first estimate the cost and profit efficiency of the sample of listed banks using the non-parametric Data Envelopment Analysis (DEA) approach. We then test both variables for co-integration and estimate the panel vector error-correction model to examine the long and short-term relationship between a bank's efficiency and stock returns. The results show that a bank's stock returns prices are co-integrated with both cost and profit efficiency, suggesting a long-term relationship between the two. The results also indicate the superiority of profit efficiency relative to cost efficiency in predicting stock returns in the ASEAN countries. Overall, we conclude both cost and profit efficiency contains useful information for shareholders who wish to explain bank stock returns.

Keywords: Bank efficiency, stock returns, Data Envelopment Analysis, panel time-series
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1. INTRODUCTION

The relationship between cost efficiency and stock returns is important as the failure to minimize production costs at a given level of outputs reduces economic rent and hence, shareholder's wealth (Clark 1996). The fact that efficient firms perform better than inefficient firms is reflected in market prices (directly through lower costs or higher output or indirectly, through higher customer satisfaction and higher prices which in return may improve stock price performance).Similarly, the relationship between profit efficiency and stock returns is also vital, as profit efficiency takes into account both revenue generation and cost control(Berger and Humphrey 1992;Fiordelisi 2007). How profit efficient the bank is will be reflected in the stock prices as it deals with the shareholder's wealth maximization.

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Likewise, a study on the effect of stock returns on bank efficiency is important since empirical studies by Berger and Mester (1997) and Casu and Molyneux (2003) found that listed banks are more efficient than non-listed due to the market discipline mechanism. However, Perera, Skully and Wickramanayake (2007) point out that this might not be true in emerging financial markets characterized by a lack of market transparency. Altunbas, Evans, and Molyneux (2001) argued that the lack of capital market discipline dampens the banking systems because it weakens the owners' control over management. Eventually the management will pursue their own agenda with less incentive for efficiency. Hence it is argued that underdeveloped stock markets characterized by low market transparency are expected to have an inefficient banking operation. However, there are no specific studies that analyze the effect of stock returns on banks' efficiency. In addition, while there is a preponderance of evidence on the relationship between bank efficiency and stock returns, the literature is silent on the long-term relationship between the two. The question of whether there exists a long-term relationship between bank efficiency and stock returns is important for investors and policy makers alike, since both banks and stock markets play an important role in developing countries as it enhances the competitive viability of the financial system. Hence, this paper examines the long- and short-term relationship between bank efficiency and the stock returns of commercial banks in selected ASEAN countries for the period1987-2007. This study contributes to the literature in two ways. First, this study analyzed the relationship between bank efficiency and stock returns using data from selected ASEAN countries. Second, unlike previous studies, this paper analyzed the long-term relationship between bank efficiency and stock returns using the panel time-series method. The application of the panel data time-series approach in analyzing the long-term relationship has never been attempted before in this kind of study.

The rest of the paper is organized as follows. Section 2 reviews related literature on the relationship between stock price performance and bank efficiency. Section 3 discusses the methodology and data used. Section 4presents the empirical results. Finally, section 5 concludes.

2. LITERATURE REVIEW

There are quite a number of studies on the effect of bank efficiency on stock performance. Gascón, González Fidalgo, and Fernández Alvarez (2002) did a cross-country analysis on the effect of the efficiency on a bank's stock performance in North America, Europe, and Japan. The results of their study show a strong positive relationship between changes in efficiency(measured by technical efficiency)on market returns. Their results are supported by Beccalli, Casu, and Girardone (2006) using European banking data. By employing both the stochastic frontier (SFA) and data envelopment analysis (DEA) approach, they found that changes in share prices are significantly explained by changes in cost efficiency. Their results suggest that the stock price of cost efficient banks outperforms the inefficient banks. Similarly Eisenbeis, Ferrier, and Kwan (1999) also found that there is a positive relationship between cost efficiency and stock returns in the US banking industry.

Fiordelisi (2007) studies the effect of shareholder value efficiency as well as cost and profit efficiency on the stock market in the French, German, Italian and UK banking systems for the period from 1997 to 2002. The results show that the performance of listed banks is positively related to cost, profit and shareholder value efficiency. Pasiouras, Liadaki, and Zopounidis (2008) investigated the impact of the technical efficiency on share price performance in Greece for the period 2001 to 2005. By employing the non-parametric method, they found that the banks' technical efficiency is statistically significant and positively related to stock returns. Likewise, Kirkwood and Nahm (2006) found that changes in profit efficiency significantly contribute to the change in stock prices of the Australian banks.

