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**Operational Efficiency and TFP Change of  
Major Cambodian Financial Institutions:  
A Data Envelopment Analysis during the 2006-2011 Period\***

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**Abstract**

This study examines the technical efficiency and productivity of 18 major domestic and foreign financial institutions in Cambodia during the period of 2006 to 2011. Data envelopment analysis was employed to estimate the efficiency of business operations and the Malmquist productivity index was used to identify the reasons for their productivity changes. Empirical results reveal that during the research period, the efficiency scores were high, while they were higher in large institutions than in small ones. When measured using a value-added approach that focused on the fund mobilization capability of financial institutions, the efficiency of domestic institutions was found to be better than that of their foreign counterparts; when measured using an operational approach that focused on the income earning capacity of institutions, there was no significant difference in technical efficiency between domestic and foreign institutions. It was also observed that Cambodian financial institutions suffered a slight drop in total factor productivity during the research period. These observations suggest that further improvement of Cambodian financial institutions' technical efficiency requires an increase in the operational capacity of individual institutions and the introduction of advanced banking technologies and skills.

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Key words: Cambodia, DEA, Commercial Banks, Specialized Banks, Microfinance  
Institutions

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## 1. Introduction

Since the early 2000s, Cambodia has achieved high economic growth and remarkable success in modernizing its economic structure. Although Cambodia is known as an agriculturally oriented country, recently its focus has shifted to the industrial and service sectors. With the transformation from a basically self-consuming economy based on social planning to a market economy based on nation-wide trade networks, the Cambodian government has adopted a long-term vision and strategy aimed at developing its economy by implementing structural reforms in all sectors of its economy, including the financial system.

The Cambodian government eagerly involved in reforming the financial systems that are viewed as having an important role in developing economies. In general, from macroeconomic view point, the remarkable development of the Cambodian financial system has been widely acknowledged (IMF, 2011). First, the National Bank of Cambodia (NBC) gained recognition for its prudent policies and regulations. Second, banks are increasingly beginning to reap the benefits of transparency even to the extent of obtaining international credit ratings. Third, the government's steadfast adherence to the market, freedom from exchange controls, and unrestricted capital movement make it one of the most "business friendly" environments in the region<sup>1</sup>.

However, from micro-economic view point, no previous studies assessing rigorously the efficiency change of business operations of financial institutions across different categories over a number of years in Cambodia. The purpose of this study is to

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<sup>1</sup> The rapid development of the financial system has also exposed it to many risks and challenges. The following are concrete examples of the problems faced by the Cambodian banking system in the recent years. First, the private banking system is still not stable and the Cambodian population has yet to place their trust in banks. There is limited access to financial services due to poor economic infrastructure and the isolated locations of financial institutions. Second, high borrowing interest rates are one of the major financing constraints faced by the populace and by small and medium enterprises (SMEs). Unstable inflation rate has also become an impediment for banks and microfinance institutions (MFIs) in the setting of interest rates. Third, some Cambodian financial institutions are mostly exposed to foreign exchange rate risk. They tap funds in foreign currency, which they exchange to Khmer riel and lend to their sub-borrowers, the rural population, and SMEs. At the time of repayment, they have to repay their fund suppliers in the same foreign currency that was tapped. In this process, these Cambodian financial institutions face a foreign exchange risk that makes it difficult to maintain profit while continuously lending. Moreover, the rapid growth of the real estate sector in Cambodia can lead to a financial crisis, since lending for real estate construction is rapidly growing. Nearly 90% of loans are collateralized by land and houses, and these loans may not correctly reflect the actual real estate price. Finally, technology is another restriction on the Cambodian financial system. Information technology is very important for establishing electronic banking; however, it is associated with high costs and other inherent banking risks. Financial institutions also face many obstacles such as lack of adequate human resources, obtaining sources of funds, effective management, regulatory compliance, inefficiency of accounting systems, among others.

investigate on the efficiency of Cambodian financial institutions and to analyze the changes in their productivity and technology<sup>2</sup>. The results presented in this paper may prove useful to identify the financial institutions' operational efficiency and suggest the underlying reasons for their performance.

The findings of this study may also help financial institutions in strategic planning, enable policy makers to improve the overall efficiency of the financial industry, and identify the need for reforms for domestic financial institutions. This study uses data envelopment analysis (DEA) to measure productivity changes in order to determine technical efficiency and technological changes. The operating approach and value-added approach will be used to explore the differences in productivity between banks. Data limitations allow us to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks, and MFIs for the period of 2006–2011.

The remainder of this paper proceeds as follows: Section 2 provides a brief overview of the Cambodian financial industry. Section 3 outlines the data and methodology employed in the study. Section 4 presents the empirical results from the DEA approach. Section 5 discusses the concluding remarks and recommendations for future research.

## **2. An Overview of the Cambodian Banking Industry**

### **2.1 Background**

The NBC was established on December 23, 1954, after the country gained its independence from the French government. Subsequently, during the period of 1975-1979, under the Pol Pot regime, the banking sector and the local currency, riel, were completely abolished. After the collapse of the Pol Pot regime in 1979, the NBC was rebuilt as the Central bank of Cambodia, and the Foreign Trade Bank simultaneously resumed in providing commercial banking services as a bank wholly owned by the government. The new Cambodian currency, riel, was introduced in the next year, and from 1991 onwards, the economy in Cambodia began its transformation from a socially planned economy to a market-oriented economy. Since then, privately owned commercial banks were established as a branch of a foreign bank or as a form of joint venture with the NBC. By 1998, there were 32 licensed commercial banks in Cambodia, and almost all of these banks were local banks that merged with foreign capital banks.

