Operational Efficiency and Productivity Change of Major Cambodian Financial Institutions During the 2006-2011 Period

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ABSTRACT
This study could be the first attempt to analyze the performance of the Cambodian financial sector from the viewpoint of microeconomics. The study examines the operational efficiency and productivity of 18 major financial institutions in Cambodia during the period 2006 to 2011. Data envelopment analysis was used to estimate the efficiency of business operations, and the Malmquist productivity index was used to identify the reasons for productivity changes. Empirical results reveal that the efficiency scores 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

1 This study is financially supported by a Grant-in-Aid for Scientific Research from the Ministry of Education and Science (Scientific Research C, No. 25380283).
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 factory productivity during the research period. These observations suggest that further improvement of the technical efficiency of Cambodian financial institutions requires an increase in the operational capacity of individual institutions and the introduction of advanced technologies and skills.

**Keywords:** Cambodia, financial institutions, DEA, operational efficiency, TFP change

### 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 nationwide 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 is eagerly involved in reforming the financial systems that are viewed as having an important role in developing economies. The International Monetary Fund [IMF, 2011] acknowledged the remarkable achievements of the Cambodian financial system. 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. The rapid development of the financial system, however, has also exposed it to challenges [Ahmed and Runggcharoenkitkul, 2014; IMF, 2011]. For instance, with many new bank entrants, Cambodia is over-banked compared with its regional neighbors and other countries at a similar level of development. In addition, financial institutions face many obstacles such as lack of adequate human resources, the inability to obtain sources of funds, ineffective management, regulatory compliance, and inefficiency of accounting systems, to name a few.

Although efficient financial institutions are essentially needed to promote economic development, there are no previous studies analyzing the performance of financial institutions in Cambodia. The lack of analytical information about the performance of financial institutions has been a serious obstacle for policy makers in monitoring the financial sector and designing an efficient financial system. The purpose of the current study is to provide useful information to assess the operational efficiency of Cambodian financial institutions and to analyze the changes in their productivity and technology. This study could be the first attempt to analyze the performance of the Cambodian financial sector from the viewpoint of economics. The results presented in this paper may be useful in understanding how the different attributes of financial institutions – such as size of business, ownership structure, and core of business – affect their operational efficiency and productivity change.

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 the difference in technical efficiency among financial institutions and to examine the changes in total factor productivity (TFP) of these institutions over time. The operating approach and value-added approach will be used to explore the differences in
productivity among banks. Data limitations allow the authors to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks, and MFIs for the period 2006–2011.

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

2. OVERVIEW OF THE CAMBODIAN BANKING INDUSTRY

This section includes a discussion of background information on the banking industry in Cambodia and provides a breakdown of the operational indicators of major Cambodian banks.

2.1. Background Information on Cambodian Banking

The National Bank of Cambodia (NBC) was established on December 23, 1954, after the country gained its independence from the French government [NBC, 2007]. Subsequently, during the period 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 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 onward, the economy of Cambodia began its transformation from a socially planned economy to a market-oriented economy. Since then, privately owned commercial banks have been 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 were local banks that merged with foreign capital banks.
From 1998 to 2001, the NBC introduced reforms in banking laws and regulations for 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.

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 involved only in lending activities. MFIs also engage in banking activities through the soliciting of deposits and granting of credit, 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 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. In addition, the 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%.

Several problems have been identified in the management of Cambodian banks [NBC, 2012]. First, the Cambodian economy is heavily dollarized, and transactions are conducted in U.S. dollars based on cash. The dollarization rate in Cambodia has recently risen to 95%. Second, the Cambodian financial network is underdeveloped. Banks are concentrated mainly in the capital city, Phnom Penh, and other major cities. Only a 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. Fourth, there is no national payment system. The limitation in the functioning of the clearing house is significant, and the settlement system is inadequate. These conditions impose the following restrictions 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 recent improvement in the resilience of financial institutions; promotion of increased transparency of bank management and
partial use of internal ratings; and consistent progress toward the deregulation of the foreign exchange market and capital trade. The negative aspects of the banking sector included the inadequacy of bank credit, low physical accessibility of the banks, particularly in rural areas, and high interest rates, which restrict borrowing by small- and medium-sized entrepreneurs. Furthermore, the management of exchange rate risk is fragile because bank financing is largely dependent on foreign funds, and the number of potentially non-performing loans could be increasing because of the rapid increase in the number 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. 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 have several implications. First, in commercial banks, the characteristics of management differ according to ownership structure. Since the loan-deposit ratio is lower and the non-interest income to total income ratio is higher in foreign banks, compared with the indicators of local 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 the amount of operational expenses as a percentage of total assets are higher in foreign banks than in local banks. These management
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Characteristics suggest that foreign banks have the advantage in terms of financing and employing staff in response to their diversification strategy.