The results from studies in developing countries also show that bank efficiency is related to stock performance. Chu and Lim (1998) studied the impact of x-efficiency and profit efficiency on share prices of the banks in Singapore, Taiwan, Western Europe, and North America for the period 1992 to 1996. They found that percentage changes in share prices are highly dependent on percentage changes in profit rather than cost efficiency. This is consistent with the study by Kirkwood and Nahm (2006) of the Australian banking system. The strong relationship between profit efficiency and stock performance might be due to the fact that investors are more concerned with the income and wealth generating aspects of the firm compared to cost control. Similar results are also found by Majid and Sufian (2006). Their results suggest that the stock prices of listed banks in Malaysia are influenced by the improvement in profit efficiency rather than cost efficiency. Furthermore, Ioannidis, Molyneux, and Pasiouras (2008) also found that there is a positive relationship between profit efficiency changes and stock returns in their study on stock returns in 19 Asian and Latin American banks.

Sufian and Majid (2007) analyzed the impact of cost efficiency on share performance in Singapore for the period 1993 and 2003. Their results show that cost efficiency contributes significantly to determining share price performance. This is in contrast with the results of Chu and Lim (1998) and Majid and Sufian (2006).

There isa paucity of studies on the effect of stock prices on bank efficiency. Most of the studies focused on the effect of share listing on a bank's performance in general (for example, Perera, Skully, and Wickramanayake 2007; and Naceur, Ben-Khedhiri, and Casu 2008). Perera, Skully, and Wickramanayake (2007) studied the impact of the stock market on bank efficiency using data from 111 South Asian commercial banks. The results show that non-listed banks outperformed the listed banks in terms of cost efficiency. Our study, to the best of our knowledge, is the first in analyzing the long-term relationship between bank efficiency and stock prices.

3. METHODOLOGY AND DATA

3.1. Methodology

The methodology involves two steps. First, we estimate both the cost and profit efficiency of the banks in our sample using the Data Envelopment Analysis approach. Second, we use these efficiency scores to analyze the long-term relationship between bank efficiency and stock returns using the panel time series approach.

We employ the linear programming Data Envelopment Analysis (DEA) approach to estimate cost and profit efficiency. This technique compares each sample bank with the "best practice" banks. In this case, each sample bank is known as the Decision Making Unit (DMU). The most efficient banks in the sample are assigned with a score of "1", while banks which are less efficient will be allocated with scores of less than one.

DEA is more flexible compared to the econometric approach, as it does not require the specification of a particular functional form for the cost or production function. Consequently, the efficiency estimation will not be subjected to possible misspecification of the cost or production function compared to the parametric approach (Bauer et al., 1998; Jemric and Vujcic 2002; Okuda and Hashimoto 2004).Furthermore, the use of DEA approach helps to avoid the independent and identically distributed (i.i.d.) which is common in the stochastic frontier approach (SFA), because the estimated efficiency scores are obtained from a linear programming approach rather than residual-based. We use the input-orientation approach in this study as it analyzes the utilization of inputs in producing a given level of outputs.

Cost efficiency is defined as how banks minimized their costs given the same amount of outputs with a given price of inputs. The cost efficiency for bank $j(j = 1,\ldots,n)$ can be expressed as follows:

$$\underset{\lambda}{Min}\, CE_o = \underset{\lambda}{Min} \sum_{i=1}^{m} w_{io} X_{io}$$

subject to:

$$\sum_{j=1}^{n} \lambda_j X_{ij} \le X_{io}, \qquad (i = 1,\ldots,m)$$

$$\sum_{j=1}^{n} \lambda_j Y_{rj} \ge Y_{ro}, \qquad (r = 1,\ldots,s)$$

$$\sum_{j=1}^{n} \lambda_j = 1,$$

$$\lambda_j \ge 0 \forall j \tag{1}$$

where:

CE_o= cost efficiency of DMU_o

X_{io} = input vector where $i=1,\ldots,m$ are the input volumes used by DMU_o

Y_{ro} = output vector where $r=1,\ldots,s$ is the amount of output produced by DMU_o

w_{io} = unit cost of the input i of DMU_o

λ_j = are unknown weights, where $j=1,\ldots,n$ corresponds to the number of DMU

The cost efficiency for the *jth* bank is given by the ratio of minimum costs to actual costs which can be estimated using Equation 2.

$$CE_o = \frac{w_o X^*}{w_o X_o} \le 1 \tag{2}$$

where CE_o is the ratio of minimum cost to the actual cost for the *o*th bank.