From 1998-2001, the NBC introduced reforms on banking laws and regulations for

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<sup>2</sup> This study is of policy oriented nature which attempts to produce beneficial information for policy makers to monitor the performance of its financial sector and design an efficient financial system.

the financial sector. Financial institutions were classified into three categories: commercial banks with a minimum paid-up capital of \$13 million, specialized banks with a minimum paid capital of \$2.5 million, and licensed/registered microfinance institutions (MFIs). Subsequently, the NBC consolidated several financial institutions to increase the resilience of the banking sector and managed to dispose of non-performing loans. The restructuring of financial institutions reduced the number of financial institutions by half.<sup>3</sup>

According to the Law on Banking and Financial Institutions in Cambodia, banking operations are defined as composed of three parts: (1) credit operations for valuable consideration, including leasing, guarantees, and commitments under signature, (2) the collection of non-allocated deposits from the public, and (3) the provision of means of payment for customers and the processing of these means of payment in the national currency or in foreign exchange. Any financial institution that carries out all of the above banking activities can be defined as a commercial bank. Specialized banks refer to institutions that carry out only one of the three basic banking activities. In practice, specialized banks are only involved in lending activities. MFIs also engage in banking activities through the soliciting of deposits and granting of credits, but their scope of operation is limited to certain thresholds to differentiate between the markets of banking and microfinance. As per the law on banking and financial institutions, the legal banking institutions in Cambodia are the locally incorporated banks and foreign bank branches. However, locally incorporated banks could refer to wholly foreign-owned banks, joint ventures with local capital banks, or foreign bank subsidiaries.

In general, the Cambodian banking sector has continued to grow since 2000 (NBC, 2010). From 2006 to 2011, the total amount of financial sector assets as a percentage of the Gross Domestic Product (GDP) increased from 26% to 63%, the number of depositors rose from 286,000 to 1,266,000, and the number of borrowers rose from 165,000 to 295,000. In the late 2000s, the number of bank loans soared and the asset management ratio increased from 100% to 120%, but the liquidity ratio decreased from 108% to 83%. However, the resilience of the banking sector improved: the ratio of non-performing loans to the total number of loans decreased from 9.8% to 2.48% in the same period, and related party lending was in the stable range of 1%-2% of net worth.

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<sup>3</sup> The restructuring of financial institutions was promoted and the Foreign Trade Bank was independently privatized in 2005 to ensure soundness and transparency in the banking sector. In addition, a new capital requirement of \$38 million was introduced for commercial banks (unless they were rated 'A' or above, or were shareholders of 'influential' foreign banks) to reduce liquidity caused by inflation and sharp increase in credit.

In addition, fixed asset ratio decreased from 19.0% to 10.7% and the ratio of loans for real estate dropped from 15.9% to 9.8%.

The following problems in the management of Cambodian banks were identified (NBC, 2012): first, the Cambodian economy is heavily dollarized and transactions are conducted in US dollars based on cash. The dollarization rate in Cambodia has recently risen to 95%. The second issue is the underdeveloped Cambodian financial network. Banks are mainly concentrated in the capital city, Phnom Penh, and other major cities. Only few banks have branch networks that cover the whole country. Thus, financial services are not very accessible and cash is largely used for payment transactions. Third, there is no inter-bank/money market or capital market in operation. The lack of monetary market instruments such as government securities and other negotiable instruments is an obstacle to the development of these markets. Another problem identified is the absence of a national payment system. The limitation in the functioning of the clearing house is significant, and the settlement system is inadequate. Therefore, under these conditions, the following restrictions are imposed on banking activities: limited capacity of fund absorption, limited capacity of loan provision, and restriction on the general management capacity of assets and liabilities. These are possible impediments to efficient bank management.

According to the IMF (2011), the performance of Cambodian banks was positive with respect to these points: (1) the resilience of the financial institutions improved and consolidated recently, (2) increased transparency of bank management and partial utilization of internal ratings were promoted, and (3) the deregulation of the foreign exchange market and capital trade has consistently progressed. The negative aspects of the banking sector included the inadequacy of bank credit, low physical accessibility of the banks, particularly in the rural areas, and high interest rates, which restricts borrowing by small and medium entrepreneurs. Furthermore, the management of exchange rate risk is fragile because bank financing is largely dependent on foreign funds and potential non-performing loans could be increasing due to the rapid growth of real estate loans. Moreover, the banking sector suffers from fundamental problems such as the lack of risk evaluation skills, inadequate human resources, and an underdeveloped accounting system.

