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Are the Operations of Microfinance Institutions Different Across Countries? A Comparative Analysis of Cambodia and the Philippines Using DEA and PCA

Daiju Aiba* and Hidenobu Okuda†

Abstract

Of all the Southeast Asian countries, Cambodia and the Philippines have well-developed microfinance institutions (MFIs). However, the environments in which MFIs operate differ considerably between the two countries. Our study investigates the differences in management characteristics and efficiency of Cambodian and Philippine MFIs during the period of 2009-2015 using Data Envelopment Analysis (DEA) and Principal Component Analysis (PCA) and measures the key management characteristics and efficiency levels of local MFIs. Our study found that Cambodian MFIs tend to target sustainability (profitability) oriented management, and Philippine MFIs tend to target outreach (financial service to the poor) oriented management. Second, MFIs in the Philippines had a tendency to shift toward more outreach-orientated management over the period of our analysis. Third, while there are no clear differences in the capital-intensity of MFI operations between the two countries, over time capital-intensity improved in both. We further examined the relationship between country-specific factors, management characteristics and efficiency. We found that overall efficiency, outreach-orientation, and labor-intensive management were associated with the initial conditions of deposit-to-GDP ratio in the period of our analysis. This suggests that the development paths of MFIs are dependent on the development of traditional financial institutions in the early period of MFI development.

Keywords: Cambodia, the Philippines, MFIs, Operational Characteristics, Data Envelopment Analysis, Principle Component Analysis.

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1. Introduction

Among the Southeast Asian countries having a market-oriented economy and a multiparty system, microfinance institutions (hereinafter referred to as MFIs) in Cambodia and the Philippines are well-developed. According to the world ranking of MFIs by the Economic Intelligence Unit, those in the Philippines and Cambodia are highly appreciated and were ranked fourth and eighth in 2012,¹ respectively, for overall business environment and second and sixth, respectively, for supervision systems (Habaradas et al. 2013).

MFIs operate under regulations that emphasize management independence in both Cambodia and the Philippines, although the management environments are different between the two countries. According to Amenomori (2010), sustainability-oriented management is becoming more prioritized and the financial services for poor people less emphasized as MFIs grow in Cambodia. In addition, the financial system is underdeveloped in Cambodia as a whole, and MFIs tend to grow and transform into commercial banks. In Cambodia then, governments have encouraged a balance between the sustainability of MFIs and their outreach to the poor. On the other hand, the financial system is already developed to a certain extent in the Philippines, and in this environment MFIs are less likely to develop into commercial-oriented financial institutions. In fact, non-profit MFIs play a major role in the Philippines and the business objectives of the MFIs in that economy tend to focus on poverty reduction rather than profitability.

In this study, we quantitatively evaluate the differences in MFI operations in Cambodia and the Philippines. Previously, a comparative study between Cambodia and the Philippines was carried out by Yukawa (2009). Yukawa (2009) applied Gutierrez-Nieto et al. (2007) to compare the efficiency and characteristics of MFI management. Gutierrez-Nieto et al (2007) proposed a combination of the Data Envelopment Analysis (DEA) and Principal Component Analysis (PCA) methodologies to reduce biases from arbitrary choices of outputs and inputs in the estimation of

¹ Cambodia's rank has continued to fall after 2012. Cambodia was ranked at 30th in 2016 and at 43rd in 2018 (Economic Intelligence Unit 2016, 2018).

efficiency. We also use this method to compare MFIs between Cambodia and the Philippines in our investigation of the differences and similarities in both management characteristics and technical efficiency between the two countries.² We use data from MFI financial statements covering the period from 2009 to 2015, collected from the Microfinance Information Exchange (MIX). Our study not only re-examines Yukawa's (2009) results using new data, but also attempts to improve the method in terms of the following points: first, theoretically appropriate variables are used in selecting input factors and output; second, we assume variable returns to scale (VRS) at the production frontiers of the MFIs because this is supposed to be more realistic in describing MFI operations; and third, we extend the period of analysis from 2009 to 2015, to investigate changes in management characteristics over the years. Furthermore, we examine country-specific factors behind the differences in MFI management between Cambodia and the Philippines using regression analysis.

The results of our analysis differ from those obtained by Yukawa (2009), who concluded that MFI management was almost the same in the two countries. First, MFIs in Cambodia are more sustainability-oriented, while those in the Philippines are more strongly outreach-oriented. Second, MFIs in Cambodia use labor more intensively in their businesses (have higher personnel costs when compared to other MFIs with the same output level) while MFIs in the Philippines have higher “non-personnel expenses” in their businesses. Furthermore, our regression analysis reveals that the development of a traditional banking sector in the early period of MFI development allows MFIs to be more outreach-oriented, since there could be a large pool of potential customers for MFIs in a county where traditional banks are less developed.³ In addition, increases in the development level of the traditional banking sector are negatively correlated with

² Technical efficiency is a measurement of the efficiency of a firm's management and is defined as the distance from the firm's best production frontier to the firm's real input and output level (Farrell 1957). Technical efficiency is also called “operational efficiency” in the literature.

³ The traditional banking sector is defined as financial institutions, commercial banks, universal banks, and thrift banks, which in general pursue profit.

the overall efficiency of MFIs, and this is also positively correlated with labor-intensity in MFI operations.

This paper is organized as follows. In Section 2, we present an overview of MFIs in Cambodia and the Philippines. In Section 3, we review the relevant previous studies. In Section 4, we introduce the methodology to compare management characteristics and efficiency among MFIs using DEA and PCA. In Section 5, we present the results of the DEA and PCA analyses on the management characteristics of microfinance institutions. In section 6, we show the results of the regression analysis on principal components, and our summary and conclusions are presented in Section 7.

2. Microfinance institutions in Cambodia and the Philippines

2.1 MFIs in Cambodia

As of 2015, financial institutions engaged in the microfinance business in Cambodia are classified into commercial banks, specialized banks, licensed and registered microfinance institutions (MFIs), and registered credit operators. Under the regulations of the National Bank of Cambodia, financial institutions that have loan assets of more than one billion Riels have to acquire a microfinance license. However, even if their asset size is small, financial institutions are encouraged to register as credit operators. In Cambodia, not only MFIs but also some commercial banks and registered credit operators are engaged in the microfinance business, while MFIs have a main role in the provision of microfinance services to the poor. The licensed and registered MFIs are required to disclose and report data to the NBC, such as account balances, shareholder composition, reserve funds and liquidity ratio to NBC, on a regular basis (Amenomori 2010). However, there is no legal restriction for unregistered NGOs and credit operators and no specific

data are available.⁴

The MFI sector experienced rapid growth in the 2010s. Table 1 presents the number of financial institutions by legal status in Cambodia. It shows that the number of MFIs has increased while growth in the numbers of commercial and specialized banks has been slow. Table 2 shows the number of borrowers and amount of loans by sector. In terms of loan amounts, commercial banks are the largest contributors to financial development in Cambodia. However, MFIs have the largest number of borrowers, with an average loan amount per borrower between USD325-USD741 during 2013-2015, much lower than the average loan size from commercial banks (between USD10,204 and USD15,126). In this regard, MFIs significantly contribute to the promotion of financial inclusion in Cambodia.