In this context, the banks are said to use *m*th unit of input in their production of *n*th unit of output.

Profit efficiency provides a better concept of the firm's objectives as it takes into account both cost of production and revenue generated by the firms in their operation. It measures the efficiency of a bank in maximizing profit given the amount of inputs, outputs, and price level. We use the alternative profit efficiency concept as ASEAN banking markets are argued to be imperfectly competitive, whereby banks have some power in setting prices. The alternative profit efficiency for bank *j* can be expressed as follows:

$$\underset{\lambda}{Max}\, PE_o = R_o - \sum_{i=1}^{m} w_{io} X_{io}$$

subject to:

$$\begin{aligned}
&\sum_{j=1}^{n} \lambda_j R_{rj} \geq R_{io}, \qquad (\mathrm{r} = 1,...,\mathrm{s})\\
&\sum_{j=1}^{n} \lambda_j X_{ij} \leq X_{io}, \qquad (\mathrm{i} = 1,...,\mathrm{m})\\
&\sum_{j=1}^{n} \lambda_j Y_{rj} \geq Y_{ro}, \qquad (\mathrm{r} = 1,...,\mathrm{s})\\
&\sum_{j=1}^{n} \lambda_j = 1,\\
&\lambda_j \geq 0 \forall j
\end{aligned} \tag{3}$$

where:

PE_o= profit efficiency of DMU_o

R_{io} = revenue efficiency of DMU_o

X_{io} = input vector where $i=1,\dots,m$ are the input volumes used by DMU_o

Y_{ro} = output vector where $r=1,\dots,s$ is the amount of output used by DMU_o

w_{io} = unit price of the input *I* DMU_o

λ_j = are unknown weights, where *j=1,…,n* corresponds to the number of DMU

The alternative profit efficiency for *j*th bank is given by:

$$APE_o = \frac{R_o - \sum_{i=1}^{m} w_o X_o}{R_o^* - \sum_{i=1}^{m} w_o X^*} \leq 1 \tag{4}$$

where APE_o is the ratio of actual profit to the maximum profit for the *o*th bank.

Equation (1) and (3) assume that the banks under estimation exhibit variable returns to scale since banks may not be able to scale their factors of productions and outputs linearly. The estimation of cost and profit efficiency based on Equation (1) and (3) is done by the DEA Frontier developed by Zhu (2008) which allows the estimation of efficiency scores for both cost and profit to be done in a single stage using the DEA approach.Next, the change in inefficiency scores for each bank is calculated using Equation 5.

$$\Delta Eff_{it} = \frac{Eff_{it} - Eff_{it-1}}{Eff_{it-1}} \tag{5}$$

where:

ΔEff_{it} = change of efficiency scores[1] of bank *i* in year *t*

Eff_{it} = efficiency scores of bank *i* in year *t*

Eff_{it-1} = efficiency scores of bank *i* in year *t-1*

After estimating the efficiency, the efficiency scores obtained were then included in the estimation of the Panel Vector Error Correction Model shown in Equation (6).

$$\begin{aligned} \Delta Y_{it} &= \alpha_{1i} + \beta_{1i} e_{it-1} + \sum_k \lambda_{11ik} \Delta Y_{i,t-k} + \sum_k \lambda_{12ik} \Delta Eff_{i,t-k} + u_{1it} \\ \Delta Eff_{it} &= \alpha_{1i} + \beta_{2i} e_{it-1} + \sum_k \lambda_{21ik} \Delta Y_{i,t-k} + \sum_k \lambda_{22ik} \Delta Eff_{i,t-k} + u_{2it} \end{aligned} \tag{6}$$

[1]Efficiency scores refer to the cost and profit efficiency scores estimated using Equation (1) and (3), respectively.

where:

ΔEff_{it} = change of efficiency scores of bank *i* in year *t*

ΔY_{it} = change in cumulative stock return of bank *i* in year *t*

$$\left[\left(1+r_{month,1}\right)\left(1+r_{month,2}\right)\ldots\left(1+r_{month,n}\right)-1\right],$$

β_{1i} = long-term effect of innovations in efficiency on stock return

$\beta_{2\mathrm{i}}$ = long-term effect of innovations in stock return on efficiency

e_{it-1} = lag of estimated residual in long-term model (7)

u_{it} = error term of bank *i* in year *t*.