## **2.2 Breakdown of the Operational Indicators in Major Cambodian Banks**

Table 1 presents a summary of the operational indicators of 18 major banks in Cambodia from 2006 to 2011. The sample was analyzed by using the econometrical method mentioned in Section 3 of this paper. The sample was divided into three

categories: commercial banks, specialized banks, and MFIs. Commercial banks were further divided into foreign banks and local banks according to ownership and into large banks and small banks according to their size in terms of assets. These indicators imply the following:

Table 1: Operational indicators of 18 major financial institutions

	Loan- deposit ratio	Non- interest income to total income	Interest expenses to total assets	Operational expenses to total assets	Number of staff to total assets
Commercial banks	70.43	27.91	1.43	2.93	0.04
o/w Foreign-owned	79.71	36.44	1.18	3.51	0.06
Local	65.07	19.15	1.72	2.23	0.03
Large	81.87	18.67	1.99	3.19	0.07
Small	72.76	32.46	1.06	3.75	0.06
Specialized banks	2562.82	6.98	0.13	6.00	0.18
MFIs	11606.33	3.41	4.71	8.98	0.31

Note: All values are average % value for the period of 2006-2011.

First, in commercial banks, the characteristics of management differ according to ownership structure. Compared to the indicators of local banks, since the loan-deposit ratio is lower and non-interest income to total income ratio is higher in foreign banks, foreign banks are less dependent on providing deposits and loans, and have made considerable progress using a diversification strategy. Furthermore, the interest expenses to total assets ratio is lower in foreign banks than in local banks. The number of staff and operational expenses as a percentage of total assets are higher in foreign banks than in local banks. These management characteristics suggest that foreign banks have the advantage in terms of financing and employing staff in response to their diversification strategy.

Second, the managerial characteristics of commercial banks differ from each other with respect to bank size. In comparison to small banks, large banks have a higher loan-deposit ratio and a lower on-interest income to total assets ratio. In terms of expenses, the number of staff to total assets ratio is higher and the operational expenses as a percentage of total assets are lower in large banks. This implies that large banks are strongly dependent on the traditional banking activities of providing deposits and loans and have an advantage in terms of low operational expenses but are not superior to small banks in terms of financing.

Third, with regard to banking activities, commercial banks, specialized banks, and

MFIs are remarkably different. Compared with commercial banks, the loan-deposit ratio as well as the operational expenses and number of staff to total assets ratio of the latter two are remarkably high. This suggests that specialized banks and MFIs are not dependent on deposits for financing and that they adopt a labor-intensive approach as indicated by their operational expenses, which are comparatively high for their asset size.

### 3. Analytical Methodology

#### 3.1. Methodology for Efficiency Measurement

This study employs the DEA method that was provided by Färe, Grosskopf, and Lovell (1985, 1994) and Lovell (1993)<sup>4</sup> to determine the efficiency of decision making units (DMUs), i.e. financial institutions. The efficiency measurement of a financial institution by using DEA identifies the potential ability of a financial institution in terms of how output could increase, while maintaining the current input level (output maximization), or alternatively, the potential ability of a financial institution in terms of how inputs could be decreased, given the current outputs (input minimization). An efficiency score for each financial institution is calculated in relation to the non-parametric frontier of best practices among financial institutions that are constructed by using observed data on input and output quantities (McKillop et al., 2002).

DEA has useful features for the measurement of efficiency of financial institutions in Cambodia<sup>5</sup>. First, the DEA has no need for preconceiving a specific functional form for identifying efficient DMUs<sup>6</sup> (Hababou, 2002; Favero and Papi, 1995; Banker et al., 1984). The DEA technique is best adopted when a commonly agreed functional form relating inputs to outputs is difficult to prove or find (Hababou, 2002). Such a specific functional form is difficult to obtain for financial institutions..

Second, when the sample size is small, the DEA technique is preferred to parametric methods (Canhoto and Dermine, 2003). In this study, data limitations allow us to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks,

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<sup>4</sup> The discussion of efficiency measurement began with Farrell (1957) who identified a measure of firm efficiency accounting for multiple inputs. Farrell (1957) decomposed the efficiency of a firm into two components: *technical efficiency* and *allocative efficiency*. The product of these two measures is the *total economic efficiency*. Charnes et al. (1978) generalized the single input-output model of Farrell (1957) to a multiple input-output model known as the CCR model (named after Charnes et al.). Tavares (2002) produces a bibliography of DEA (1978-2001).

<sup>5</sup> The main drawback of DEA is its assumption that data are free from measurement errors. In addition, since the measurement of efficiency is relative, an efficient DMU identified in the analysis cannot be compared with DMUs outside the sample.

<sup>6</sup>Hababou (2002) and Avkiran (1999) discuss thoroughly the merits and limitations of DEA.

and MFIs for the period of 2006–2011. In practice, the sample size is too small for conducting formal econometric analysis via a parametric approach.

