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# Bank Efficiency in Southeast Asian Countries

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**Abstract:** Since, the 1997 financial crisis, the effected countries has implement huge changes by either accepting the financial support from International Monetary Funds (IMF) or taken an alternative step by stringent their capital policy. Since then, many researchers have taken the advantages by looking into the cause and fewer have look upon the impact of the policy in bank efficiency. This study will implement a non-parametric analysis on the bank efficiency during the post crisis period of 1999 to 2005 and taken into consideration the implication of environmental variables. The early result suggested that the policy does significantly affected by the environmental variables in assuring the success of each policy changes and transformation as to regain the crisis region economic growth.

**Key words:** Banks, financial policy, efficiency, IMF, capital policy

## INTRODUCTION

Countries in the Asian region have enjoyed steady growth and excellent economic performance for several decades. Indonesia, Korea, Malaysia, Philippines and Thailand had a GDP growth of around 8-9% per annum from the beginning of the 1990s. The Asian financial crisis began in Thailand and then spread to other countries including Malaysia, Indonesia, Korea and the Philippines. The foreign exchange market failure during the period of financial turmoil eroded investors' confidence triggers a sharp drop in currency values. The situation worsened as further currency devaluations, stock market crashes, soaring inflation and severe economic recession increased capital outflow. Much has been said about the factors contributing to the financial crisis, including: over reliance on short term foreign capital, excessive investment in real estate, inadequate financial supervision and politically motivated credit allocations that resulted in growing non-performing loans (Kim, 2007).

As soon as the crisis hit in mid 1997, these countries took immediate action towards recovery. The IMF played its part as a supportive agent in Indonesia, Korea, Thailand and Philippines whereas Malaysia rejected IMF support. These actions included several drastic measures, especially focused on fostering stability in the financial sectors such as:

- Reforming financial sectors through mergers and acquisitions (to avoid further bank collapses and helping to create stronger banks)
- Improving transparency and regulation
- Strengthening corporate governance and allowing more competition (changing the entry policy and allowing more foreign banks entry)

These changes have provided us with a framework to analyse their links to promoting bank efficiency and improving bank competition. Overall these actions have had a positive impact as all the countries concerned regained their growth development and created a stronger financial industry.

The dataset used in this study contains observations relative to commercial banks operating in the five SEA countries (Indonesia, Korea, Malaysia, the Philippines and Thailand) worse hit by the 1997 financial crisis. To ensure sample homogeneity and comparability with previous studies, we have excluded savings bank, development banks, investment banks, regional rural banks, joint-venture banks and any wholly-owned and subsidiaries banks.

As shown in Table 1, the number of banks for each country have changed dramatically due to government intervention in response to the 1997 crisis including nationalizing, closing unviable, carrying out compulsory purchases and transferring assets to healthier, creating larger core and providing capital injection to recapitalize banks (Williams and Nguyen, 2005).

Table 1: Numbers of banks by country and year: 1999-2005

| Years | Indonesia | Korea | Malaysia | Philippine | Thailand | Total |
|---|---|---|---|---|---|---|
| 1999 | 67 | 16 | 32 | 32 | 16 | 163 |
| 2000 | 56 | 17 | 27 | 28 | 17 | 145 |
| 2001 | 50 | 16 | 26 | 24 | 17 | 133 |
| 2002 | 48 | 16 | 27 | 31 | 17 | 139 |
| 2003 | 49 | 17 | 27 | 32 | 17 | 142 |
| 2004 | 49 | 17 | 26 | 27 | 16 | 135 |
| 2005 | 44 | 13 | 26 | 21 | 15 | 119 |
| Total | 363 | 112 | 191 | 196 | 115 | 976 |

Bank scope

**Literature review:** There are two strands of literature which relate to the present study: those relating to bank efficiency which includes the methodologies of measuring bank efficiency with environmental variables, those dealing with bank efficiency with environmental variables in the Asian countries. During the past few decades the banking sectors around the world experienced profound regulatory and technological changes as well as experiencing several financial crises. Changes in regulatory, liberalization and restructuring including the applications in computer and communications technology together with the introduction of new financial instruments have altered the way banking is conducted. Such changes significantly modified the technology of bank production. In this regard, a frequently asked question was about the effect of these changes on the efficiency and productivity of the banks. A large number of studies tried to answer this question by proposing new methods to measure the efficiency of the banking sectors. Our concentration is look on the technical efficiency for Asian banks especially with the experienced of policy and regulatory impact in the recent years. Even though the certainty of the recovery still ambiguity matters but it is interesting to know for now the improvements through bank efficiency that may indicate that Asian is towards better and stronger regime.

**Bank efficiency:** The concept of efficiency in banking has been considered widely in literature, both non-parametric and parametric techniques (Drake *et al*., 2006). The research has advanced greatly in the past three decades. Berger and Humphrey (1997) run surveys on financial institution efficiency and primarily they summarize and critically review empirical estimates of financial institution efficiency. Finding found that the various methods (the five major different econometric techniques for estimating efficiency frontiers are non-parametric which include: data Envelopment Analysis (DEA), Free Disposal Hull (FDH) and parametric frontier which comprise three main approaches; Stochastic Frontier Approach (SFA), distribution-free approach and Thick Frontier Approach (TFA)) in measuring efficiency do not always yield consistent results and suggest some ways how to improve the used of these methods to bring about findings that are more consistent, accurate and useful.