Prior to the estimation of Equation (6), the estimated residual is obtained by estimating the long-term model in Equation (7).

$$Y_{it} = \alpha_i + \delta_t + \beta_i Eff_{it} + e_{it} \tag{7}$$

where:

Y_{it} = cumulative stock return of bank *i* in year *t*

Eff_{it} = efficiency score of bank *i* in year *t*

e_{it} = estimated residuals of bank *i* in year *t*.

Equation (7) allows for co-integrating vectors of varying magnitudes between individual observations α_i and time fixed effects δ_t. Y_{it} and Eff_{it} are assumed to be integrated of order one I(1) for each member of the panel. In addition, the residual of e_{it} needs to be integrated of order one I(1) under the null hypothesis of no co-integration. The null hypothesis is rejected if a co-integration relationship exists between stock returns and bank efficiency. To test for the co-integration relationship between the variables, we used the Pedroni (1995, 1999) seven residual-based tests that allow for heterogeneous fixed effects, deterministic trends, and heterogeneous short-term dynamics. Four of these seven tests pool the autoregressive coefficients across different countries during the unit-root test and thus constrain the autoregressive parameters to be homogeneous across countries.

Pedroni refers to these within-dimension-based statistics as *panel co-integration statistics*. The other three test statistics are based on estimators that average the individually estimated autoregressive coefficients for each country, thus allowing the autoregressive coefficient to be heterogeneous across countries. Pedroni refers to these between-dimension statistics as *group-mean panel co-integration statistics*. The first of the panel co-integration statistics is a non-parametric variance ratio test. The second and third are panel versions of the Phillips and Perron (PP) *rho* statistic and *t* statistic, respectively. The fourth statistic is a panel ADF *t* test analogous to the LLC (2002) panel unit root test. Similarly, the first of the group-mean panel co-integration statistics is analogous to the PP *rho* statistic, the second is a panel version of the PP *t* statistic, and the third is a group mean ADF *t* test analogous to the IPS (2003) panel unit root test. The standardized distributions for the panel and group statistics are given by

$$K = \frac{\varphi - \mu\sqrt{N}}{\sqrt{v}} \sim N(0,1) \quad (8)$$

where φ is the respective panel or group statistic, and μ and ν are the expected mean and variance of the corresponding statistic, tabulated by Pedroni (1999).

Before proceeding to the co-integration analysis, all variables must be verified so that they are integrated of order one. We employ the Levin, Lin, and Chu (LLC) test with the assumption that there is a common unit root process across cross-sections.

3.2. Data

The sample of the study consists of a balanced-panel data set of 45 selected commercial banks in the ASEAN-5 countries (Malaysia, Thailand, Indonesia, Singapore, and the Philippines) for the period 1987 to 2007. We chose the period of 1987 to 2007 because the listing of the companies and banks in the stock markets of ASEAN-5 mostly started in the mid-1980s. The sample excludes the period of the 2008 global financial crisis because this major crisis has changed the nature of banking businesses in the world, and most banks in both the developed and developing countries are still in a consolidation process, which may create bias in the estimation.

The value-added approach proposed by Berger and Humphrey (1992) is used to determine the inputs and outputs vector. This approach treats deposits as outputs as it provides transaction and safekeeping output services (Dietsch and Lozano-Vivas, 2000). The three input vectors employed in this study are labour, physical capital and loanable funds. The price of labour is computed by dividing the total personnel expenses the total assets of the banks. The price of physical capital is computed by dividing the cost of capital (namely depreciation of fixed assets) by total fixed assets. The price of loanable funds is calculated by dividing the total interest expenses incurred in deposits taking and borrowed funds with the total loanable funds of the banks.

This study only takes into consideration the traditional banking activities. Hence, two outputs vector are used; total loans and total investment. The off-balance sheet activities are excluded from the study as these activities are relatively restricted in ASEAN-5 commercial banking. On the other hand, the outputs used in estimating profit efficiency are net interest income and net non-interest income. All the data in the analysis are from the banks' annual report which can be obtained from IBCA Bankscope. All outputs, total costs and profit before tax are in USD million.