According to Drake (2004), the application of the DEA method to banking is described as follows. Assuming that there is  $N$  number of financial institutions, let  $x_i$  represent the input matrix of the  $i$ -th financial institution and  $y_i$  represent its output matrix. Let the  $K \times N$  input matrix be denoted as  $\mathbf{X}$  and the  $M \times N$  output matrix be denoted as  $\mathbf{Y}$ . The efficiency measure of each of the  $N$  financial institutions is maximized by DEA determining the ratio of all weighted outputs over all weighted inputs, where the weights are selected from the dual linear programming problem specified below:

$$\begin{aligned}
 & \min_{\theta, \lambda} \theta \\
 & \text{subject to} \\
 & \quad -y_i + \mathbf{Y}\lambda \geq \mathbf{0} \\
 & \quad t\theta x_i - \mathbf{X}\lambda \geq \mathbf{0} \\
 & \quad \lambda \geq \mathbf{0}
 \end{aligned} \tag{1}$$

where  $\lambda$  is an  $N \times 1$  vector of constants, and  $\theta$  is scalar and is the economic efficiency score of the  $i^{\text{th}}$  financial institution. According to the Farrell (1957) definition, it will satisfy  $\theta \leq 1$ , with 1 indicating a point on the frontier and hence a technically efficient financial institution. The linear programming problem must be solved  $n$  times, once for each financial institution in the sample. A value of  $\theta$  is then obtained for each individual financial institution.

There are two basic models of DEA, which are based on the assumption of constant return to scale (CRS) and variable returns to scale (VRS). The CCR model requires financial institutions to operate on the flat portion of the long run average cost curve, which implies that all financial institutions are at the optimal scale. When some banks are not operating at an optimal scale, by introducing a variable that represents the returns to scale, the VRS model allows for the calculation of technical efficiency that is free from scale efficiency effects (Banker et al., 1984, Coelli, 1996)<sup>7</sup>.

### 3.3. Productivity Change Measurement

The concept of comparing the inputs of a DMU over two periods of time (period  $t$  and period  $t+1$ ), whereby the input in one time period can be decreased while maintaining the same level of output in the second period, forms the basis of the

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<sup>7</sup> This model is known as the BCC model.



Malmquist index<sup>8</sup>. The Malmquist productivity index ( $M$ ) enables productivity growth to be classified into changes in efficiency (the catch-up effect) and changes in technology (innovation). Each sample, separated by year, represents a single frontier, constructed on the assumption of the same technology. Therefore, the comparison of efficiency measures of a DMU over a certain period cannot be interpreted as technical progress; rather, it refers to changes in efficiency (Canhoto and Dermine, 2003).

The Malmquist index ( $M$ ) of total factor productivity change is the geometric mean of the two indices based on the technology used in period  $t$  and  $t+1$  respectively. In other words,  $M=ET$ , where  $M$  is the Malmquist productivity index,  $E$  is the change in efficiency from period  $t$  to  $t+1$ , and  $T$  is the measure of technical progress measured by shifts in the frontier from period  $t$  to  $t+1$ . Any variation in the reference technology used affects the interpretation of the index. When the reference technology is based on period  $t$ , then  $M > 1$  implies an increase in productivity.

### 3.4. Data and Study Period

The annual data of financial institutions in Cambodia from 2006 to 2011 were used in this study. The variables were obtained from financial statements published by the Banking Supervision Department of the NBC. Data limitations allow us to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks, and MFIs for the period of 2006–2011. The sample consisted of 18 financial institutions representing nearly 80% of the bank industry's total assets<sup>9</sup>.

As in recent studies, the operating approach and value-added approach will be used to explore the differences in productivity between financial institutions. The operational approach is a concept that focuses on "efficiency as seen from the revenue side of the banks". The value-added approach is a concept that focuses on "efficiency as seen from the asset side of the banks". Accordingly, three inputs and two output variables were chosen. In the operating approach, the input variables used were interest expense ( $x_1$ ), the number of branches ( $x_2$ ), and the number of employees ( $x_3$ ); interest income ( $y_1$ ) and non-interest income ( $y_2$ ) were used as output variables. In the value-added approach, on the other hand, the inputs were similarly interest expense ( $x_1$ ), the number of branches ( $x_2$ ), and the number of employees ( $x_3$ ), while the outputs were total deposits ( $y_1$ ) and gross loans ( $y_2$ ). Table 2 presents the summary of data used to construct efficiency frontiers.

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<sup>8</sup> Grosskopf (2003) provides a brief history of the Malmquist productivity index and discusses the theoretical and empirical issues related to the index. For the decomposition of Malmquist productivity index, see Lovell (2003).

<sup>9</sup> See Table A-1 in appendix.

Table 2: Variables used in the value-added and the operating approaches

Variables	Value-added approach Items Used	Operating approach Items Used
$y_1$	Deposits	Interest Income
$y_2$	Loans	Non-Interest Income
$x_1$	Interest expenses	Interest expenses
$x_2$	Number of branches	Number of branches
$x_3$	Number of staff	Number of staff