Table 1

Operational Indicators of 18 Major Financial Institutions in Cambodia

<table>
<thead>
<tr>
<th></th>
<th>Loan-Deposit Ratio</th>
<th>Non-Int. Income to Total Income Ratio</th>
<th>Interest Expenses to Total Assets Ratio</th>
<th>Opera. Expenses to Total Assets Ratio</th>
<th>Number of Staff to Total Assets Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial banks</td>
<td>70.43</td>
<td>27.91</td>
<td>1.43</td>
<td>2.93</td>
<td>0.04</td>
</tr>
<tr>
<td>o/w Foreign-owned</td>
<td>79.71</td>
<td>36.44</td>
<td>1.18</td>
<td>3.51</td>
<td>0.06</td>
</tr>
<tr>
<td>Local</td>
<td>65.07</td>
<td>19.15</td>
<td>1.72</td>
<td>2.23</td>
<td>0.03</td>
</tr>
<tr>
<td>Large</td>
<td>81.87</td>
<td>18.67</td>
<td>1.99</td>
<td>3.19</td>
<td>0.07</td>
</tr>
<tr>
<td>Small</td>
<td>72.76</td>
<td>32.46</td>
<td>1.06</td>
<td>3.75</td>
<td>0.06</td>
</tr>
<tr>
<td>Specialized banks</td>
<td>2562.82</td>
<td>6.98</td>
<td>0.13</td>
<td>6.00</td>
<td>0.18</td>
</tr>
<tr>
<td>MFIs</td>
<td>11606.33</td>
<td>3.41</td>
<td>4.71</td>
<td>8.98</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Non-Int. = Non-interest; Opera. = Operational

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

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

Third, commercial banks, specialized banks, and MFIs are remarkably different with regard to banking activities. Compared with commercial banks, the latter two have a remarkably high loan-deposit ratio as well as operational expenses and number of staff to total assets ratio. This fact 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. ANÁLYTICAL METHODOLOGY

This section discusses the methodology used in this study for efficiency measurement, the productivity change measurement, and data and study period.

3.1. Methodology for Efficiency Measurement

This study uses the DEA method provided by Färe, Grosskopf, and Lovell [1985, 1994] and Lovell [1993]² 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 the current input level (output maximization) is maintained, 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.

Compared with the parametric approach, DEA has useful features for the measurement of efficiency of financial institutions in Cambodia. First, there is no need for the DEA to pre-conceive a specific functional form for identifying efficient DMUs [Coelli, 1998]. The DEA technique is best adopted when a commonly agreed functional form relating inputs to outputs is difficult to prove or find. 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 the current study, data limitations allow the authors to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks, and MFIs for the period 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 formally described as follows. Assuming that there are \( N \) 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 \( X \) and the \( M \times N \) output matrix be denoted as \( Y \). 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:

\[
\min_{\theta,\lambda} \theta \\
\text{subject to} \\
- y_i + Y\lambda \geq 0 \\
t \theta x_i - X\lambda \geq 0 \\
\lambda \geq 0
\]  

(1)

where \( \lambda \) is an \( N \times 1 \) vector of constants, and \( \theta \) is scalar and is the economic efficiency score of the \( i \)-th financial institution. 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) [Banker et al., 1984; Coelli, 1996]. The CRS 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, the VRS model – by introducing a variable that represents the returns to scale – allows for the calculation of technical efficiency that is free from scale efficiency effects.

3.2. Productivity Change Measurement

Each sample, separated by year, represents a single frontier that is 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 is based on 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. The Malmquist productivity index ($M$) enables productivity growth to be classified into changes in efficiency (the catch-up effect) and changes in technology (innovation).