The summary statistics for the variables used in this study are presented in Table 1. The statistics clearly show that both the average price of inputs and its standard deviation of the commercial banks in Indonesia is the highest in the region. On the other hand, commercial banks in Singapore have the biggest lending and investment activities with a total of USD40,417.088million and USD32,587.253million in total loans and investment, respectively. As well as that, commercial banks in Singapore generate the highest profit with a net interest income of USD2863.220million and a net non-interest income of USD472.401million.

Table 1

Summary statistics of input prices, inputs, outputs, and profits of commercial banks in ASEAN-5 (in USD): 1987 – 2007

	Price of labor	Price of capital	Price of funds	Personal (Million)	Fixed Assets (Million)	Deposit (Million)	Loan (Million)	Investment (Million)	Interest Income (Million)	Non-interest income (Million)
Indonesia										
Mean	0.014	1.321	0.079	78.669	115.933	4920.629	2330.852	2832.238	576.179	44.957
Standard Deviation	0.006	4.624	0.054	103.970	155.460	6624.311	2845.084	4298.291	746.880	69.302
Range	0.041	40.867	0.504	445.497	627.742	28411.513	13720.911	18205.696	3420.595	334.938
Minimum	0.005	0.133	0.035	1.085	0.011	2.260	7.171	22.352	3.099	0.047
Maximum	0.046	41.000	0.540	446.581	627.753	28413.773	13728.082	18228.048	3423.694	334.985
Malaysia										
Mean	0.007	0.161	0.028	152.793	150.773	17568.335	12515.000	7564.661	949.018	191.313
Standard Deviation	0.001	0.048	0.004	111.171	107.577	13394.573	9210.855	6183.037	663.956	186.474
Range	0.007	0.233	0.018	487.859	351.664	61856.064	39184.021	30196.668	3008.126	821.223
Minimum	0.005	0.083	0.019	44.184	32.338	4137.132	3418.368	1249.816	286.053	31.763
Maximum	0.012	0.316	0.037	532.043	384.001	65993.195	42602.389	31446.484	3294.178	852.987

Philippines										
Mean	0.012	0.191	0.046	35.378	99.019	2201.516	1032.589	1338.984	165.602	50.189
Standard Deviation	0.003	0.165	0.011	41.004	116.886	2463.667	1303.224	1327.337	186.966	48.172
Range	0.010	0.478	0.050	178.409	352.591	10301.252	5984.279	5400.106	802.676	174.934
Minimum	0.008	0.031	0.030	2.849	5.407	163.043	98.672	10.732	13.007	2.668
Maximum	0.019	0.509	0.080	181.258	357.998	10464.295	6082.950	5410.838	815.683	177.602
Singapore										
Mean	0.005	0.073	0.021	478.102	990.912	63333.384	40417.088	32587.253	2863.220	472.401
Standard Deviation	0.001	0.016	0.007	203.513	199.469	23352.751	12234.495	14919.700	1388.460	228.509
Range	0.003	0.056	0.020	735.903	765.510	86855.964	44745.638	49850.913	4678.287	811.509
Minimum	0.003	0.046	0.012	186.763	621.623	32184.036	26150.362	13756.421	1400.380	163.158
Maximum	0.006	0.102	0.032	922.667	1387.133	119040.000	70896.000	63607.333	6078.667	974.667
Thailand										
Mean	0.009	0.085	0.026	112.279	714.244	12090.913	8997.488	3747.096	637.441	163.191
Standard Deviation	0.004	0.039	0.011	98.881	555.608	10346.880	7923.708	3622.862	573.630	151.882
Range	0.016	0.172	0.051	371.243	2063.246	40314.486	28739.084	14293.803	2351.417	633.808
Minimum	0.003	0.027	0.009	6.567	27.299	287.448	257.239	101.713	28.648	-0.461
Maximum	0.020	0.199	0.060	377.810	2090.545	40601.934	28996.322	14395.516	2380.064	633.347

Source: authors' calculation

Next, the summary statistics of the calculation of stock returns and estimated cost and profit efficiency based on the DEA approach are presented in Table 2. The statistics show that on average the banking stock in Malaysia exhibited a return of 13.5% for the past 30 years. In addition, the results also show that commercial banks in Singapore are relatively cost and profit efficient with average efficiency scores of 92.7% and 73.2%, respectively. This may be due to the fact that Singapore has the highest lending and investment activities compared to the other five countries in our analysis.