Casu *et al*. (2004) compares parametric and non-parametric estimates of productivity change in European banking between 1994 and 2000. Productivity change has been decomposed into technological change or change in best practice and efficiency change. The results found that productivity growth has grown with the improvements in technological change and there does not appear to have been 'catch-up' by non-best practice institutions. Their results also shows although, competing methodologies sometimes identify conflicting findings for the sources of productivity for individual years, yet the two approaches do not yield different results in term of identifying the components of productivity growth especially in European banking during the 1990s. Weill (2004) investigates the consistency of efficiency by measuring cost efficiency of banks on selected European banking using three frontier techniques:

- Stochastic Frontier Approach (SFA)
- Distribution-free approach and Data Envelopment Analysis (DEA)

The efficiency scores computed by all three techniques are quite consistent with standard measure of performance. The results favor the lack of robustness between approaches, even if there are some similarities between parametric approaches.

Altunbas *et al*. (2000) look into the impact of risk and quality factors on bank's cost by using the stochastic cost frontier as to evaluate scale and X-efficiencies with technological change for commercial banks in Japan between 1993 and 1996. This study employ loan loss provisions to control for output quality with a financial capital and a liquidity ratio included to control risk. This paper following approach suggested by Mester (1996) where risk and quality factor need to be taken into account in order to avoid optimal size bank to be overstated. Results also find that level of financial capital has high influence on scale efficiency and appears less sensitive to risk and quality factors.

Recently, more researchers are incorporating the impact of environmental, economic and regulatory factors on bank efficiencies in both parametric and non-parametric approach (parametric studies treated external variables as control variables to the functional form by assuming to have direct effect on the production or cost structure therefore, each bank would face a different frontier or cost frontier. Whereas for non-parametric studies, external variables are used as non-discretionary inputs and/or outputs and having a direct effect on the effeicient production frontier (Drake *et al*., 2006)). Fried *et al*. (1999) produces a non-parametric, linear programming, frontier procedure for obtaining a measure of managerial efficiency that controls for exogenous features of the operating environment. Using a sample of a nursing home, this study illustrates statistical tests of the effects of external conditions on the efficient use of each individual input/output. The result shows by controlling for external environment, the

average efficiency score increased. Dietsch and Lozano-Vivas (2000) investigates the influence of the environmental conditions on the cost efficiency of French and Spanish banking. By introducing new methodology for cross country comparisons of efficiency using a parametric approach their results demonstrate that environmental variables contribute significantly in efficiency scores between the two countries (Chaffai *et al*. (2001) and Akhigbe and McNulty (2003) also provide analysis by including environmental variables in their research with parametric approach. Result shows significant effect of these environmental variables in their results). Lozano-Vivas (1998) use DEA Model, incorporating environmental variable factors together with the banking variables of the basic model. They investigates the operating efficiency differences a sample of commercial banks across 10 European countries and shows that country-specific environmental conditions strongly influence the behavior of each country's banking industry.

These studies (primarily focused on developed countries and the European Union) suggest that environmental factors can have a strong influence on the end results. This study therefore aims to apply this methodology to banks in the Asian selected countries. It is hypothesised that banks operating in less developed economic environments would perform better if they operated in healthier economies.

**Impact of environmental and regulatory variables on asian bank efficiency:** Banking efficiency research has been conducted extensively for US commercial bank to a smaller extent for European financial institutions and relatively little for Asian financial institutions (Chantapong, 2005; Kwan, 2003; Berger and Humphrey, 1997). In the vast literature on banking efficiency, only few studies have applied cross country estimations of efficiencies in Asian countries.

Williams and Nguyen (2005) used country specific factors to examine the impact of changes in the bank governance on bank performance. Their results tend to support bank privatization and the repeal of state ownership in economic grounds. Williams and Nguyen (2005) look into different ownership for Asian banks and estimates alternative profit efficiency for Asian Bank using parametric approach. The finding shows strong relationship between bank liquidity, the state of capital regulation and population density in determining bank efficiency. Leaven (1999) is the only cross-country study of Asian bank efficiency we aware of using DEA. Leaven's study is comparable to Williams and Nguyen (2005). Using risk factors, Leaven (1999) investigates the

Table 2: Mean descriptive statistics of inputs and outputs, 1999 to 2005

| Variables | Indonesia | Korea | Malaysia | Philippines | Thailand |
|---|---|---|---|---|---|
| **Outputs** | | | | | |
| $y_1$ = interest | 245.16 | 2947.37 | 362.48 | 109.083 | 469.618 |
| income | (596.07) | (2817.96) | (480.93) | (146.138) | (485.735) |
| $y_2$ = non-interest | 20.22 | 1005.94 | 68.06 | 12.925 | 31.430 |
| income | (44.98) | (1535.54) | (104.15) | (22.783) | (55.086) |
| **Inputs** | | | | | |
| $x_1$ = interest | 170.24 | 1828.58 | 179.39 | 113.438 | 472.202 |
| expense | (458.66) | (1631.31) | (243.22) | (145.409) | (480.334) |
| $x_2$ = non-interest | 56.36 | 547.92 | 74.36 | 14.347 | 172.862 |
| expense | (121.40) | (548.58) | (97.90) | (27.412) | (374.668) |

Bank scope. Standard deviation is in brackets (All variables are in million USD. We applied broad variable definitions as presented by IBCA Bankscope in order to minimise any possible bias arising from different accounting practices. Similar approaches were also employed by previous literature (Casu *et al*., 2004; Pastor *et al*., 1997))

overall performance of banks organized under different ownership structure. The main caveats might be pointed out with regard to the study in Table 2 is that none of these study accounts for differences in environmental conditions among countries to look upon the impact of this variables on bank efficiency.