The Malmquist index ($M$) of total factor productivity (TFP) 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.

3.3. 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.

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3 For the decomposition of Malmquist productivity index, see Lovell [2003].

Volume 9, Number 3, September 2014
published by the Banking Supervision Department of the NBC [NBC, 2007, 2012]. Data limitations allow the authors to focus on only 18 out of nearly 30 Cambodian commercial banks, specialized banks, and MFIs for the period 2006–2011. The sample consisted of 18 financial institutions representing nearly 80% of the bank industry’s total assets.4

As in recent studies, the operating approach and value-added approach are commonly used to explore the differences in productivity among financial institutions [Grigorian and Manole, 2002; Katib and Mathews, 2000]. 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 current study. 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.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Value-Added Approach Items Used</th>
<th>Operating Approach Items Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>(y_1)</td>
<td>Deposits</td>
<td>Interest income</td>
</tr>
<tr>
<td>(y_2)</td>
<td>Loans</td>
<td>Non-interest income</td>
</tr>
<tr>
<td>(x_1)</td>
<td>Interest expenses</td>
<td>Interest expenses</td>
</tr>
<tr>
<td>(x_2)</td>
<td>Number of branches</td>
<td>Number of branches</td>
</tr>
<tr>
<td>(x_3)</td>
<td>Number of staff</td>
<td>Number of staff</td>
</tr>
</tbody>
</table>

4 See Appendix.
4. MAJOR FINDINGS

This section presents the empirical results of efficiency measurement using DEA, discusses the attributes of bank efficiency, and presents the results of measuring efficiency changes.

4.1. Empirical Results of Efficiency Measurement using DEA

Figure 1 and Figure 2 illustrate the DEA results for measuring the efficiency of major Cambodian banks for the period 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.

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**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 the situation in Central-Eastern European countries and South/Central American countries, the efficiency gap between banks in Asian countries is relatively small [Hasimoto, 2006]. 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](image)

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, Southeast Asian economies were expanding because of a favorable global economy. In contrast, in the latter part of the observation period, several incidents such as the sub-prime 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 about recession and financial instability in Southeast Asian countries. However,
the drop of the mean value in the operating approach in 2010 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. A bank is defined as large when it is ranked as one of the four largest bank in Cambodia, and a bank is defined as small 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. The sample was also classified based on ownership structure; i.e., as foreign or local banks. A bank is defined as a foreign bank when the ratio of foreign share exceeds 50%; otherwise, it is a local bank. Figure 3 and Figure 4 show the differences between the average efficiency scores of banks in these groups, according to the value-added approach and the operating approach, respectively.

![Figure 3. Bank Size and Ownership Structure (Value-Added Approach)](image-url)
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 use their resources better than foreign banks do 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.

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 use their resources better than small banks do in terms of financial intermediaries and bank profitability. Generally, the banking business features economies of scale as its own industrial
character. Interestingly, this suggestion, which is mentioned in previous studies, is consistent with the result obtained in the current study.

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 – with regard to 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, whereas 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.

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 use, such as concessional resources and financial aid, among others.
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Figure 5. The Average Score of Each Bank Sector (Value-Added Approach)

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

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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.

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

<table>
<thead>
<tr>
<th></th>
<th>Value-Added Approach</th>
<th>Operating Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Catch-up Effect</td>
<td>Frontier Shift</td>
</tr>
<tr>
<td>The number of banks improved (per total number of banks)</td>
<td>6 (42.9)</td>
<td>2 (14.3)</td>
</tr>
<tr>
<td>Mean of all banks</td>
<td>1.010</td>
<td>0.990</td>
</tr>
<tr>
<td>Foreign banks</td>
<td>1.005</td>
<td>0.990</td>
</tr>
<tr>
<td>Local banks</td>
<td>1.021</td>
<td>0.989</td>
</tr>
<tr>
<td>Large banks</td>
<td>1.007</td>
<td>0.987</td>
</tr>
<tr>
<td>Small banks</td>
<td>1.001</td>
<td>0.992</td>
</tr>
<tr>
<td>Commercial banks</td>
<td>1.017</td>
<td>0.988</td>
</tr>
<tr>
<td>Specialized banks</td>
<td>0.974</td>
<td>0.986</td>
</tr>
<tr>
<td>MFIs</td>
<td>0.990</td>
<td>1.004</td>
</tr>
</tbody>
</table>

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

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.