To persuade each MFI to increase its operation across the country, regulations have been developed in the MFI sector.⁵ In 2008, the National Bank of Cambodia started to issue licenses for deposit-taking microfinance institutions allowed to receive deposits from the public. The emergence of these deposit-taking microfinance institutions has developed the microfinance market. The number of registered MFIs increased from 17 in 2007 to 61 in 2015 (NBC 2016). The assets of all the MFIs is about 3,656,480 USD, and 88.3% of the assets were shared by 7 deposit-taking microfinance institutions in 2015 (NBC 2016).

This recent development in the Cambodian microfinance sector was also assisted by large capital inflows. According to Rellie (2011), Cambodia is the fourth largest destination of international debt in the MFI sector, and one fourth of the international debt for Cambodian MFIs is from private lenders. Aiba and Loviey (2019) also investigated the recent trend of debt in Cambodian MFIs using data from the MIX Market. They show that the borrowings of large MFIs are in large part financed from abroad. Furthermore, FDI flows into MFIs have been also prominent. In 2015, there were FDI flows of 514.65 billion USD into the financial sector in

⁴ The activities of unregistered NGOs are now being limited to those that are for public interest in the social development area (Alip et al. 2010).

⁵ For more detail of the history of microfinance development, see Aiba and Roviey (2019).

Cambodia, which is about one third of total FDI flows (1,822.80 billion USD).⁶ And one third of all FDIs into the financial sector are for investment in MFIs in Cambodia.

Table 1: Number of Financial Institutions by Legal Status in Cambodia

Table 2: Loan Portfolio and Outreach of Cambodia's Banking System

2.2 MFIs in the Philippines

There are three main entities that carry out microfinance services in the Philippines (Microfinance Council of the Philippines 2010, 2016; Amenomori 2010). The first are the microfinance NGOs, which are those NGOs engaged in microfinance and aiming to reduce poverty. The microfinance NGOs are categorized into three forms: those that have converted to a *commercial bank* format to carry out financing, charity foundation NGOs, and overseas NGOs (Habaradas et al. 2013). All microfinance NGOs are required to register with the Securities and Exchange Commission (SEC) as nonstock, non-profit organizations (Microfinance Council of the Philippines 2010). The second is cooperative credit associations at the regional level, and these are registered with the Cooperative Development Authority (CDA). Following the 2008 revisions to the *Cooperative Development Act*, registered cooperatives began to carry out financing under the auspices of the CDA. The third group is the rural, thrift and cooperative banks, the types of banks that are engaged in retail microfinance operations. Those so-called microfinance banks are supervised by Bangko Sentral ng Pilipinas (BSP), the central bank of the Philippines. In particular, banks with microfinance loans making up at least 50% of their gross loan portfolio are classified as “Microfinance-Oriented Banks.” Meanwhile, those banks whose microfinance portfolio is less than 50% of their total loan portfolio are classified as “Banks Engaged in Microfinance”

⁶ This information is provided by the Council of Development for Cambodia.

Operations” (Microfinance Council of the Philippines 2010). In this paper, we define both types of banks as microfinance banks. Beginning in the 1990s, these banks started to carry out financing activities for customers in certain geographical regions. Lastly, there are small-scale financial institutions, such as pawnshops, which make micro loans.

All deposit taking institutions (banks, cooperatives) are subject to prudential regulation, and microfinance NGOs collecting savings greater than the compensating balance are subject to regulation and supervision. Banks with microfinance operations are to remain under the regulation and supervision of the BSP. Cooperatives are under the supervision and regulation of the CDA, and NGOs are encouraged to submit information to the Microfinance Council of the Philippines.⁷

Table 3 shows the number of financial institutions in the Philippines banking system. It is noted that Cooperatives engaged in savings and credit operations and microfinance NGOs are not included in the BSP data on the Philippines financial system.

Table 3: Number of Financial Institutions by Legal Status in the Philippines

Table 4 shows the number of borrowers and total loans of MFIs and traditional banks in the Philippines. The loans made by MFIs in Philippines are much smaller than those made by the traditional banking sector. The sum of loans of microfinance banks and NGOs were less than 1 percent of the universal, commercial, and thrift and cooperative banks in 2015. This is different from the MFIs in Cambodia, where total loans amount to about 20% of the total loans of commercial banks (Table 2).

Table 4: Loan Portfolio and Outreach of the Philippine Banking System

⁷ Retrieved from the Bangko Sentral ng Pilipinas website on 17 December 2019
http://www.bsp.gov.ph/about/advocacies_micro_facts.asp#1

The Philippines government maintains a policy of providing a sustainable microfinance market based on a free market economy, and governments do not directly engage in providing credit or guarantees to MFIs in general. The role of the government is to provide supervision and make policies so that the market functions efficiently. Unlike the Cambodian government, the Philippines government has no policies to promote conversion from NGOs to licensed MFIs and then to commercial banks; the policy in recent years has been to promote autonomous microfinance (Habaradas et al. 2013). The Central Bank regulates and supervises banks while the CDA regulates and supervises cooperatives. No government agency has jurisdiction over NGOs⁸ (Amenomori 2010; Habaradas et al. 2013).

2.3 The differences in microfinance business environments between Cambodia and the Philippines

First, we compare the economic growth and financial deepening in Cambodia and the Philippines. Figure 1 shows GDP growth in Cambodia and the Philippines. Both countries experienced high economic growth in the period of our study. Second, we discuss the financial deepening of the banking sector in Cambodia and the Philippines (Figure 2). Panel A of Figure 2 presents the level of financial deepening in terms of deposits as percentages of GDP, and Panel B presents this in terms of private credits as percentages of GDP. Both indicators show that financial deepening in Cambodia was less than the Philippines in 2009, but that Cambodia has been catching up to the Philippines over the years. Note that these indicators only capture the development of the banking sector, a stock market has also been developed in the Philippines. However, the trend of the indicators still suggest that Cambodia's banking sector has developed rapidly over the period of our study, while development of the banking sector has been slow in the Philippines.

⁸ Although microfinance NGOs are required to make appropriate disclosures and file audited financial statements and general information sheets on an annual basis to the SEC, they are not subject to prudential regulation and supervision.

Figure 1: GDP Growth in Cambodia and the Philippines

Figure 2: Financial Deepening in Cambodia and the Philippines

Next, we show the difference in financial inclusion between Cambodia and the Philippines. Table 5 outlines indicators of financial inclusion from the World Bank's Global Findex database. Here, we present the percentages of financial accounts, and the percentages of the banking population in Cambodia and the Philippines as of 2011, 2014, and 2017. In terms of the percentage of the population that hold financial accounts, Cambodia showed a lower level than the Philippines in 2011. However, Cambodia experienced significant increases in the percentage of its population that hold financial accounts and was catching up to the Philippines in 2014. In 2014 and 2017, financial access in Cambodia was also at the same level as the Philippines in terms of the percentage of the population who had borrowed money in past years. It is also noteworthy that financial access for females is as high as that of the general population in both the Philippines and Cambodia.

Table 5: Financial Inclusion in Cambodia and the Philippines

According to Gutierrez-Nieto et al. (2007), because legal systems and other conditions vary by country, comparisons of various countries' microfinance institutions show that technical efficiency or management characteristics differ. It has been pointed out that there are differences between Cambodia and the Philippines in terms of their MFI's technical efficiency and business content due to differences in government policies, legal systems, financial systems, and the like (Amenomori 2010).