Whereas, the only paper we found of using environmental environment and regulatory factors on a specific country in Southeast Asia is Drake *et al*. (2006). This study incorporate the different operating environments in the estimation of technical efficiency by using second stage Tobit regression approach advocated by Fried *et al*. (1999) and employ Tone (2001)'s Slacks-Based Model (SBM) to conduct the DEA. Both adjustments indicate significant impact on technical inefficiency measures, variations in efficiency levels and trends and also indicate different impacts of environmental factors on different size groups and financial sectors.

## MATERIALS AND METHODS

**Method of analysis:** The approach is based on the four-stage methodology proposed by Fried *et al*. (1999) where by we account for the impact of environmental variables in a DEA-based study. The aim is to incorporate the influences of the external variables on Southeast Asian banking efficiency measurements. In doing so, we allowed slack or surpluses due to the environment variables and used it to calculate adjusted values for the primary inputs. In other words, the new radial efficiency measures incorporate the environmental variables.

The following study explains the four-stage formal procedure for intermediation DEA approach with input oriented models.

**Stage 1:** We calculate a DEA frontier using the traditional inputs and outputs according to standard

production theory. Specifically, we followed the non-parametric DEA approach to measure efficiency with an input minimization orientation. Based on changes that were expected on input levels, the input oriented is chosen to reflect the differences in the market structures. We employed the intermediation approach as we view banks as intermediaries with loans and other earning assets as output and capital, labour and deposits as inputs (Sealey and Lindley, 1977). The same approach is also applied in similar banking efficiency studies such as Altunbas and Chakravarty (2001), Casu *et al.* (2004) and Drake *et al.* (2006). The DEA model used to compute technical efficiency in the stage 1, for unit k, k = 1, ..., K, is formulated as the following Linear Programming (LP) problem:

$$\begin{aligned} &\min_{\theta,\lambda} \theta \\ &\text{Subject to } \theta x^k \geq X\lambda \\ &\qquad Y\lambda \geq y^k \\ &\qquad e\lambda = 1 \\ &\qquad \lambda \in R_+^k \end{aligned} \tag{1}$$

where, $y^k$ and $x^k$ are output and input vectors for unit k, respectively, $\lambda$ is a scalar value representing a proportional contraction of all inputs, holding input ratios and output level constant. The minimum value of $\theta$ that satisfies all constraints is the Farrell radial technical efficiency measure. In this stage, we exclude the external variables (there are other variables which influence the ability of a firm to transform inputs into outputs but they are uncontrollable. These variables are the external environment such as ownership, location or regulatory regime. There are two possibilities, first a firm with favourable external environmental variables and second unfavourable external conditions. Due to fact that external environmental variable are inconsistence/unpredictable, the radial efficiency score generated by the initial model may have (under) overstated the efficiency of producers operating under (un)favourable conditions (Fried *et al.*, 1999)) while computing for Technical Efficiency (TE) score as well as input slacks and output surpluses for each observation according to Banker *et al.* (1984) (the use of the CRS specification when not all firms are operating at optimal scale, results on measure of Technical Efficiency (TE) that are confounded by Scale Efficiencies (SE). The use of VRS specification permits the calculation of TE devoid of these SE effects" (Coelli *et al.*, 2005.) Variable returns to scale envelopment DEA analyses of all the four stages are available upon request to researchers). The radial measure computed in the first stage provides an evaluation of the performance of a productive unit relative to best practice, predicated upon the inputs and the outputs included in the model and ignoring the possible additional inefficiencies implied by non-radial slacks and surpluses (Fried *et al.*, 1999).

**Stage 2:** We focus on estimating N input equations using an appropriate econometric technique. The dependent variables are total radial plus non-radial; the dependent variables are measures of external variable applicable to the particular input. The objective of stage 2 analysis is to quantify the effect of external conditions on the excessive use of inputs. The N equations are specified as:

$$\begin{aligned} &E_j^k = f_j(Z_j^k, \beta_j, u_j^k), \\ &j = 1, ..., N, \; k = 1, ..., K \end{aligned} \tag{2}$$

Where:

$E_j^k$ = Unit k's total input slack (radial plus non-radial) for input j based on the DEA results from stage 1

$\beta_j$ = A vector of variables characterizing the environmental variables for unit k that may affect the utilization of input j

$Z_j^k$ = A vector of coefficients

$u_j^k$ = A disturbance term

**Stage 3:** Is to use the estimated coefficients from the regression to predict total input slack for each input and for each unit based on its external variables:

$$\begin{aligned} &\hat{E}_j^k = f_j(Z_j^k, \hat{\beta}_j), \\ &j = 1, ..., N, \; k = 1, ..., K \end{aligned} \tag{3}$$

Where:

$\hat{E}_j^k$ = Predicted total input slack for input j based on Tobit regression results from second stage

$Z_j^k$ = A vector of variables characterizing the environmental variables for unit k that may affect the utilization of input j

$\hat{\beta}$ = Predicted coefficients

Predictions on total input slacks are then used to adjust the primary input data for each unit according to the differences between maximum predicted input slack and predicted slack:

$$\begin{aligned} &\Delta\zeta = Max^k\{\hat{E}_j^k\} - \hat{E}_j^k, \\ &j = 1, ..., N, \; k = 1, ..., K \end{aligned} \tag{4}$$

Using the differences in Eq. 4, the primary input unit data for each unit is adjusted:

$$x_j^{kadj} = x_k^k + \Delta\zeta$$
$$j = 1, ..., N, k = 1, ..., K \quad (5)$$
$$\Delta\zeta = \max^k\{\hat{E}_j^k\} - \hat{E}_j^k$$

Adjusting the input using Eq. 4 creates an equal base for all DMUs in regards to all their non-controllable factor surroundings. Adjusting generates an identical pseudo environment which is the least favourable for all DMUs.