Finally, it was found that nearly all the features mentioned above focus on the distinct attributes of banks. When bank size and ownership structure are the focus, 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

The analytical information about performance of financial institutions is a serious obstacle for policy makers in monitoring the financial sector and designing an efficient financial system. This study is the first attempt to provide the basic information necessary to examine the technical efficiency and productivity change of 18 major domestic and foreign financial institutions in Cambodia. 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 during the period 2006-2011. The empirical results reveal the following:

1. Measured using both the operating approach and the value-added approach, the efficiency score of the Cambodian banking industry demonstrated a relatively high technical efficiency during the observed period, except for the year 2010. Similar to the situation in neighboring countries, the difference in efficiency between banks was small. Although the efficiency gap among individual banks increased in 2010 when macroeconomic circumstances deteriorated because of 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, the authors found that 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, the authors 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.

For individual financial institutions, these observations suggest managerial implications to improve their own operational efficiency. First, the enlargement
of the operational size is determinately important to improve the operational efficiency of individual institutions. Second, the introduction of advanced banking technology and skills is essentially needed to stem the decline of TFP and push it back.

For the policy maker, these observations also suggest the challenges to build more efficient Cambodian financial institutions. First, government should induce financial institutions to enlarge their size of business to improve their operational efficiency. A variety of policy measures such as promotion of mergers and acquisitions or a rise in minimum capital requirement is effective for this purpose. Second, government should help financial institutions adopt the advancement of banking technology and skills. Improvement of market environments surrounding financial institutions, such as regulatory compliance or efficiency of accounting systems, is prerequisite for this purpose.

This paper has limitations and presents issues requiring further study. First, its analysis is limited to 18 major financial institutions and includes the period from 2006 until the end of 2011. The number of financial institutions in Cambodia has been increasing since 2012, necessitating an expansion of the database. Second, this paper focuses on measuring the operational efficiency and TFP change of financial institutions, but does not directly examine the determinants of them. To specify the distinctive determinants of operational efficiency and TFP change over time, a study of econometric analysis is needed, based on theoretical hypothesis⁵. The authors intend to conduct empirical analyses of these issues in a future study.

APPENDIX

Data on the 18 major Cambodian banks included in this study are presented in the table on the following page.