Of the ASEAN nations, Cambodia has one of the least developed financial sectors. In an effort to nurture financial institutions, the Cambodian government has established a system that shifts NGOs and unregistered MFIs into the financial markets, putting in place a policy to create licensed and register MFIs. Some MFIs, such as the ACLEDA Bank, the largest commercial bank in Cambodia, started operations as NGO MFIs, and then transformed into commercial banks as they grew larger. According to Amenomori (2010), Cambodian MFIs have tended to move away from non-profits towards commercial enterprises overall. Moreover, the customer base of non-profits such as NGOs and non-registered microfinance institutions largely consists of the extremely poor and the disabled, while the customer base of commercial MFIs has shifted towards the less poor.

Compared to Cambodia, the Philippines has enjoyed a much more well-defined financial sector since 2000. The Philippines banking sector consists of commercial banks, universal banks, thrift banks, rural banks and cooperative banks with considerably higher levels of assets than their counterparts in Cambodia. Moreover, the securities market consists of both bond and stock markets and is much more advanced than Cambodia's. The development of finance-related laws has also progressed, and with the 1995 Savings Bank Act (National Act No. 7906) and the 1992 Rural Bank Act (National Act No. 7353), a mechanism to contribute to small- and medium-sized enterprises and rural areas was put in place. Given such a market environment, there are more microfinance institutions in the Philippines than there are in Cambodia and, in regard to the functions of these MFIs, it has been clarified that emphasis is to be placed on providing the poor with access to finance (Amenomori 2010).

2.4 Management Indices of MFIs in Cambodia and the Philippines

Table 6 shows the major management indicators for the MFIs in Cambodia and the Philippines that we analyzed. First, as a feature common to both countries, there is a large degree of variation

amongst individual institutions. In Cambodia, the total asset base of the biggest MFI is USD701,292 thousands while those of the smallest is USD5,159 thousands. In the Philippines, the biggest MFI has assets of USD151,374 thousands while the smallest has USD 488 thousands.

Table 6. Management Indices of MFIs in Cambodia and the Philippines

There is a big difference in the management characteristics of MFIs between Cambodia and the Philippines. First, in terms of total asset size, Cambodia's MFIs are larger than Philippine MFIs on average. Second, the average asset size per staff is USD127 thousand for the MFIs in Cambodia while it is USD65 thousands for the MFIs in the Philippines. Third, average wages are almost at the same level in Cambodia and the Philippines. The average wage is USD 4.8 thousand for MFIs in the Philippines and USD 5.3 thousand for MFIs in Cambodia. However, there is a large variation in wages, and wages tend to be low for small MFIs in the Philippines. Fourth, non-personnel expenses per staff⁹ are USD 4.5 thousands for MFIs in Cambodia and USD 4.0 thousands for the Philippines. However, there is a large difference within MFIs in the Philippines as the largest has expenses per staff of USD10.2 thousands and the smallest USD1.9 thousands.

Summarizing the above points, there are remarkably large disparities in the size of the upper and lower ranks of MFIs for each country. Overall, however, it is clear that among the 4 largest MFIs, MFIs in Cambodia tend to be larger than those in the Philippines, although no such differences are clear when looking at average wages.

The management characteristics of both countries differ particularly in regard to personnel expenses. MFIs in the Philippines tend to show higher non-personnel expenses per staff member than personnel expenses as non-personnel expenses per staff exceeded wages in 7 MFIs in the Philippines, while non-personnel expenses per staff exceeded wages in only 3 MFIs in

⁹ Non-personnel expenses are calculated as total operating expenses minus personnel expenses.

Cambodia. This may suggest that Philippine MFIs manage to save personnel expenses more than Cambodian MFIs and invest intensively in non-personnel expenses.

3. Previous Research

3.1 The Technical Efficiency of MFIs

Numerous studies have investigated the relationships between the technical efficiency and management characteristics of MFIs¹⁰. In this literature, two approaches to measuring the technical efficiency of MFIs are often applied; parametric approaches and non-parametric approaches. The most popular method of the former is the Stochastic Frontier Approach (SFA), and this method uses parametric assumptions in its error terms for estimation. The main advantage of SFA is to separate the error terms into random shocks (Fall et al. 2018).¹¹ Applying SFA to cross-country observations, Hermes et al. (2011) found a trade-off between outreach and the sustainability of MFIs. However, the disadvantage of SFA is the need to assume a specific production function for production or cost functions. Misspecification of these production or cost functions could cause bias in the measurement of inefficiency.

A representative example of the non-parametric approach is Data Envelopment Analysis (DEA). DEA has some advantages over SFA. First, it does not require a specific function in the functional form of the frontier. Second, it is flexible and well-suited for multi-product industries (Fall et al. 2018). Since MFIs have multiple objectives in their operations, DEA could be suitable for the analysis of the efficiency of MFIs. However, there are also disadvantages in DEA. Estimation of efficiency by DEA is sensitive to measurement errors and outliers in the data. In addition, DEA is essentially a base estimator in finite samples, in the sense that firms' operations

¹⁰ Fall et al. (2018) present a comprehensive survey of this literature.

¹¹ According to Fall et al (2018), this is why SFA gives lower management efficiency than DEA.

cannot be 100% efficient but it estimates 100% efficiency for best-practice firms in the data (Simar and Wilson 2007).

Apart from the selection of estimation approaches, there are also challenges in estimating technical efficiency for MFIs. One of the largest challenges is the selection of output and input variables. As mentioned above, there are a wide range of types of microfinance institutions. Some MFIs focus on expanding the provision of financial services to the poor (outreach), while others focus on sustainability (profit). Thus, we need to consider that objective function of MFIs could vary across MFIs. If we only measure technical efficiency among the different types of MFIs, interpretation of the difference in measured efficiency could be difficult.

In this regard, Gutierrez-Nieto et al. (2007) adopted a DEA-based method to capture diverse management characteristics as comprehensively as possible. The method, which was originally proposed by Serrano-Cinca and Molinero (2004), estimates the efficiency of a firm's operations under the situations in which each firm could have different input and output variables in their operation. This method includes DEA in the first stage and Principal Component Analysis (PCA) in the second stage. Following this method, rather than making specific choices of input and outputs from a particular viewpoint, Gutierrez-Nieto et al. (2007) selected inputs and outputs that are related to the outreach and sustainability of MFIs and measured the efficiency of each MFI for all the different possible specifications of inputs and outputs using DEA in the first stage. Then, in the second stage, PCA was carried out on the measured efficiency scores to extract a small number of interpretable variables, such as a variable for overall efficiency and a variable representing the extent of outreach and sustainability. Gutierrez-Nieto et al. (2007) used this method for the analysis of MFIs in Latin-American countries, and discussed differences in the technical efficiency of microfinance institutions in relation to the directionality of outreach and sustainability.

3.2 Management characteristics and efficiency of MFIs in the Philippines and Cambodia

The management characteristics and efficiency of MFIs in Cambodia and the Philippines have been investigated by single-country-case studies and international comparative studies. Okuda et al. (2016) measured the technical efficiency and technological progress rate of major financial institutions in Cambodia using DEA; studying the characteristics of MFIs as compared to commercial and specialized banks from the viewpoint of sustainability management. Similarly, Crawford et al. (2014) also used DEA, revealing that for MFIs in Cambodia, institutions that focus on poverty reduction tend to have lower profitability. In addition, Okuda et al. (2016) also analyzed the management characteristics of MFI using the Gutierrez-Nieto et al. (2007) method. For the Philippines, Desrocheset et al. (2003) *estimated the cost function with a parametric approach, measuring the efficiency of each MFI.* Finally, Alinsunurin (2015) used the Gutierrez-Nieto et al. (2007) method to investigate MFI management characteristics in the Philippines.