**Stage 4:** Once the primary input unit data has been adjusted, we re-run the DEA model in stage 1 under the new input-output specification according to the new input created and generate new radial measures of efficiency. These radial measure scores measure the efficiency that is attributable to external variables.

**Data and variables:** In the banking literature, there has been considerable disagreement regarding the appropriate definition of inputs and outputs. We adopted the intermediation approach proposed by Sealey and Lindley (1977) assuming that bank collects deposit, to transform them, using loans and capital, into loans as opposed to production approach which views the bank as using loans and capital to produce deposits and loans. Following the intermediation approach we specify two inputs: $x_1$ = Interest expense, $x_2$ = Non-interest expense (personnel expenses and other administration expenses) and two outputs, choose from income-earning assets; $y_1$= Interest income, $y_2$ = Non-interest income (non-interest income+net fee/income). Interest expense serves as the proxy for deposits, non-interest expense for expenses incurred in conducting the financial intermediation process whereas, interest income for loans and non-interest income for fees revenues generated from the non-traditional and off balance sheet activities (Avkiran 1999a, b).

**Environmental variables:** The variables used were grouped accordingly into two main (Dietsch and Lozano-Vivas (2000) categorized their environmental variables in three categories; main conditions, bank structure and regulations and finally, accessibility of banking services) categories and presented in the descriptive analysis in Table 3. The first group is called "main conditions" this includes a measure of per-capita income, Gross Domestic Product (GDP per-capita). Per-capita income affects numerous factors related to the demand and supply of banking services especially deposits and loans. Countries with higher per-capita income have a banking system that operates in a mature environment, resulting in more competitive interest rates and profit margins.

The second category is named bank structure and regulations which consists of Loans over Total Deposits (LTD) and Equity over Total Assets (ETA) of banking in each country. The intermediation ratio presented by Loans over Total Deposits (LTD) captures differences between the selected banking industries in term of their ability to convert deposits into loans. This relates to bank holdings of government securities and crowding out of private borrowing by public sector or inadequate institutions to support lending to the private sector (this explains the situation in Indonesia, Thailand and the Philippines with out-dated bankruptcy laws compared to Korea and Malaysia. Another structural weakness that may be reflected by using intermediation ratio is the failure in transaction law with massive misallocation of funding) (Fried *et al*., 1999). A higher intermediation ratio may lower the banking industry cost (Casu and Molyneux, 2003; Dietsch and Lozano-Vivas, 2000; Pastor 2002; Fried *et al*., 1999). This may reflect developments in the legal and regulatory framework that support both the financial intermediation process and lower costs to banks. This includes the development of effective secured transaction laws and bankruptcy procedures that had taken place in the process of crisis recovery in the selected countries.

The average capital ratio is measured as Equity over Total Assets (ETA) this provides a proxy to regulatory conditions. It also accommodates bank management and risk preferences. There is a theoretical argument to support the signs of both negative and positive influences on the relationship existing between capital

Table 3: Mean environmental variables, 1999-2005

| | Indonesia | | Korea | | Malaysia | | Philippines | | Thailand | |
|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 1999 | 2005 | 1999 | 2005 | 1999 | 2005 | 1999 | 2005 | 1999 | 2005 |
| GDP | 745.790 | 1280.00 | 9549.54 | 15840.00 | 3984.00 | 4970.00 | 1018.88 | 1320.00 | 1984.94 | 2490.00 |
| ETA | 5.899 | 13.06 | 4.64 | 6.05 | 9.58 | 10.82 | 19.00 | 12.35 | 8.07 | 13.41 |
| | (29.750) | (10.20) | (1.72) | (1.24) | (4.48) | (8.49) | (9.42) | (4.25) | (7.91) | (9.96) |
| LTD | 58.820 | 72.92 | 64.07 | 84.64 | 69.92 | 61.55 | 67.53 | 60.58 | 83.73 | 90.19 |
| | (50.210) | (40.90) | (11.43) | (11.78) | (18.87) | (26.72) | (16.93) | (18.31) | (28.33) | (26.68) |
| LLPL | 22.179 | 4.10 | 6.39 | 1.51 | 6.24 | 4.58 | 6.21 | 10.04 | 15.49 | 7.44 |
| | (15.920) | (3.20) | (3.02) | (0.23) | (4.58) | (1.75) | (2.86) | (6.13) | (12.60) | (4.95) |

Standard deviation is in parenthesis; Bank scope; Asian Development Report

ratio and efficiency. Berger and DeYoung (1997) assert that the higher the solvency and prudence (capital ratio) of the banks, the lower the bad loans are meaning less cost incurred to recover these loans and therefore appear more efficient i.e., banks with higher capital ratio will show higher efficiency levels. Contrary to this idea is that a low capital ratio can cause moral hazard behaviour due to the danger of accepting risky business by banks with solvency problems, investing in very profitable activities, which will appear efficient in the short term. Pastor (2002) asserts that lower capital ratio may cause moral hazard behaviour. Solvency in a bank may induce investing in risky business which appear to be profitable activities and therefore efficient in the short term. This cause of action is taken due to a lower capital ratio and is acted upon whilst knowing the probability of facing the consequences of their risky behaviour in the long term. Based on the above argument we will not make any prior assumptions about the sign of influence of the capital ratio.