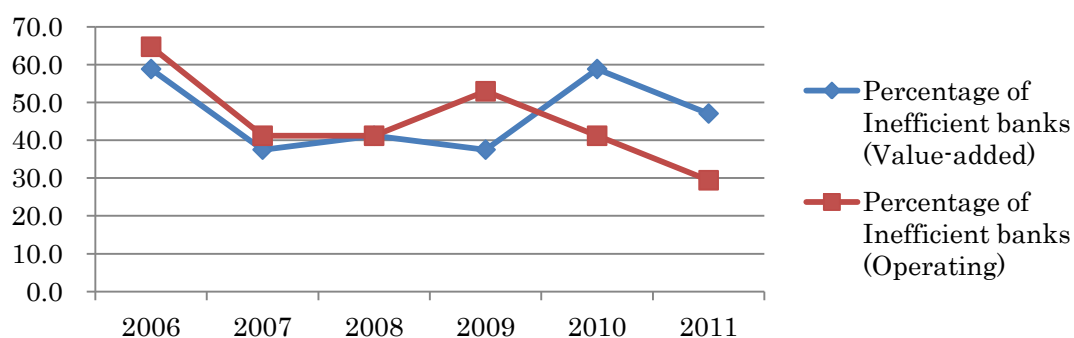
## 4. Major Findings

### 4.1. Empirical Results of Efficiency Measurement using DEA

Figure 1 and Figure 2 below illustrate the DEA results for measuring the efficiency of the major Cambodian banks for the period of 2006-2011 using the value-added approach and operating approach. Figure 1 indicates the ratio of inefficient banks to the total number of banks in the sample. An inefficient bank is one that does not produce on a production frontier, when the production frontier is measured on an annual basis, and which wastes input elements in some situations.

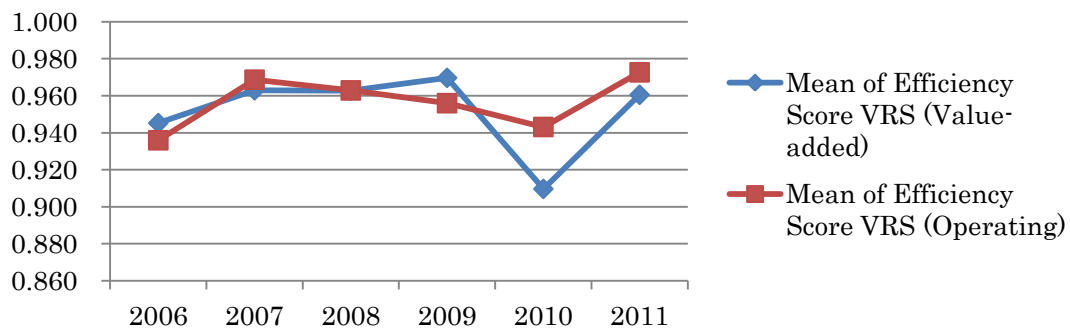
According to Figure 1, the ratio of inefficient banks to the entire sample was stable throughout the observation period. It fluctuated between 40% and 60% when measured using the value-added approach that focuses on the number of financial intermediaries. When measured using the operating approach that focuses on bank profitability, the ratio fluctuated between 20% and 60%. These approaches did not show an obvious trend over the observation period. However, it was observed that the ratio tends to decrease slightly over time in the operating approach, but the evidence was inconclusive.

Figure 1: The Percentage of Inefficient Banks in the Sample



According to Figure 2, the mean of the efficiency scores was high every year, regardless of whether the value-added or operating approach was used. This suggests that a larger number of Cambodian banks are managed in the domain near the production frontier, and that the efficiency gap between banks is small. Compared with Central-Eastern European countries and South/Central American countries, it was observed that the efficiency gap between banks is relatively small in Asian countries (Hasimoto, 2006; Okuda & Take, 2012). Interestingly, the efficiency gap between banks is even smaller in the Cambodian banking sector, which is still in its infancy stage.

Figure 2: The Mean of Technical Efficiency Scores

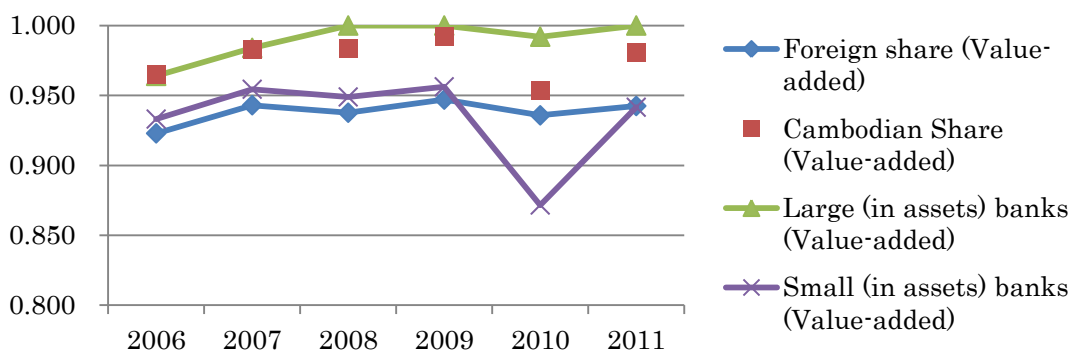


However, when the variations in average efficiency scores were considered in the value-added approach and the operating approach respectively, it was found that these changes had an increasing trend in the earlier part of the observation period, but temporarily dropped substantially in 2010. The background behind these findings is as follows: in the earlier part of the observation period, South-East Asian economies were expanding due to a favorable global economy. In contrast, in the latter part of the observation period, several incidents such as the subprime mortgage issue, the economic downturn caused by the Lehman Brothers bankruptcy in 2008, and the European debt crisis, sent the global economy into a tailspin and caused widespread concerns regarding recession and financial instability in South-East Asian countries. However, the drop of the mean value in 2010 in the operating approach was smaller than in the value-added approach. This suggests that Cambodian banks were able to profitably suppress the influence of the global economic crisis, while the volume of financial intermediation dropped in response to the deteriorating economic situation.