As an international comparative study of MFIs in Southeast Asia, Tahir et al. (2013) compared the technical efficiency of microfinance institutions in five ASEAN countries including Cambodia using DEA while considering both management sustainability and the provision of services to the poor. Using data from Cambodia and the Philippines obtained from MIX in 2008, Yukawa (2009) examined the management characteristics and efficiency of MFI in both countries and found no clear difference in MFI operations between them. Hermes et al. (2018) found that the efficiency of MFIs decreases as financial development rises; their study used cross-country panel data of MFIs from the MIX Market database.

Regarding the selection of MFI products and inputs, most previous studies, including Okuda et al. (2016), Crawford et al. (2014), and Tahir et al. (2013), have established their use of a combination of *a priori* and *measured* technical efficiency. However, with this method, the selection of combinations is arbitrary and, moreover, it has the drawback that it can only partially capture the management characteristics of MFIs with diverse management systems.

Following Yukawa (2008), our study uses the methodology outlined in Gutierrez-Nieto et al. (2007) to investigate the management characteristics and efficiency of MFIs in Cambodia and the Philippines during the period from 2009 to 2015. Our study differs from Gutierrez-Nieto et al. (2007) and Yukawa (2008) as follows: first, in our study, we attempted to improve the measurement of MFI inputs. With Gutierrez-Nieto et al. (2007) and Yukawa (2008), two inputs were established. One of these was the number of employees and the other was operating expenses, including personnel expenses. This is inappropriate in the sense that labor and other factors are measured in an overlapping manner using these inputs. Moreover, there is also a problem that differences in labor quality are ignored since labor is measured in terms of number of employees, and this makes the interpretation of measurement results ambiguous. In our study, the inputs are personnel expenses and non-personnel expenses. By using personnel expenses as the input variable, the differences in the quality of labor shown by differences in wages can be controlled, in addition to avoiding the overlapping of inputs.

Second, in our study we generalize the assumptions in DEA to measure the efficiency of MFIs. Gutierrez-Nieto et al. (2007) and Yukawa (2009) assumed that the production function of MFIs showed constant return to scale (CRS). This assumption might be justified when MFIs adjust input and output to optimal levels in the long run. However, in reality, the inputs and outputs of each MFI are not sufficiently adjusted due to time constraints. Therefore, we instead use a more general assumption of variable returns to scale (VRS) in the production function to create a more realistic situation. Third, while Yukawa (2009) used data from MIX relating to 2008, we made our period of analysis from 2009 to 2015. The MFIs of both countries continued to grow during this period, while Cambodia's have grown especially rapidly. Our study also captures the dynamics of MFI development in each country.

Lastly, we further investigated the country-specific factors behind the differences in management characteristics between the Philippines and Cambodia. We develop the hypothesis that the initial conditions of financial development in the traditional banking sector determines the

development paths of MFIs, and we statistically examine the relationship between the initial condition of the traditional banking sector and the principal components of overall efficiency, outreach-orientation, and labor-intensity. Using cross-country samples from MIX, Vanroose and D'Espallier (2013) found that low financial development in the traditional banking sector is associated with a larger number of borrowers and higher profitability in MFIs. Hermes (2018) also used SFA to examine the relationship between traditional banking sector development and the efficiency of MFIs and found that MFIs are more efficient in a country with a less developed traditional banking system. Our study complements their findings by using the DEA and PCA technique to comprehensively investigate the efficiency and management characteristics of MFIs and their relationship with the development of the traditional banking sector. In contrast to Vanroose and D'Espallier (2013) and Hermes (2018), our study documents the proposition that the earlier conditions of the financial development of the traditional banking sector are correlated with the outreach-orientation of MFIs rather than the current level of financial development.

4. Analytical Method

The two-step methodology applied by Gutiérrez-Nieto et al. (2007), measuring the efficiency of all possible combinations of input and output choices in the first step (Step 1) and then distinguishing financial institutions with similar characteristics in the second step (Step 2), allows for systematic and comprehensive data analysis. Following Gutiérrez-Nieto et al. (2007), we conduct a two-step analysis using DEA and PCA. As previously mentioned, the estimated values of technical efficiency could differ depending on the selection of inputs and outputs. Therefore, in Step 1 of the analysis, we measure the technical efficiency of MFIs with respect to all the possible combinations of inputs and outputs. By doing so, we reduce biases from arbitrary choices of outputs and inputs. Next, in Step 2 of the analysis, PCA is conducted on the estimated efficiency scores of all the different combinations of outputs and inputs to extract the underlying technical

efficiency in those estimated efficiency scores. In this step PCA extracts a component representing overall efficiency that affects all of the estimated efficiency scores in different specifications, and a component representing management characteristics such as outreach-/sustainability-orientations and the labor-intensity of MFI management.

4.1 Estimating technical efficiency using DEA

The technical efficiency of MFIs is estimated by DEA in Step 1. The DEA is based on two different assumptions: that the production frontier exhibits either a constant return to scale (CRS) or a variable return to scale (VRS). In this study, a VRS is assumed in the production frontier as discussed above. The linear programming for DEA with a VRS-type production frontier is given by equation (1):

$$\begin{aligned}
 & \min_{\lambda, \theta} \theta_i \\
 \text{s.t.} \quad & -\mathbf{y}_i + \mathbf{Y}\boldsymbol{\lambda} \geq 0 \\
 & \theta_i \mathbf{x}_i - \mathbf{X}\boldsymbol{\lambda} \geq 0 \\
 & \sum_l^N \lambda_l = 1 \\
 & \boldsymbol{\lambda} \geq 0
 \end{aligned} \tag{1}$$

Where: θ_i is a scalar variable representing the technical efficiency of a given MFI i ($\theta_i \leq 1$), and MFIs on the production frontier when $\theta_i = 1$. \mathbf{X} is a $M \times N$ vector of input factors; \mathbf{Y} is a $K \times N$ vector of output factors; y_i and x_i represent bank i 's $K \times 1$ output vector and $M \times 1$ input vector, respectively; and $\boldsymbol{\lambda}$ represents the constant term vector of $N \times 1$. The bank i 's technical efficiency θ_i can be obtained by solving the minimization problem (1) with respect to all banks, thus θ_i is a measure of the operational efficiency of the microfinance institution. The value of θ_i declines as the distance from bank i 's output and input to production frontier increases.

Theoretically, as DEA does not assume a functional form backed by economic theory, there is need for careful variable selection to avoid a meaningless measurement result.¹² In addition, in contrast to ordinary financial institutions, microfinance institutions have an essential role to provide financial services to the poor, therefore considering this point is necessary when specifying input and output factors.

4.2 Examination of management characteristics using PCA

In Step 2, a PCA is conducted to extract the common factors in technical efficiency scores of the MFIs measured with different output and input specifications in Step 1. PCA is more like a data reduction technique in which a researcher reduces a large number of variables to a smaller, more manageable number of factors.¹³ Estimated technical efficiencies for N MFIs by J specifications (all of the possible combinations of inputs and outputs) in Step 1 are decomposed to a smaller number of interpretable variables by PCA. This assessment clarifies what combinations of inputs and outputs explains the efficiency gap among MFIs.¹⁴

We define estimated technical efficiencies for N MFIs by the j th specification as $N \times 1$ vectors. The first principal component \mathbf{Z}_1 is a $N \times 1$ vector obtained by choosing the coefficients $a_{11}, a_{12}, \dots, a_{1J}$ such that the unbiased variance $S(\mathbf{Z}_1)$, with respect to the variable \mathbf{Z}_1 defined in equation (2) is maximized for the efficiency scores ($\boldsymbol{\theta}_1, \boldsymbol{\theta}_2, \dots, \boldsymbol{\theta}_J$) calculated for each MFI in Step 1. These coefficients are also called factor loadings of principal components. The size of vector ($a_{11}, a_{12}, \dots, a_{1J}$) is assumed to be unity:

$$\mathbf{Z}_1 = a_{11}\boldsymbol{\theta}_1 + a_{12}\boldsymbol{\theta}_2 + \dots + a_{1J}\boldsymbol{\theta}_J \quad (2)$$

¹² There have been three representative approaches used in past studies involving DEA with respect to production factor and output selection: the value-added, operating, and intermediation approaches (Grigorian and Mahole 2002).