To further account for risk and to act as a proxy for output quality we employ Loan Loss Provision normalized to total Loans (LLPL). The inclusion of LLPL is also to act as a control variable in order to correct any possible discrimination by regulators of banks in imposing provisioning rules (Laeven, 1999). Studies by Altunbas *et al*. (2000) and Drake and Hall (2003) found that bank efficiency scores might be biased as failure to incorporate risk in their results may have a significant impact on relative efficiency scores. Laeven and Majnoni (2003) suggested that risk should be incorporated into efficiency studies via the inclusion of loan loss provisions (in contrast, Akhigbe and McNulty (2003) utilised a profit function approach which included equity capital to control in a very rough fashion for the potential increased cost of funds due to financial risk) following the general consensus among risk agent analysis and practitioners that economic capital should be tailored to cope with unexpected losses and loan loss reserves should instead buffer the expected component of the loss distribution. Coherently with this interpretation, loan loss provisions required to build up loan loss reserves should be considered and treated as a cost; a cost that will be faced with certainty over time but with uncertainty as to when it will materialize.

Remarkably every country has improved their per capita income over the period. Despite differences in action taken by each country along with several disruptions along the recovery process (such as terrorism threats for example the 9/11 attack in America; bombing in Bali, Indonesia; SARS pandemic and earthquakes), SEA counties continue to grow stronger. Furthermore, during the period studied, the solvency, restructuring and liberalization constraints imposed by banking authorities' each countries banks are obliged to maintain a higher capital ratio and intermediation ratio.

## RESULTS AND DISCUSSION

**DEA empirical results:** In this study, we focus on the ability of firms to obtain maximal output from a given set of inputs in other words, technical efficiency using the input orientation. The DEA efficiency scores can then be interpreted to show how much each bank could reduce its input usage to, without reducing output, if it were as technical efficient as the best practice banks. As shown in Table 4, the selected Asian commercial banks faced technical inefficiency. On average the technical efficiency is 35% over the full sample collected for the period of 1999-2005. This clearly shows the impact of the 1997 financial crisis on the capability of the financial sector, commercial bank in particular when facing the biggest downturn in their performances in terms of providing services and gaining income.

Table 5 reports the average efficiency scores for each country using the basic model without taking into account the specific environmental conditions of each country. From 1999-2005, each country experienced several changes in their economic policies and involved in aggressive financial sector restructuring. Two different actions taken in order to overcome the financial turmoil, first by accepting support from the IMF (Indonesia, Korea, the Philippines and Thailand) second implementing capital control (Malaysia). Both methods have improved the efficiency of the countries at a different pace and in addition some were left imbalanced, due to other economic and political disruptions for example Indonesia.

Table 4: Estimation on Data Envelopment Analysis (DEA) for full sample

| Estimated efficiencies | Mean | SD | Min. | Max. |
|---|---|---|---|---|
| Technical efficiency; Input oriented | 0.354 | 0.130 | 0.072 | 1 |

Data envelopment analysis: Output variables: $y_1$, $y_2$; Input variables: $x_1$, $x_2$; Underlying technology assumes Variable Returns to Scale (VRS)

Table 5: National frontier technical efficiency categorised by country, year

| Countries | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Indonesia | 0.610 | 0.783 | 0.732 | 0.708 | 0.764 | 0.809 | 0.862 |
| Korea | 0.969 | 0.954 | 0.929 | 0.972 | 0.962 | 0.964 | 0.938 |
| Malaysia | 0.885 | 0.899 | 0.894 | 0.903 | 0.902 | 0.908 | 0.915 |
| Philippines | 0.920 | 0.777 | 0.927 | 0.858 | 0.865 | 0.899 | 0.966 |
| Thailand | 0.821 | 0.820 | 0.890 | 0.914 | 0.939 | 0.946 | 0.937 |

The Philippines experienced a political crisis in the year 2000 which may imply why the efficiency is low in this particular year. The political crisis arising from allegations of corruption made against President Ramos Estrada further damaged investor confidence, triggering intensified downward pressure on the Peso, a 400 basis point hike in policy interest rates and a significant slowdown in growth

The results of stage 1 which are based on traditional DEA are estimated against a national efficient frontier comprised of all the observations for each of the selected countries for the post crisis period, 1999-2005. The estimations produced mixed results, showing that the effects of the crisis on each country differed with some of the countries experiencing severe economic contractions.

National frontier estimations indicate a lower mean efficiency for Indonesia while the others (Korea, Malaysia, Philippines and Thailand) show an average of >80% during the period of study. Each country has shown how they have responded to their recovery plan, either following an IMF restructuring programme (Indonesia, Korea, the Philippines and Thailand) or capital control (Malaysia). Malaysia changed greatly compare to the other countries. This may due to Malaysia economy at the time of crisis are much better in terms of liquidity condition, lower foreign debts to GDP and lower short term debt ratio which means Malaysia had less possibilities for lesser impact from the financial crisis (Yoon, 2005).

Indonesia reached the lowest average technical efficiency score and this result is consistent with Kwan (2003)'s. Korea accepted an IMF bailout in November 1997 with an agreement on a $55 billion rescue package with the IMF, The World Bank and The Asian Development Bank (ADB). The increase in average efficiency in Korea proved the success of the rescue package and restructuring programme implemented. For Thailand, the estimation is similar to other studies conducted on Thai bank efficiency (Chansarn, 2008). Looking at the trend of the national frontier categorised by year, the average efficiency increased steadily between the periods of study. The results reflect the economic strategy announced by Thailand's Financial Sector Master Plan where the country enhanced competition which led to an increase in efficiency of the banking sector.