⁵ Grigorian and Manole [2002] is a good example.
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Acleda</td>
<td>49%</td>
<td>51%</td>
<td>6,065,581</td>
<td>4,745,562</td>
<td>3,799,281</td>
<td>2,817,755</td>
<td>1,899,200</td>
<td>900,576</td>
<td>508,287</td>
<td>338,154</td>
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<td>2</td>
<td>Advanced Bank of Asia Limited</td>
<td>100%</td>
<td></td>
<td>817,998</td>
<td>616,791</td>
<td>234,538</td>
<td>176,421</td>
<td>163,154</td>
<td>111,765</td>
<td>87,015</td>
<td>93,739</td>
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<tr>
<td>3</td>
<td>Anret MFI</td>
<td>98%</td>
<td>2%</td>
<td>482,109</td>
<td>355,983</td>
<td>297,800</td>
<td>286,515</td>
<td>3,522</td>
<td>92,388</td>
<td>62,416</td>
<td>39,281</td>
</tr>
<tr>
<td>4</td>
<td>ANCO Specialized Bank</td>
<td>100%</td>
<td></td>
<td>38,350</td>
<td>34,851</td>
<td>15,411</td>
<td>10,810</td>
<td>10,688</td>
<td>11,038</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>ANZ Royal Bank (Cambodia) Limited</td>
<td>55%</td>
<td>45%</td>
<td>2,840,347</td>
<td>2,462,684</td>
<td>2,153,368</td>
<td>1,700,784</td>
<td>2,241,988</td>
<td>839,301</td>
<td>370,364</td>
<td>0</td>
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<tr>
<td>6</td>
<td>Cambodia Agriculture Industrial Specialized Bank</td>
<td>100%</td>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>12,788</td>
<td>15,684</td>
<td>12,897</td>
<td>12,505</td>
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<tr>
<td>7</td>
<td>Cambodia Asia Bank Ltd</td>
<td>100%</td>
<td></td>
<td>271,189</td>
<td>233,705</td>
<td>125,170</td>
<td>108,603</td>
<td>129,027</td>
<td>89,806</td>
<td>72,187</td>
<td>60,968</td>
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<tr>
<td>8</td>
<td>Cambodia Mekong Bank Public Ltd</td>
<td>100%</td>
<td></td>
<td>183,550</td>
<td>172,594</td>
<td>181,580</td>
<td>194,192</td>
<td>248,674</td>
<td>109,339</td>
<td>88,076</td>
<td>82,803</td>
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<tr>
<td>9</td>
<td>Cambodian Commercial Bank Limited</td>
<td>100%</td>
<td></td>
<td>474,833</td>
<td>426,485</td>
<td>612,358</td>
<td>628,779</td>
<td>651,741</td>
<td>519,549</td>
<td>460,263</td>
<td>479,072</td>
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<tr>
<td>10</td>
<td>Cambodian Public Bank Limited</td>
<td>100%</td>
<td></td>
<td>4,093,420</td>
<td>4,087,116</td>
<td>3,932,487</td>
<td>4,060,377</td>
<td>2,260,384</td>
<td>983,973</td>
<td>664,892</td>
<td>575,352</td>
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<tr>
<td>11</td>
<td>Canada Bank Plc</td>
<td>100%</td>
<td></td>
<td>5,279,836</td>
<td>4,351,832</td>
<td>3,130,658</td>
<td>2,411,010</td>
<td>2,242,342</td>
<td>1,522,579</td>
<td>1,225,674</td>
<td>1,012,965</td>
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<tr>
<td>12</td>
<td>Foreign Trade Bank of Cambodia</td>
<td>100%</td>
<td></td>
<td>1,654,958</td>
<td>1,355,498</td>
<td>1,152,163</td>
<td>1,078,204</td>
<td>882,057</td>
<td>896,493</td>
<td>673,701</td>
<td>663,361</td>
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<tr>
<td>13</td>
<td>Manulife Japan Bank Plc</td>
<td>85%</td>
<td>15%</td>
<td>501,262</td>
<td>504,609</td>
<td>179,853</td>
<td>167,314</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>14</td>
<td>Peng Heng SME Bank Ltd</td>
<td>100%</td>
<td></td>
<td>34,659</td>
<td>32,752</td>
<td>22,160</td>
<td>20,797</td>
<td>20,503</td>
<td>16,909</td>
<td>16,167</td>
<td>15,074</td>
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<tr>
<td>15</td>
<td>Prasak MFI</td>
<td>90%</td>
<td>10%</td>
<td>620,015</td>
<td>455,272</td>
<td>295,288</td>
<td>247,566</td>
<td>148,067</td>
<td>106,511</td>
<td>52,176</td>
<td>36,552</td>
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<tr>
<td>16</td>
<td>Singapore Banking Corporation Ltd</td>
<td>100%</td>
<td></td>
<td>256,538</td>
<td>225,497</td>
<td>195,742</td>
<td>191,141</td>
<td>195,825</td>
<td>159,818</td>
<td>127,163</td>
<td>117,037</td>
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<tr>
<td>17</td>
<td>Union Commercial Bank Plc</td>
<td>42.4%</td>
<td>57.6%</td>
<td>1,025,197</td>
<td>822,285</td>
<td>615,049</td>
<td>482,470</td>
<td>484,253</td>
<td>423,585</td>
<td>348,780</td>
<td>405,206</td>
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<tr>
<td>18</td>
<td>Vattana Bank</td>
<td>100%</td>
<td></td>
<td>763,629</td>
<td>828,492</td>
<td>790,555</td>
<td>775,627</td>
<td>525,085</td>
<td>287,390</td>
<td>220,643</td>
<td>160,014</td>
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</table>

KHR: Khmer Riel, Local currency of Cambodia
REFERENCES
Hashimoto, H 2006. Study on foreign bank entry into emerging markets against the background of globalization, Industrial Management Research, Nihon University Faculty of Economics Research Institute, No. 36: 151-166


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