Table 2
Summary statistics of stock return, cost efficiency and profit efficiency score of commercial banks in ASEAN-5 (in USD): 1987 – 2007

	Return	Cost	Profit
Malaysia			
Mean	0.135	0.910	0.638
Standard Deviation	0.218	0.051	0.172
Range	0.812	0.175	0.598
Minimum	-0.224	0.825	0.402
Maximum	0.588	1.000	1.000
Thailand			
Mean	0.055	0.756	0.629
Standard Deviation	0.377	0.128	0.189
Range	2.086	0.527	0.797
Minimum	-0.636	0.473	0.203
Maximum	1.450	1.000	1.000
Indonesia			
Mean	0.076	0.711	0.717
Standard Deviation	0.254	0.120	0.167
Range	1.063	0.457	0.530
Minimum	-0.290	0.501	0.470
Maximum	0.773	0.958	1.000
Singapore			
Mean	0.079	0.927	0.732
Standard Deviation	0.270	0.073	0.183
Range	1.130	0.193	0.556
Minimum	-0.729	0.807	0.444
Maximum	0.401	1.000	1.000
The Philippines			
Mean	0.189	0.721	0.710
Standard Deviation	0.568	0.112	0.137
Range	4.572	0.607	0.584
Minimum	-0.769	0.393	0.416
Maximum	3.804	1.000	1.000

Source: authors calculation

4. RESULTS AND DISCUSSION

4.1. Unit Root Test

The unit root test employed in this study is based on theLevin, Lin, and Chu (LLC) and ADF-Fisher tests. Levin, Lin and Chu (2002) suggested that the unit root test of LLC provides a good approximation to the test statistics in panels of moderate size which is consistent with the sample of observation in this study. The results are presented in Table 3 and show that the null hypothesis for unit root cannot be rejected for all the series in the level. Nevertheless, the null hypothesis for unit root is rejected for the series in the first difference. This indicates that all the series are stationary at I(1) and might be co-integrated in the long-term.

Table 3

Panel unit root test

	Levin, Lin, and Chu		ADF-Fisher	
	Level	First difference	Level	First difference
Stock price	-1.252	-868.300***	65.681	163.594***
Cost efficiency	-0.1604	-14.043***	104.331	141.774***
Profit efficiency	0.3030	-15.127***	82.387	310.327***

Source: authors' calculation

*Notes: ***,**,and* denotes 1%, 5%, and 10% significance level*

4.2. Panel co-integration test

The results of the panel co-integration test between stock returns and cost efficiency and between stock returns and profit efficiency are presented in Table 4. Four within-group tests and three between-group tests are used to test for co-integration. The results of the within-group tests and between-group tests for co-integration show that the null hypothesis of no co-integration can be rejected at the 1% level. This indicates that there is a long-term relationship between cost efficiency and stock returns in the selected ASEAN countries. A similar result was also found in the relationship between stock returns and profit efficiency. Therefore, previous studies that ignore the co-integrating relationship binding bank efficiency and stock returns are suspect due to the serious misspecification. Based on these results, we invoke Grangers representation theorem and specify the Error Correction Model (ECM) to examine the short and the long-term intertemporal relationships between bank efficiency and stock returns.

Table 4

Panel co-integration test

	Cost efficiency	Profit efficiency
Panel v-statistic	2.2390**	2.792***
Panel ρ-statistic	-6.775***	-6.774***
Panel t-statistic (non-parametric):	-12.546***	-12.672***
Panel t-statistic (parametric)	-12.559***	-10.310***
Group ρ-statistic	0.005	-0.214
Group t-statistic (non-parametric):	-16.660***	-15.510***
Group t-statistic (parametric)	-15.145***	-14.595***

Source: authors' calculation

*Notes: ***,**,and* denotes 1%, 5%, and 10% significance level*

4.3. Panel Vector Error-Correction model

We used the panel vector error-correction model (panel VECM) to analyze the short-term relationship between stock returns and bank efficiency. The results of the Langrage Multiplier test in Table 5 suggest that the pooled mean group is the most appropriate model to be used, suggesting that there is no country difference in the relationship between stock returns and bank efficiency. Hence, the results can be generalized to explain the relationship between the stock returns and bank efficiency of the commercial banks in the ASEAN countries.