The Philippines has been receiving IMF guidance towards crisis recovery since the debt crisis in 1980. However, despite the prolonged process the Philippines still put in a poor economic performance due to its macroeconomic instability and low domestic savings. The country reformation efforts contributed to political instability and macroeconomic instability which had stifled investment. Nevertheless, the results reveal that the Philippines are among the least effected countries to be hit by the crisis. Overall, the average efficiency shows sound recovery for the country which may due to an on-going stability process which came about even before the crisis erupted.

However, due to each country's different common frontier, these results are unable to be used to compare the differences in efficiency between the aforementioned selected countries Indonesia, Korea, Malaysia, the Philippines and Thailand. Therefore, it is more appropriate to measure efficiency relative to common frontiers in order to enable the comparison of banking efficiency score across countries. For the purpose of international comparison, we must first define the common frontier based on the traditional approach in which we exclude the specific environmental conditions for each country. That is to say, the common frontier is built by pooling data sets and estimating the technical efficiency with two inputs and two outputs. Estimating such a common efficient frontier may be controversial, since one can argue that bank technology may vary across countries. Yet, during the period of study we assumed that the bank technology in the sample countries were neither similar nor changes as the recovery took place actively. More importantly, common frontier is commonly employed in current studies as a way to compare bank efficiency scores over time (Drake *et al*., 2006; Thoraneenitiyan and Avkiran, 2009).

The common frontier results in stage 1 suggest a lower mean efficiency (similar results to study done by Thoraneenitiyan and Avkiran (2009). Overall, the results show that average efficiency levels for each country are lower than the results obtained from the national frontiers (Table 6). So far the results agree with the presumption that the country specific variable is important in explaining efficiency differences and neglecting this factor may generate too much inefficiency (Drake *et al*., 2006; Chiu and Chen, 2009; Thoraneenitiyan and Avkiran, 2009).

On average the results show similar outcomes for all the countries and reflect the crisis's impact on their performances. The possible explanation for this low efficiency estimation in this initial stage (with exception to Korea) is probably due to the influence of environmental factors. For example, all the selected countries experienced a quiet growth in GDP at the beginning of the crisis and the first few years of the recovery period, this followed by a fluctuation of interest rates during the year of study and changes in bank regulations that effected the banks as a whole, during the post crisis period. The impact of environmental variables is tested in the following study.

Table 6: Common frontier technical efficiency categorised by country, year

| Countries | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Indonesia | 0.578 | 0.630 | 0.583 | 0.561 | 0.571 | 0.572 | 0.631 |
| Korea | 0.844 | 0.873 | 0.839 | 0.864 | 0.885 | 0.884 | 0.933 |
| Malaysia | 0.683 | 0.781 | 0.801 | 0.760 | 0.718 | 0.714 | 0.668 |
| Philippines | 0.639 | 0.646 | 0.692 | 0.682 | 0.638 | 0.755 | 0.730 |
| Thailand | 0.663 | 0.656 | 0.771 | 0.804 | 0.869 | 0.912 | 0.878 |

**Quantifying the effect of environmental variables:** There are two regression equations, one for each input. The dependent variables are the total radial plus non-radial input slacks. The independent variables are selected environmental variables (this analysis relies on previous empirical studies for the selection of these variables (Drake *et al*., 2006; Lozano-Vivas, 1998; Dietsch and Lozano-Vivas, 2000; Thoraneenitiyan and Avkiran, 2009)). In the second stage, these variables are chosen to investigate the impact of environmental factors that may distort the validity of the initial efficiency analysis.

Single equation tobit (Greene (1990) for a discussion of the tobit specification) are estimated since the independent variables are the same across the two input slack equations. The parameter estimated and standard errors are summarized in Table 7. In general, the influence of the environmental variables is in line with the expectations. The results demonstrate the role of main conditions represented here by per capita income as per expectation has a positive sign. This signifies that the development in per capita income affects the operating and financial costs which incurred when supplying a given level of services. The results signify that a change in economic policy does give an impact on the overall structure of a macroeconomic cycle. The same results can be found in a previous study (Williams and Nguyen, 2005). Their study found strong effects of macroeconomic variable measured by GDP per capita. The same results can also be found by Lozano-Vivas (1998) and Hahn (2007) where both papers considered income per capita as influential variables in determining local banking market conditions. Thoraneenitiyan and Avkiran (2009) found that the level of economic development is positively associated with bank inefficiency. They argued that the result contradicts what is expected in a free market economy. However, since the Asian banking systems are highly regulated this would suggest that higher GDP per capita is not necessarily going to lead to more competition and less inefficiency in search of profits.

Second, the variables that describe the structure of the domestic banking which represented by capital ratio has a negative sign. The ratio of Equity over Total Assets (ETA) is used to capture the bank structure by looking into bank management and risk preferences. Kwan (2003) states that this ratio is expected to have a negative sign, since well capitalized banks reflect both high quality management and an aversion to risk taking these bank are likely to be more cost efficient in producing banking outputs. The intermediation ratio which is represented by a proportion of total Loans over Total Deposits (LTD) of selected banking sectors are used to reflect the ability of different banks in converting deposits into loans. A negative relationship is anticipated since the higher the intermediation ratio, the greater the efficiency in the financial service provision as it also has significantly at a lower costs (Carvallo and Kasman, 2005). This may reflect development in the legal and regulatory framework that supports both the financial intermediation process and lowers the costs to banks. In the meantime this regime has incurred vital changes in the development of effective secured transaction laws and bankruptcy procedures that are necessary to support lending to customers.