#### 4.2. Attributes of Bank Efficiency

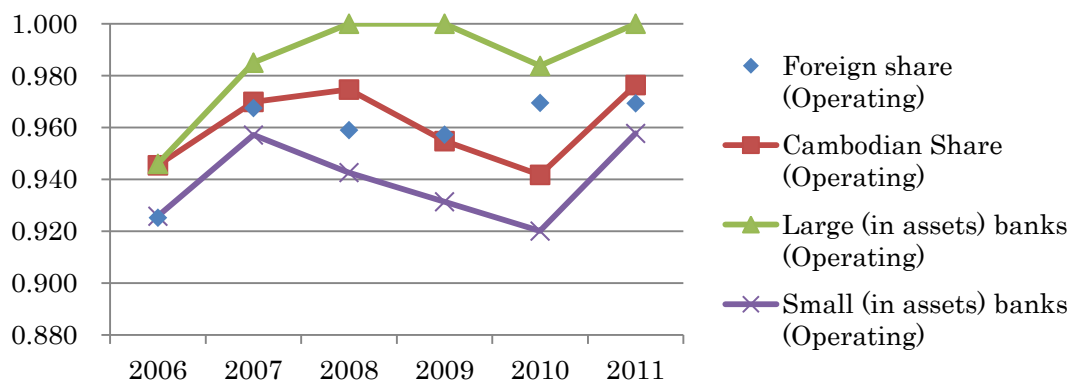
A variety of attributes was used to measure the efficiency of banks in the sample. Therefore, the sample was classified into groups according to bank attributes, derived from the data, and the mean of each group was compared to examine how bank attributes affect bank efficiency. First, the entire sample was classified into two groups based on size, either large or small. The sample was also classified based on ownership structure, i.e., as foreign or local banks. Figure 3 and Figure 4 show the differences between the average efficiency scores of banks in these groups. A bank is defined as a foreign bank when the ratio of foreign share exceeds 50%; otherwise, it is a local bank. Furthermore, a bank is defined as a large bank when it is ranked as one of the four largest banks in Cambodia, while a bank is defined as a small bank when its total assets amount to less than one-tenth of the average amount of total assets of the entire financial sector; there are ten small banks in the sample.

Figure 3: Bank Size and Ownership Structure (Value-Added Approach)



First, the average efficiency score of foreign banks was compared with that of local banks in both figures. The average efficiency of local banks was higher than that of foreign banks in the value-added approach. It is unclear which of these two groups is superior to the other since the ranking of the efficiency scores of these groups differ each year. These results suggest that local banks utilize their resources better than foreign banks in terms of financial intermediaries, but the management of foreign banks and the management of local banks are similar in terms of bank profitability. Hence, it can be inferred that local banks have adopted the traditional business model, which focuses on the deposit and loan business, whereas foreign banks have adopted the business model that focuses on income fees besides the deposit and loan business.

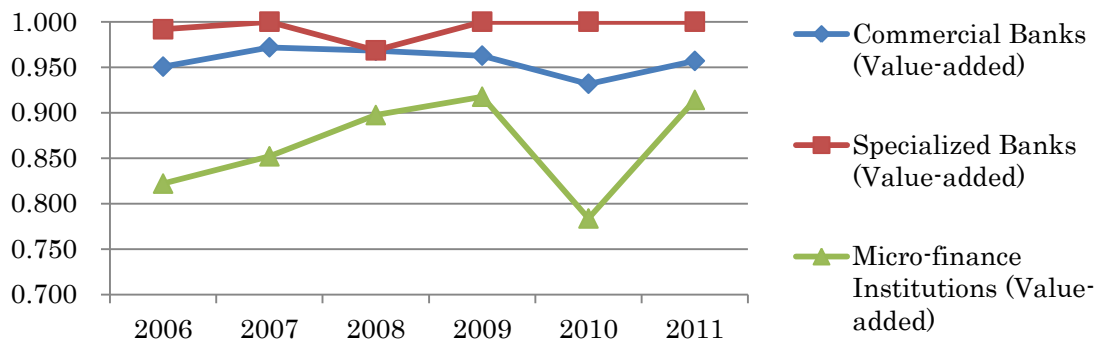
Figure 4: Breakdown of Bank Size and Ownership Structure (Operating Approach)



When the average efficiency score of large banks was compared with that of small banks as shown in Figure 3 and Figure 4, the mean score of large banks was found to be higher than that of small banks, regardless of which approach was used. This result indicates that large banks utilize their resources better than small banks in terms of financial intermediaries and bank profitability. Generally, the banking business features economies of scale as its own industrial character. Interestingly, this suggestion mentioned in previous studies is consistent with our result.