¹³ Jolliffe (2002) provides comprehensive guidance on the detail of PCA.

¹⁴ PCA is a method used to condense multidimensional data to low-dimensional space with minimal loss. By condensing multidimensional data to 2- or 3-dimensional data, the information contained in the data can be visualized.

In the same procedure, the second principal component, a $N \times 1$ vector \mathbf{Z}_2 , is also obtained by choosing the coefficients $a_{21}, a_{22}, \dots, a_{2J}$, such that the unbiased variance $S(\mathbf{Z}_2)$, with respect to the variable \mathbf{Z}_2 defined in equation (3), is maximized for the efficiency scores ($\boldsymbol{\theta}_1, \boldsymbol{\theta}_2, \dots, \boldsymbol{\theta}_J$) in Step 1. The size of vector $(a_{21}, a_{22}, \dots, a_{2J})$ is assumed to be unity and uncorrelated with a vector of factor loadings of the first principal component $(a_{11}, a_{12}, \dots, a_{1J})$:¹⁵

$$\mathbf{Z}_2 = a_{21}\boldsymbol{\theta}_1 + a_{22}\boldsymbol{\theta}_2 + \dots + a_{2J}\boldsymbol{\theta}_J \quad (3)$$

The third principal component \mathbf{Z}_3 was obtained by the same process as for the first and the second principal components.¹⁶

4.3 Selection of input and output factors and the dataset

According to Yaron (1994), the evaluation of MFIs needs two frameworks; one is an outreach framework for evaluating financial access for the poor, and the other is a sustainability framework for evaluating an institution's financial stability and profitability. Unlike for-profit financial institutions, such as the commercial banks, MFIs also play the role of expanding access of financial services for the poor. MFIs also strive to maintain the sustainability of operations, and the expansion of their scale, by earning income appropriately and utilizing financial and physical resources for their own operations, in contrast to pure aid organizations and philanthropic groups. In fact, profit-seeking behavior can be a means to increase outreach activities at the same time, and this is not necessarily purposeful.

¹⁵ The lack of correlation between principal component 1 and principal component 2 results in a vertical coefficient vector, and an inner product of the coefficient vector of zero.

¹⁶ According to Jolliffe (2002), the variance in the estimation of factor loadings $(a_{k1}, a_{k2}, \dots, a_{kj})$ of k th principal components depends on sample size and the values of eigenvalues of the k th principal component. The estimator of principal components of higher eigenvalues has lower variance than the PCs of lower eigenvalues. Thus, the PCs of the three largest eigenvalues could be more reliable and the results are more stable than the other PCs.

As described in Table 7, three outputs and two inputs are defined in our study. Output 1 and Output 2 are the variables representing the degree of outreach conducted by microfinance institutions. Output 3 is the variable representing the degree of sustainability practiced by microfinance institutions. Interest income, the most important source of income of MFIs, is used to capture the profit-seeking operations of MFIs. Input A is the amount of labor input, and personnel expenses are used as a proxy variable. Input B is the input factor for other inputs, and for the proxy variable we used non-personnel expenses, which is defined as total operating expenses minus personnel expenses. As mentioned above, in contrast to Gutierrez-Nieto et al. (2007), we would rather use personnel expenses than number of staff to capture the quality of the labor force. The data used in this study were extracted from the MIX Market dataset. Sample sizes in Cambodia and Philippines for each year are shown in Table 8.

Table 7: Input and output of MFIs

Table 8: Number of MFIs sampled in the MIX Market Database

5. Empirical results of DEA and PCA

5.1 Efficiency Scores and PCA Analysis in Cambodia and the Philippines

In Step 1, we conducted DEA from 2009 to 2015 with the assumption of VRS using our MFI sample.¹⁷ The sample size for this analysis was 340. Since the production function could change due to technological changes across the years, we divided the MFI sample by years and conducted DEA separately on each yearly MFI sample. There are 21 different specifications of outputs and inputs since we used 2 inputs and 3 outputs for DEA.¹⁸

¹⁷ We excluded ACLEDA Bank, which is the largest commercial bank, from DEA since it is extremely large compared to the other MFIs in our sample.

¹⁸ In the estimations made with DEA, we did not adjust the dollars for PPP. However, the estimation of efficiency scores is done for each year, and inflation rates were stable over the period. We considered that the inflation rate does not crucially affect the fundamentals of our analysis.

In Step 2, we conducted PCA to extract the overall efficiency and management characteristic measurements for MFIs in Cambodia and the Philippines. We conducted PCA on 21 DEA measures of efficiency in Step 1 with a set of pooled samples from 2009 to 2015.¹⁹ Table 9 illustrates the factor loadings resulting from the PCA.²⁰

Table 9: Results of PCA for the MFIs from 2009 to 2015

The first three principal components explain 87.7% of the 21 technical efficiencies in Step 1. The eigenvalue of the first principal component (PC1) was 11.670. That of the second principal component (PC2) was 3.667, and that of the third principal component (PC3) was 3.080. The percentages of total variations of PC1, PC2, and PC3 were 55.6%, 17.4%, and 14.7%, respectively. In PC1, each combination of input and output has high positive coefficients on all factor loadings. Thus, all of the technical efficiencies of different combinations of input and output greatly contributed to PC1, and PC1 reflected the MFIs overall efficiency in management. This means that if PC1 is higher, MFIs achieve a high efficiency in both sustainability and outreach.

In PC2, the factor loadings are positive and large in the technical efficiencies that are measured with output 1 (number of borrowers). This is supposed to represent the outreach-orientation of MFIs. Thus, PC2 represents the outreach-orientation of MFI operation, meaning that if PC2 is higher, MFIs are more outreach-oriented. In PC3, a negative relationship was observed for all combinations of personnel expenses (Input A) as an input, while a positive relationship was observed in all combinations including operating expenses (Input B). Therefore,

¹⁹ The sample size in the PCA is 340 and this is small. However, the sample size of MFIs is typically low, and the same method as in our study is often used with small samples (e.g., Gutierrez-Nieto et al. 2007, and Yukawa 2009). Even though the sample size is relatively small, the results of our analysis still show a similar trend in the estimated factor loadings of PCs to Gutierrez-Nieto et al. (2007) and Yukawa (2009).

²⁰ The results of the principal component analysis are based on the results obtained through data envelopment analysis on the assumption of variable harvests. Data envelopment analysis produced similar results to the assumption of fixed harvests used by Yukawa (2009).

PC3 could be interpreted as measure of the efficient use of capital or labor. If MFIs show higher PC3, their operations are more efficient in the use of capital and less efficient in the use of labor, meaning that the operations of the MFIs are more labor-intensive.