The control variable, ratio of Loan Loss Provision over total Loans (LLPL) shows a positive sign. This may occur since within the period of recovery, LLPL were implemented gradually but transparently in order to allow banks time to restructure and mobilize new capital and to avoid aggravating credit supply problems. The results also found that LLPL and ETA variables are significant in suggesting that banking production costs are significant on loan quality and capitalization of the bank as both variables capture managerial quality. Overall, the regression suggested that most of the efficiency differences found across the selected SEA countries banking systems are due to country-specific variables as found in previous studies (Dietsch and Lozano-Vivas, 2000; Lozano-Vivas, 1998; Pastor *et al*., 1997; Casu *et al*., 2004). The results also show that most of the variables are statistically significant which confirms that the differences in economic conditions are affecting the efficiency.

**Re-compute DEA results:** The final stage is to re-run the initial DEA outputs with the adjusted inputs. The results comprise of the composite efficiency index (the radial score) which incorporates the effects of environment variables. Table 8 represents the descriptive statistics of the efficiency scores from stage 4. Mean efficiency from stage 4 DEA analyses shown in Table 8 suggests that after adjusting for the variations on the environmental variable's influences, mean efficiency score has improved dramatically. As revealed, the efficiency scores show significant changes in all the selected country.

Table 7: Tobit Regression Results (1999-2005)

| | Dependent variables | |
|---|---|---|
| Independent variables | Interest expense | Non-interest expense |
| Constant | 71.27 (7.43)*** | 24.63 (5.46)*** |
| Equity/Total Assets (ETA) | -2.466 (-7.86)*** | -0.592 (-4.03)*** |
| Loan/Total Deposits (LTD) | -0.492 (-4.32)*** | -0.181 (-3.37)*** |
| Loanlossprovision/Total Loan (LLPL) | 1.212 (3.87)*** | 0.082 (0.53) |
| Gross Domestic Product (GDP) | 0.005 (5.14)*** | 0.002 (5.53)*** |

Dependent variables are total radial plus non-radial slacks. Standard errors of the parameter estimates are in parenthesis. ***indicate that the parameter estimate is significantly different from zero at 10% level

Table 8: National frontier categorised by country, year

| Countries | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Indonesia | 0.866 | 0.880 | 0.821 | 0.776 | 0.774 | 0.765 | 0.911 |
| Korea | 0.967 | 0.944 | 0.946 | 0.936 | 0.926 | 0.946 | 0.960 |
| Malaysia | 0.818 | 0.888 | 0.924 | 0.875 | 0.896 | 0.914 | 0.926 |
| Philippines | 0.881 | 0.725 | 0.869 | 0.784 | 0.748 | 0.860 | 0.956 |
| Thailand | 0.869 | 0.829 | 0.816 | 0.918 | 0.826 | 0.865 | 0.987 |

Table 9: Common frontier characterising by country and by year

| Countries | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|
| Indonesia | 0.183 | 0.630 | 0.467 | 0.583 | 0.445 | 0.621 | 0.548 |
| Korea | 0.872 | 0.873 | 0.881 | 0.900 | 0.905 | 0.895 | 0.937 |
| Malaysia | 0.626 | 0.780 | 0.826 | 0.708 | 0.636 | 0.682 | 0.647 |
| Philippines | 0.599 | 0.646 | 0.732 | 0.679 | 0.657 | 0.747 | 0.748 |
| Thailand | 0.711 | 0.656 | 0.750 | 0.756 | 0.755 | 0.873 | 0.788 |

This result indicates a significant impact after introducing the environmental variable to the relative efficiency scores as it is consistent with previous studies (mostly in European countries) where the efficiency increased markedly (Drake *et al*., 2006; Dietsch and Lozano-Vivas, 2000; Lozano-Vivas, 1998; Pastor *et al*., 1997; Casu *et al*., 2004). Compared to the previous cross country studies, besides concentrating on European countries, SEA efficiency scores vary during the selected period. This result was expected since during the study period, all five countries experienced different threats towards their economic and political stabilization which indirectly impacted on the whole process of recovery. Bauer *et al*. (1998) concluded that efficiency scores differ considerably, as shown in his study on comprehensive comparisons across five different measurement methodologies.

Characterising the national frontier results by country and looking into the common frontier results in Table 9, both show that the efficiency mean on average have increased, even for Indonesia (with a slower pace at the beginning of 1999). With descriptive statistics explained in Table 3, this seems to comply with the assumption that country specific variables are an important factor in explaining average efficiency differences. Given these findings, it is believed that environmental variables have an important role in explaining the differences in banking efficiency. Variations in the countries backgrounds give us an uneven increase in efficiency results, compared to previous studies. This result corresponds with arguments found in Dietsch and Lozano-Vivas (2000) and Lozano-Vivas (1998) where changes in the average mean efficiency scores very much depend on the average country specific conditions. The year 1999 saw the beginning of new policies towards recovery by all the countries. Korea, Indonesia, the Philippines and Thailand progressed towards their commitment with the IMF financial program while Malaysia struggled to overcome the downturn by implementing new capital controls. These economies were also soon hit by a second shock, the severe recession in the global high tech industry in 2001 which led to further sharp downturns in exports and output growth in most of East Asia.