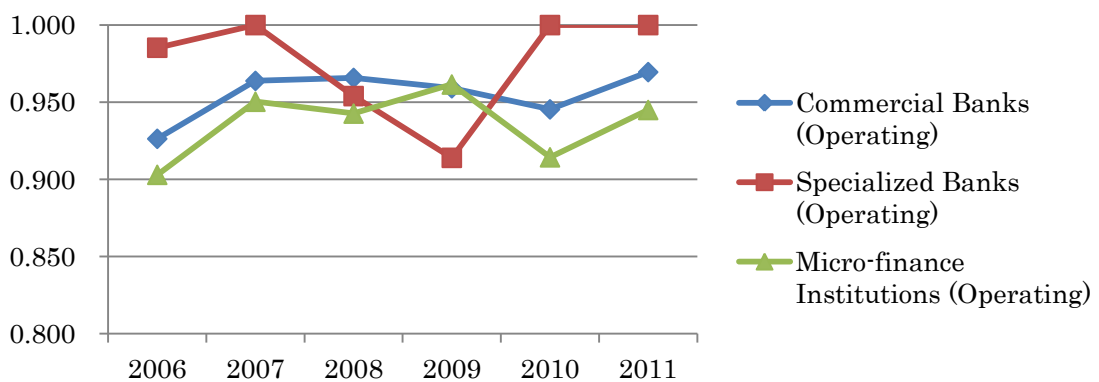
Finally, Figure 5 and Figure 6 present the average efficiency scores of the three distinct banking sectors included in the sample: commercial banks, specialized banks, and MFIs, in the value-added and operating approaches respectively. In the value-added approach, which focuses on fund mobilization, MFIs had the lowest average efficiency score every year, and specialized banks had a higher efficiency score than commercial banks every year, except in 2008. MFIs have the advantage in raising funds since they can obtain financial aid from donor organizations, while they are restricted in terms of fund management because they lend only for the purpose of agricultural and rural development or poverty reduction. The empirical results show that MFIs cannot afford to avoid the additional input of resources in terms of finance intermediation due to the restriction on lending practices. On the other hand, specialized banks can conduct their operations with minimal waste of resources as they focus exclusively on loan activities in terms of financial intermediation.

Figure 5: The Average Score of Each Bank Sector (Value-Added Approach)



In the operating approach, which focuses on profitability, the gap in the average efficiency scores between distinct sectors were relatively small compared with those in the value-added approach. However, both approaches shared common features: MFIs had the lowest average efficiency scores every year and specialized banks had high average efficiency scores throughout the observation period. A possible reason for weaker variations in the average efficiency scores between the banking sectors in the operating approach than in the value-added approach can be the fact that the results are influenced by the advantages that MFIs utilize such as concessional resources, financial aid, among others.

Figure 6: Average Score of Each Bank Business Sector (Operating Approach)



#### 4.3. Results of Measuring Efficiency Changes

Table 3 presents the results of the calculation of efficiency changes in major Cambodian banks over a six-year period from 2006 to 2011. The Malmquist index represents the changes in total factor productivity (TFP) and indicates improvement in productivity if the measured value is greater than 1 and decreased productivity if the

value is less than 1. Furthermore, the TFP change can be classified as follows: efficiency change, which shows the catch-up to the productivity frontier in individual banks, and technical change, which shows the shift in the productivity frontier. Similarly, both scores indicate an improvement if they are greater than 1 and deterioration if they are less than 1. The former is known as the catch-up effect since it represents the proximity of individual banks to the most efficient level of bank operation. The latter indicates a shift in the productivity frontier by the most efficient banks; it can be interpreted as the magnitude of technical progress in banks for which it is measured.

The empirical results are as follows: first, the TFP of the major Cambodian banks decreased slightly over a six-year period from 2006 to 2011. Only three banks improved their average TFP in the given period. Moreover, the average TFP of all banks in the sample fell below both the value-added approach and the operating approach.

Second, when the TFP change was divided into the catch-up effect and the productivity frontier shift, it was observed that the catch-up effect was positive in the value-added approach, indicating that the efficiency gap between banks had reduced, but was negative in the operating approach, indicating that the efficiency gap between banks had expanded. Furthermore, the frontier shift was negative indicating that negative technical progress occurred both in the value-added and the operating approaches.

Table 3: TFP Change, the Catch-up Effect, and the Frontier Shift (Malmquist Index)

	Value-added Approach			Operating Approach		
	Catch-up Effect	Frontier Shift	TFP Change	Catch-up Effect	Frontier Shift	TFP Change
The number of banks improved (per total number of banks )	6 (42.9)	2 (14.3)	3 (21.4)	4 (33.3)	2 (16.7)	3 (25.3)
Mean of all banks	1.010	0.990	0.993	0.999	0.997	0.996
Foreign banks	1.005	0.990	0.995	0.996	0.998	0.994
Local banks	1.021	0.989	0.995	1.003	0.996	0.999
Large banks	1.007	0.987	0.993	1.002	0.992	0.995
Small banks	1.001	0.992	0.993	0.995	1.001	0.996
Commercial banks	1.017	0.988	0.997	0.998	0.997	0.996
Specialized banks	0.974	0.986	0.960	n.a.	n.a.	n.a.
MFI	0.990	1.004	0.993	1.010	0.994	1.004

Note: The score represents improvement if it is greater than 1 and deterioration if it is less than 1.

Finally, it was found that nearly all the features mentioned above focus on the distinct attributes of banks. Focusing on bank size and ownership structure, the TFPs of all categories decreased. When TFP change was classified into two changes, the

catch-up effect was observed in the value-added approach for all categories, but in the operating approach, it was observed only in the local and large banks. However, for the shift in the production frontier, negative technical changes were observed in both approaches. Among the different banking sectors, MFIs had a different trend for TFP changes to a certain extent.