5.2 Discussion on the results of PCA

Figure 3 is a scatter diagram that plots the scores of PC1 and PC2 for each MFI observed in 2009 and 2015. In the nature of PCA, Point (0.0) is the average of scores of the whole MFI sample, and the scores on its left and right (or top and bottom) show whether they are above or below average, respectively. The horizontal axis shows the scores of the PC1 for each MFI, indicating the extent of the overall efficiency of sustainability and outreach. The vertical axis shows the scores in terms of PC2 for each MFI, indicating its tendency to pursue outreach. If PC2 scores are high, the MFI's tendency to pursue outreach is high.

Figure 3: Scatter diagram of PC1 and PC2 (VRS)

As Figure 3 shows, Cambodian MFIs were located in fewer areas than Philippine MFIs on average in 2015, suggesting that MFIs in Philippines are more outreach-oriented than MFIs in Cambodia. In terms of PC1, Cambodian MFIs are mostly located on the right-hand side of the diagram, compared to MFIs in the Philippines. The results suggest that MFIs in Cambodia are operating more efficiently than those in the Philippines.

If we compare the results from the period between 2009 and 2015, we find that the plots of MFIs in Philippines are more often located in the upper areas of the figure in 2015 than in 2009, suggesting that MFIs in Philippines became more outreach-oriented over this period. A similar trend can be also found for MFIs in Cambodia, but the changes for MFIs in Cambodia were not as large as those in the Philippines.

Figure 4 is a scatter diagram that plots PC1 and PC3. As mentioned, Point (0.0) is the average of all MFIs, and the scores on the left and right (or top and bottom) show whether they are above or below average, respectively. The horizontal axis shows scores generated by the PC1 for each MFI, representing the overall efficiency of sustainability and outreach. The vertical axis shows the scores on PC3 for each MFI, representing the management strategy that MFIs use non-personnel expenses efficiently and instead use personnel expenses intensively if PC3 is high.

Figure 4: Scatter diagram of PC1 and PC3 (VRS)

As Figure 4 shows, there seems to be a difference between MFIs in Cambodia and the Philippines in terms of PC3. It seems that Cambodian MFIs tend to be located in the upper quadrant more often than the Philippines MFIs. In the meantime, there is also a common trend between the two countries. MFIs in both countries moved from the upper areas of the figure in 2009 to lower areas in 2015. This suggests that MFI management characteristics changed from capital-efficient and labor-intensive ones to more capital-intensive and labor-efficient operations in both Cambodia and the Philippines.

Figure 5 is a scatter diagram that plots the MFI scores of PC2 and PC3. The horizontal axis shows the scores of PC2 for each MFI. The vertical axis shows the scores of PC3 for each MFI. Again, MFIs in both countries show a similar time trend in that MFIs moved from upper to lower areas of the figure between 2009 and 2015, and MFIs moved to the right-hand side on the whole from 2009 to 2015.

Figure 5: Scatter diagram of PC2 and PC3 (VRS)

Table 10 shows the average of PCA scores in Cambodia and Philippines across these years. Trends in yearly changes in each PCA are consistent with the observed findings above. In

the Philippines, PC2 (outreach-orientation) has increased significantly, while Cambodia showed slight increases from 2009 to 2015. The yearly trends in PC3 are also consistent with the observations above. PC3 has decreased in both countries, suggesting that MFI operations have become more capital-intensive and more efficient in their use of their labor forces over the years.

Since many rural and cooperative banks in the Philippines dropped from our MFI sample in 2012-2015, there is a concern that the trend in MFI operations in the Philippines may be caused by a decline in the sustainability-oriented MFI sample. To confirm whether this bias caused the observed difference between Cambodia and the Philippines, we calculated the average of the PCA scores only with NGOs in the Philippines. We found that the trends in the average PCA scores did not change, thus the findings in this section are not specific to a certain type of MFI.

Table 10: Average of Principal Component Scores by Countries

6. Determinants of Operational Characteristics

6.1 The Conditional Determinants of PCA Scores

What differences in the operational environment between the Philippines and Cambodia can explain these differences in MFI management characteristics? In the literature on the analysis of the efficiency of financial institutions, previous studies have regressed estimated efficiency scores on country-specific variables, such as macroeconomic and regulatory differences, or financial institution-specific variables such as asset sizes and liquidity conditions (Havrylchyk 2006; Okuda and Aiba 2016). Following these studies, we examine the relationship between the country-specific factors in business environments and the management characteristics of MFIs by regressing the PCA scores of individual MFIs. Specifically, we estimate the following equation:

$$\begin{aligned}
PCA \ Score_{i,j,t} = & \alpha + \beta_2 Financial \ Development_{j,t} \\
& + \beta_3 Financial \ Development_{j,2009} \cdot Time \ Trend_t \\
& + \beta_4 GDP \ Growth_{j,t} + \beta_5 Time \ Trend_t + v_i + u_{i,j,t}
\end{aligned} \tag{4}$$

Where: $PCA \ Score_{i,j,t}$ is the score of PCA on DEA score for MFI i in country j in year t , which was obtained in the previous section.

We ran the regression for PC1, PC2, and PC3, respectively. For the explanatory variables, we included the following indicators that are considered as potential determinants of outreach-orientation: (1) the degree of financial development of the traditional banking sector ($Financial \ Development_{j,t}$); (2) the growth rate of GDP ($GDP \ Growth_{j,t}$), which represents the potential demand for borrowings; and (3) the Interaction terms of financial development in 2009 and time trend ($Financial \ Development_{j,2009} \cdot Time \ Trend_t$), which captures the path-dependence of MFI development particularly caused by the initial conditions of financial development in these countries.

First, we examine the relationship between financial development and MFI operations. In the Philippines and Cambodia, regulatory frameworks for MFIs have been created in recent decades. Before the emergence of formal financial institutions such as MFIs, traditional commercial banks and NGOs were already providing financial services in those countries. Thus, the development of MFIs could be dependent on the initial conditions of the financial development of traditional banking sectors. If the development of other financial institutions is low, there will be a large number of potential borrowers left for MFIs to service. In general, MFIs extend loans to risky and costly customer segments, and commercial banks extend loans to less risky and costly borrowers. However, if a country has a less-developed financial sector, less risky and costly customers also remain unbanked by existing financial institutions. In such environments, MFIs can also expand their customer base to these borrowers. Therefore, the level

of financial development should be negatively correlated to the outreach-oriented operations of MFIs. We use ratio of bank deposits to GDP as our proxy for financial development. These data were collected from International Financial Statistics.

Furthermore, apart from the level of current financial development, we also expect that the earlier conditions of financial development matter in the development of MFI operations. To capture the path-dependence of the earlier conditions of financial development, we included the interaction terms of time trend and level of financial development as of 2009. GDP growth represents the potential demand of loans for MFIs. It is expected that the higher the growth rate, the more that clients would find opportunities to invest such as starting businesses, business expansion, or educational investment, leading to higher demand for MFI loans. Economic growth is proven to play a role in the performance studies of banks and MFIs (Ahlin 2011; Vanroose and D'Espallier 2013; D'Espallier 2017) This variable is expected to be positively related to outreach oriented performance. These data were also collected from International Financial Statistics.

6.2 Estimation results of determinants of PCA scores

Table 11 shows the results of the regression of PCA scores on the environmental variables. We used fixed-effect estimation for each model presented in the table.