Table 5

Estimation of Langrage Multiplier Test

Dependent variable	LM-statistics
ΔReturn(Cost)	0.78
ΔCost	1.43
ΔReturn(Profit)	0.04
ΔProfit	0.01

Source: authors calculation

Table 6 presents the results of the panel error-correction model estimation between stock returns and both cost and profit efficiency. Consistent with our earlier findings, the ECMs indicate the presence of a potent long-term causal relationship between bank efficiency and stock returns in the selected ASEAN countries; the error-correction term (ECT) in both cost and profit efficiency are negative and statistically significant at the 1% level. Interestingly, the results show that in the short-term, there is no evidence that a bank's cost efficiency affects stock returns and vice-versa. However, there is ample evidence that profit efficiency affects stock returns and vice-versa. The empirical evidence suggests that a bank's cost efficiency and stock returns are primarily bound over the longer-term horizon. This result is quite significant in the sense that previous literature found a contemporaneous effect of either stock returns on a bank's cost efficiency (Beccalli, Casu and Girardone, 2006, or a bank's cost efficiency on stock returns (Liadaki and Gaganis, 2010). However, we argue that our result is superior since we take into account the co-integrating relationship binding bank efficiency and stock returns.

Table 6

Panel Error-Correction Model between stock return and efficiency

Variable	Cost Efficiency				Profit Efficiency			
	ΔReturn		ΔCost		ΔReturn		ΔProfit	
	Coef	t-stat	Coef	t-stat	Coef	t-stat	Coef	t-stat
Constant	0.010	0.099	0.010	1.559	-0.088	-1.288	0.023	1.486
ΔReturn	-	-	-0.008	-0.581	1.689	3.311***	0.085	2.261**
$\Delta Return_{t-1}$	0.902	1.148	-0.009	-0.648	-	-	-0.038	-1.104
ΔCost	-0.184	-0.581	-	-	-	-	-	-
$\Delta Cost_{t-1}$	0.361	1.169	0.151	2.312**	-	-	-	-
ΔProfit	-	-	-	-	0.223	2.130**	-	-
$\Delta Profit_{t-1}$	-	-	-	-	-0.074	-0.571	-0.083	-1.243
ECT_{t-1}	-0.935	-1.185	-0.186	-4.403***	-1.742	-3.389***	-0.434	-4.847***

Source: authors calculation

*Notes: ***, **, and * denotes 1%, 5%, and 10% significance level*

The short-term relationship suggests that it takes time for stock returns and bank efficiency to adjust back to equilibrium. The stock returns consist of all publicly available information and this can be reflected in the efficiency score, as it is computed from published accounting numbers (Ball and Kothari, 1994; Chu and Lim, 1998). However, the stock returns do not reflect in a time basis and therefore, the stock returns may deviate at times from the accounting values but slowly converge back to equilibrium in the long-term. The evidence of a long-term relationship supports Chu and Lim's (1998) suggestion that the performance of banks in terms of efficiency could serve as a price discovery process for stock market performance, and vice versa.

In addition, the short-term relationship between profit efficiency and stock returns clearly indicates the superiority of profit efficiency relative to cost efficiency in predicting stock market returns in ASEAN countries. This supports the hypothesis that bank performance in terms of profit efficiency might be better reflected in the stock returns as it deals with shareholder's wealth maximization (Chu and Lim, 1998).

CONCLUSION

This paper examined the relationship between bank efficiency and stock returns of commercial banks in selected ASEAN countries for the period1987–2007. First, we estimated both the cost and profit efficiency of the banks in our sample using the Data Envelopment Analysis (DEA) approach. Second, we used these efficiency scores to analyze the long-term relationship between bank efficiency and stock returns using the panel time series approach.

The empirical results strongly show that bank stock returns are co-integrated with both cost and profit efficiency, suggesting a long-term causal relationship between the two variables. The results also suggest that it takes time for the stock market and bank efficiency to adjust back to equilibrium. In addition, the results also clearly indicate the superiority of profit efficiency relative to cost efficiency in predicting stock market returns in the selected ASAN countries. This supports the hypothesis that bank performance in terms of profit efficiency is better reflected in the stock returns as it deals with shareholder's wealth maximization (Chu and Lim, 1998).

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