## **5. Conclusion**

This study examined the technical efficiency and productivity of 18 major domestic and foreign banks in Cambodia during the period of 2006-2011. This study used DEA to estimate the efficiency of banking operations and applied the Malmquist productivity index to identify the sources of their productivity change.

The empirical results reveal the following:

- (1) Measured using both the operating approach and the value-added approach, the efficiency scores of the Cambodian financial institutions were a relatively high during the observed period with the exception of 2010. Similar to other neighboring countries, the difference in efficiency between financial institutions were small. Although the efficiency gap among individual banks increased in 2010 when macroeconomic circumstances deteriorated due to the Lehman shock and the Euro crisis, it decreased to its previous level in 2011.
- (2) The technical efficiency of domestic banks was greater than that of foreign companies when measured using the value-added approach, which focused on the fund mobilization capability of banks. On the other hand, there was no significant difference between the technical efficiency of domestic and foreign banks when measured using the operating approach, which focused on the income-earning capability of banks. This observation suggested that domestic banks pursued a business model that is different from that of foreign banks.
- (3) Using both the operating approach and the value added approach, technical efficiency was greater in large banks than in small banks. These observations indicate that large banks made better use of operational resources than small banks.
- (4) Using both the operating approach and the value added approach, it was observed that the entire Cambodian banking industry suffered a slight decrease in TFP during the research period from 2006 to 2011. In addition, when the change in TFP change was decomposed into the catch-up effect and the productivity frontier shift, the latter was negative indicating the occurrence of negative technical progress both in the value-added approach and the operating approach.
- (5) Among the different banking sectors, MFIs had a different trend in terms of



technical efficiency as well as TFP changes. MFIs had the lowest average efficiency score every year both in the value added approach and the operating approach. On the other hand, there was no significant difference between the TFP change of MFIs and other types of banks when measured using both the operating approach and value added approach.

It seems that these observations suggest two policy targets for building a more efficient Cambodian financial institutions. The first is to increase the size of business operations of individual financial institutions and the second is to promote the advancement of banking technology and skills. However, this paper focuses on measuring the operational efficiency and TFP change of financial institutions but does not directly examine their determinants. We acknowledge the limitation of this study and leave it for further research to investigate what factors affect the performance of financial institutions.

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## Appendix

Table (A-1) 18 Major Financial Institutions

Total Assets (Millions of KHR*)											
N.	Name of Financial Institutions	FS	CS	2011	2010	2009	2008	2007	2006	2005	2004
1	Aceda	49%	51%	6,063,681	4,745,962	3,799,281	2,817,755	1,899,200	900,576	508,287	338,154
2	Advanced Bank of Asia Limited	100%		817,998	616,791	234,558	176,421	163,154	111,765	87,015	93,739
3	Amret MFI	98%	2%	482,109	355,983	297,800	286,515	3,522	92,388	62,416	39,281
4	ANCO Specialized Bank		100%	38,330	34,851	15,411	10,810	10,688	11,030	0	0
5	ANZ Royal Bank (Cambodia) Limited	55%	45%	2,840,347	2,462,684	2,153,368	1,700,784	2,241,988	830,301	370,364	0
6	Cambodia Agriculture Industrial Specialized Bank		100%	0	0	0	0	12,788	15,684	12,997	12,505
7	Cambodia Asia Bank Ltd	100%		271,189	233,705	125,170	108,603	129,027	89,866	72,187	60,968
8	Cambodia Mekong Bank Public Ltd		100%	183,550	172,594	181,580	194,192	248,674	109,339	88,076	82,803
9	Cambodian Commercial Bank Limited	100%		474,833	426,485	612,358	628,779	651,741	519,549	460,263	479,072
10	Cambodian Public Bank Limited	100%		4,093,420	4,087,116	3,932,487	4,060,377	2,260,384	983,973	664,892	575,352
11	Canada Bank Plc		100%	5,279,836	4,351,832	3,130,658	2,411,010	2,242,342	1,522,579	1,225,674	1,012,965
12	Foreign Trade Bank of Cambodia		100%	1,654,958	1,355,408	1,152,163	1,078,204	882,057	896,493	673,701	663,361
13	Maruhan Japan Bank Plc	85%	15%	501,262	354,099	179,853	167,314	0	0	0	0
14	Peng Heng SME Bank Ltd		100%	34,659	32,752	22,100	20,279	20,503	16,909	16,167	15,074
15	Prasak MFI	90%	10%	629,015	455,272	295,288	247,586	148,067	106,511	52,176	36,552
16	Singapore Banking Corporation Ltd	100%		256,538	225,497	195,742	191,141	195,825	150,818	127,163	117,037
17	Union Commercial Bank Plc	42.4%	57.6%	1,025,197	822,285	613,049	482,470	484,253	423,585	348,780	405,206
18	Vattanac Bank		100%	763,629	828,402	790,555	775,627	525,085	287,390	220,643	160,014
KHR: Khmer Riel, Local currency of Cambodia											

Source: National Bank of Cambodia, Supervision Reports, 2012.