During the period of study, per capita growth in this nation has shown a slower and steady growth and through IMF assistance and implementation of capital controls they have fulfilled the need to research towards improving their country economic development after the crisis (Yellen, 2007). Indonesia seems to have improved their performance non-etheless Indonesia remains the country slowest to recover and 10 years after the meltdown Indonesia's recovery is still among the slowest in the Asian crisis affected countries (Azis, 2008).

Efficiency scores are relatively high for Korea compared to the other selected countries. Korea's efficiency has substantially changed after the inclusion of environmental variables. This could be partly explained by the observed differences in the data of the environmental variables in Table 3. This reveals the fact that Korean banking has undergone substantial structural reforms since the 1997 financial crisis. The recovery in the economy is reflected by the increase in GDP which has helped to restore confidence in the financial sector and has brought the restructuring and mergers plans into reality.

Malaysia experienced a banking crisis in the 1980s and implemented a reform programme to lead them into the recovery of the 1980s downturn. The experience contributed towards better institutional and regulatory structures compared to others such as Indonesia, the Philippines and Thailand. The Malaysian experience of capital controls appear to have had a salutary effect, mainly because controls were supported by a sound macroeconomic policy framework, bank and corporate restructuring, an undervalued currency, credit supervision and time-bound measures. A favourable external environment has also undoubtedly helped Malaysia to recover from the crisis. Furthermore, Malaysian controls on short-term capitals have been justified in the transition period as financial safeguards, the introduction of these measures was very timely with them being implemented just, before the crisis erupted fully (Chirathivat, 2007; Kawai and Takagi, 2003).

Even though the Philippines exhibited similar characteristics to the other countries in the Asian region which suffered tremendous effects on their economy and social consequences, the Philippines was considered the least affected by the crisis with only four distressed financial firms, two of which were banks and the other two non-bank financial institutions which were eventually closed (Bongini *et al*., 2001). The analysis shows an increase of mean efficiency after the inclusion of

environmental variables which implies that the Philippines were recovering swiftly and steadily from the crisis. The Philippines have implemented reforms in their financial sector since the economy downturn in 1980s and then proceeded with reforms in the 1990s which enabled the systems to withstand shocks. The embankment of general Banking law in 2000 and Special Purpose Vehicle Acts (SPVs) in 2002 modernised the legal framework governing the banking system and gave incentives for the disposal of bank's non-performing loans.

The stability of the Thai commercial banks has improved greatly. Thailand's banks efficiency levels are higher relatively to the other countries with the exception of Korea. Looking at the Thai banks performances, the average efficiency increases at a continual and steady pace. The results in Table 8 and 9 reveal the indication of the environmental variables in Table 3 during the period of study. Financial liberalisation in Thailand began during the late 1980s and accelerated in the early 1990s. Chansarn (2005) investigated the efficiency of the Thai financial sector after the financial crisis (1999-2004) by using Total Factor Productivity (TFP). Its findings indicate that the efficiency in the Thai financial sector, the commercial bank sector and in finance and security companies diminished over the period of 1998-2004 while the efficiency in the insurance company sector remained unchanged over the period of study. However, a sharp decrease in efficiency in these three sectors occurred in the period of 1998-2004. Chansarn (2008) looked into the relative efficiency of Thailand's commercial banks during 2003-2006 by using Data Envelopment Analysis (DEA). The analysis indicates that Thai commercial banks were efficient during the period of study.

## CONCLUSION

During the 1997 financial crisis, the region was led into financial turmoil which lasted till early 2000. This caused an enormous contagion effect which started in Thailand and then spread into Indonesia, Malaysia and the Philippines. The impact was even large enough to spread outside the region which brought the world's eleventh largest economy, Korea to the brink of bankruptcy and led to defaults by Russia and Brazil. The affected countries introduced corrective measures to try and contain the economic damage caused by the crisis.

These three counties and Malaysia implemented comprehensive bank restructuring strategies which included restoration of the viability of the financial system as soon as possible so that it can efficiently mobilize and allocate funds (a core banking system must be in place to preserve the integrity of payment systems, capture financial savings and ensure essential credit flows to the economy); throughout the process, provision of an appropriate incentive structure to ensure effectiveness and, as far as possible, avoid moral hazards for all market participants, including bank owners and managers, borrowers, depositors and creditors, asset managers and government agents involved in bank restructuring and supervision and minimization of the cost to the government by managing the process efficiently and ensuring appropriate burden sharing (by distributing losses to existing shareholders). The IMF provided financial support and reform programmes in three worst hit countries-Indonesia, Korea and Thailand. However, initial hesitation from the authorities of these countries created difficulties in the restoration of confidence in both the corporate and financial sectors. Meanwhile, for Malaysia, the government implemented capital control policies and rejected any financial support programmes from the IMF. However, these crisis-resolution measures remain highly controversial and despite all of the arguments, the countries have recovered from the crisis and are finding their way back into economy and financial sector stability.

Overall, the results show that when the common frontier is defined without environmental variables, the mean efficiency scores are quite low in comparison. Looking at specific-environmental conditions, we found that this result is mainly due to the differences in the environmental conditions in which banks perform services. So, when environmental variables are included in the common frontier, the differences in mean efficiency are significantly increased (except for Indonesia which initially started with a lower mean efficiency). The results quite clearly indicate that the failure to incorporate slacks formally and directly into the efficiency analysis (as in the BCC approach) can sometimes produce inflated and misleading indications of relative efficiency (Drake *et al*., 2006).

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