Table 11: Estimation of Determinants of PCA Scores

First, we found that the interaction terms of time trend and earlier conditions of financial development were associated with PC1, PC2, and PC3 at less than 1 percent statistical significance in any specifications. PC1 (overall efficiency) is lower if the earlier condition of financial development is higher. In addition, levels of current financial development are also negatively associated with the overall efficiency of MFIs. This result is in line with the previous

finding by Hermes (2018), which used SFA to estimate the efficiency of MFIs. Using DEA estimations with weaker assumptions of inputs and outputs of MFI operations, the results of our analysis also showed that financial development affects the efficiency MFIs in Cambodia and the Philippines.

Interestingly, regarding PC2 (outreach-orientation), the level of current financial development is not statistically correlated to PC2, but the interaction term of time trend and level of financial development in the earlier period is significantly correlated to PC2. These results suggest that the earlier conditions of development in the traditional banking sector affects and explains the difference in the development of MFI operations between Cambodia and the Philippines. This result is different from the findings of Vanroose and D'Espallier (2013) and Hermes (2018), which examined the association of outreach with current levels of financial development. Our results suggest that the development of the traditional banking sector does not necessarily weaken the outreach-orientation of MFI management in line with the results of Hartarska and Mersland (2012) and Hartarska and Nadolnyak (2011). Our results further suggest that if the earlier condition of financial development is low, MFIs will grow into sustainability-oriented ones even though the traditional banking sector expands.

Furthermore, PC3 (Labor-intensity) is higher if the earlier conditions of financial development are higher. Levels of current financial development are also estimated as positively correlated with PC3. This suggests that the labor-intensity of MFI operations depends on both past and current level of financial development. Lastly, we found that the coefficient of GDP growth was significantly negative in PC1 and positive in PC3. This indicates that GDP growth is associated with the inefficiency of MFIs, and this drives MFIs to rely more on labor inputs. As the economy grows, presumably there is a higher demand for credit. Such increases in demand might force MFIs to screen more applicants, resulting in a need for more labor.

7. Conclusion

In this paper, we conducted DEA on a sample of MFIs with various definitions of inputs and outputs and extracted a few important management characteristics of MFIs using PCA on the efficiency scores measured by DEA, following the method of Gutierrez-Nieto et al. (2007). Based on the MIX Market database, we analyzed these MFIs from 2009 to 2015 in Cambodia and the Philippines, which have different economic systems and thus different environments for MFIs. To quantify the impact of the country-specific differences in business environments on the operational characteristics of MFIs, this study also investigated the factors behind the differences in MFI management by regressing PCA scores on the country-specific variables.

The results of our analyses are different from those of previous studies. Yukawa (2009) found no difference between MFIs in Cambodia and Philippines in terms of overall efficiencies and management characteristics. In contrast to that study we found the following differences between MFIs in Cambodia and the Philippines. First, while MFIs in Cambodia have a strong tendency to pursue sustainability, those in the Philippines have a strong tendency to pursue outreach. Second, MFIs in the Philippines have a tendency to use non-personnel expenses more efficiently than personnel expenses (capital-intensive operations), but those in Cambodia have a tendency to select a management strategy that inputs personnel expenses more efficiently than non-personnel expenses (labor-intensive operations). However, MFI managements in both countries tend to shift toward the capital-intensive model over time.

Regression analysis revealed that: (i) the high development of the traditional banking sector in the early period of MFI development pushes MFIs to more outreach-oriented operations. This is possibly because there could be large potential customers for MFIs if the other financial institutions are less developed; (ii) Development of financial institutions also lowers the overall efficiency of MFIs, and is also positively associated to labor-intensity in MFI operations; and (iii) Comparing the PCA scores revealed that there is a difference in MFI operations between

Cambodia and the Philippines, possibly because of regulatory or cultural differences or differences in government policy relating to the MFI sectors.

This paper documented similar observations to previous studies. Amenomori (2010) found that the governing body of MFIs tends to shift from the government to the private sector, both in Cambodia and the Philippines, and that the shift from “nonprofit” to “profit” is clear in Cambodia, despite the fact that nonprofit organizations still play a big role in the Philippines. The results of this paper clarified that Cambodian MFIs have a strong tendency to pursue sustainability while Philippine MFIs have a strong tendency to pursue outreach. This observation is in line with Amenomori’s conclusion that there is no difference between the two countries in terms of “nonprofit” to “profit.”

Our results shed light on policies for the microfinance sector. Our analysis revealed that MFIs could grow to become more sustainability-oriented and more efficient if the traditional banking sector is less developed at an early stage of microfinance development. This suggests that MFIs tend to cover the clients who could be normally covered by traditional banking sector in such situations. In fact, several MFIs have transformed into commercial banks recently in Cambodia to pursue new clients. For example, Sathapana merged with a commercial bank in 2016, as did Kredit as recently as 2020. Furthermore, there were acquisitions of large MFIs in Cambodia. HKL was acquired by a large Thai foreign bank, and some part of the shares of AMK were acquired by a Chinese company. In this situation MFIs could have potential to reach those clients who traditional banks fail to reach. However, it also implies that MFIs and commercial banks could compete with each other in the long term, and this higher level of competition could harm the outreach of MFIs (McIntosh and Wydick 2005), while improving their efficiency (Caudill et al. 2009) . Thus, policy makers should take this trend into account when shaping policy regarding the commercialization of MFIs.

Lastly, we describe the limitations and challenges of our current study. Our results do not suggest that the development of the traditional banking sector will drive MFIs to reduce loans to

the poor. Indeed, over-all efficiency (PC1) is also positively associated with the development of the traditional banking sector, implying that MFIs also reach more clients efficiently. However, with our data it is not clear whether MFIs serve a wider range of poor clients. Thus, further investigation is needed to examine the relationship between client characteristics and the development of the traditional banking sector.

In addition, the data from MIX Market do not cover all MFIs in Cambodia and the Philippines. The MIX Market database only covers the MFIs that self-report their financial statement to the MIX Market. Thus, there could be selection bias in the study using this database, as pointed out by Bauchet and Morduch (2013). Nevertheless, MFIs that are engaged in intensive microfinancing tend to report their financial statements to the MIX Market, particularly in Cambodia and the Philippines. In the case of the Philippines, the Microfinance Council of the Philippines collects the financial reports of MFIs and submits these to the MIX Market. In the case of Cambodia, all of the top ten MFIs in terms of asset size reported to the MIX Market during the period of our analysis. However, there are many more financial institutions which provide microfinance loans in Cambodia and the Philippines. Thus, more comprehensive datasets should be used to understand MFI management in future studies.

Furthermore, our study only covers two countries so we still need to examine the factors behind MFI development by extending case studies to others. Given the small variation across countries and years, our regression analysis could not capture other macroeconomic factors, which could also shape the development path of MFIs. Lastly, our regression analysis covers the average MFI behaviors by countries. However, there could be heterogeneity in the development path across MFIs. Some MFIs could be more sustainability-oriented, but others could be more outreach-oriented over the years. This heterogeneity in the development of MFIs is also important from a policy making perspective and should therefore be investigated in future studies.

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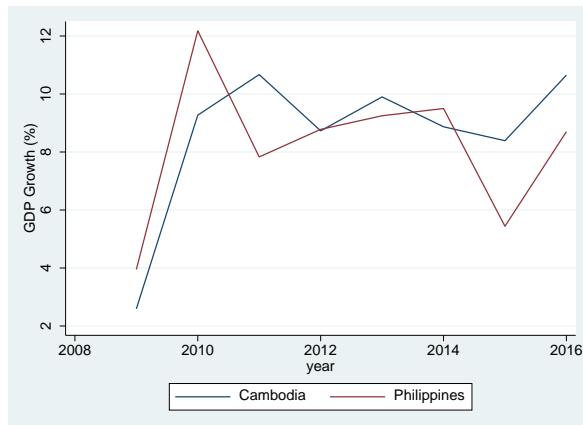
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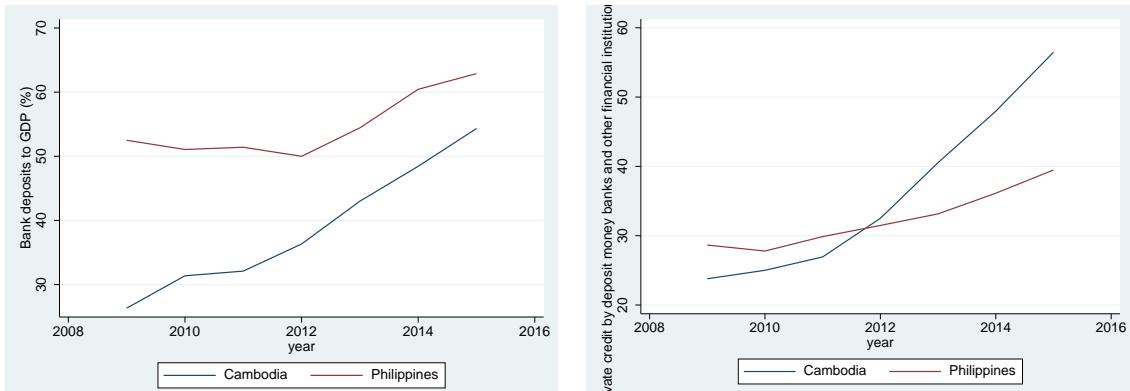
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Figure 1: GDP Growth in Cambodia and the Philippines



Source: International Financial Statistics

Figure 2: Financial Deepening in Cambodia and the Philippines



Panel A: Bank Deposit as a percentage of GDP

Panel B: Credit by Private Financial Institutions as a percentage of GDP

Source: Global Findex.

Figure 3: Scatter diagram of PC1 and PC2 (VRS)

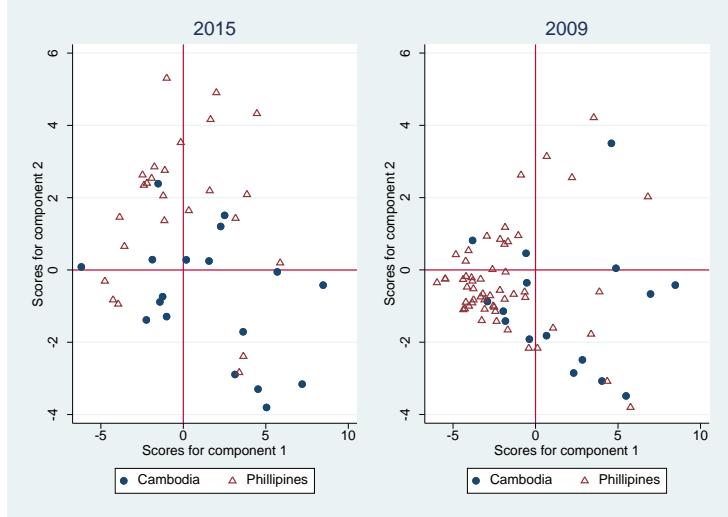


Figure 4: Scatter diagram of PC1 and PC3 (VRS)

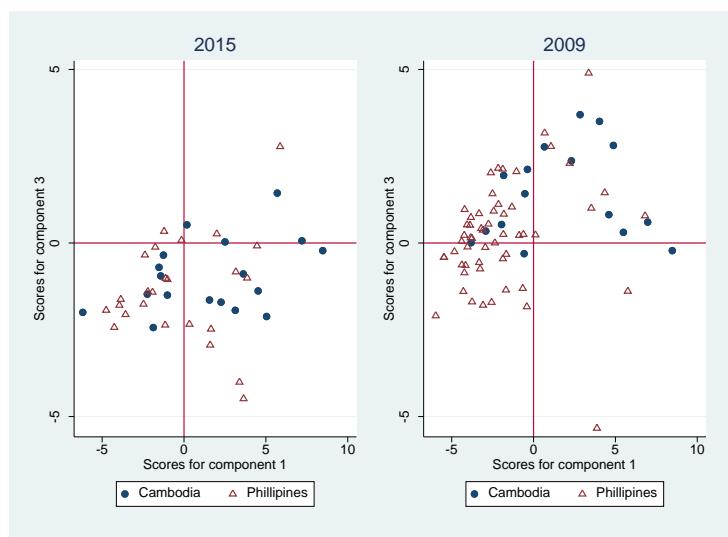
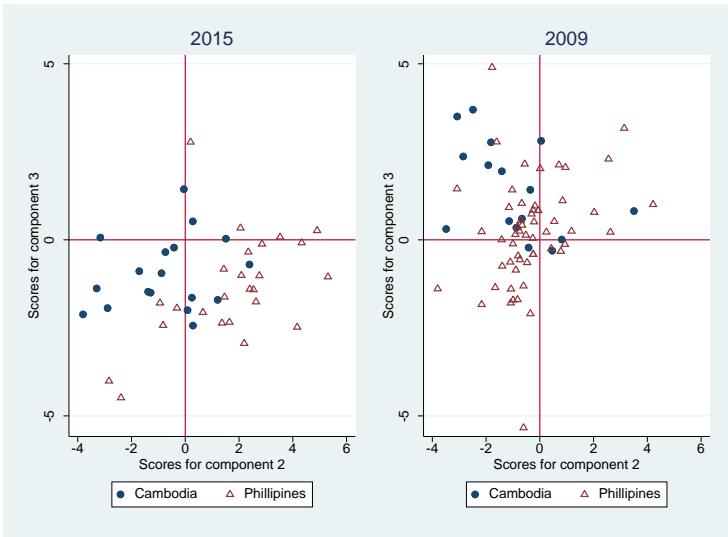


Figure 5: Scatter diagram of PC2 and PC3 (VRS)



Source: MIX Market and Author's Calculation.

Table 1: Number of financial institutions by legal status in Cambodia

Year	Commercial Bank	Specialized Bank	MFI
2009	27	6	19
2010	29	6	23
2011	28	7	37
2012	32	7	42
2013	35	8	43
2014	35	9	46
2015	36	11	61

Source: National Bank of Cambodia. 2010-2016. *Supervisory Annual Report*.

Note: Data of credit operators were not available during our study period.

Table 2: Loan Portfolio and Outreach of Cambodia's Banking System

	2013		2014		2015	
	Number of Borrowers	Amounts of Outstanding Loans (in Millions of USD)	Number of Borrowers	Amounts of Outstanding Loans (in Millions of USD)	Number of Borrowers	Amounts of Outstanding Loans (in Millions of USD)
Commercial Bank*	371,966	3,786	433,690	5,429	499,638	7,558
Specialized Bank*	4,363	141	4,421	152	6,044	208
MFIs**	1,565,526	510	1,718,297	872	2,022,235	1,548

Note: Data of credit operators are not available.

Source: *Data is from the National Bank of Cambodia and the Credit Bureau of Cambodia.

**Data is from the Cambodia Microfinance Association.

Table 3: Number of Financial Institutions by Legal Status in the Philippines

Year	Universal and Commercial Bank*	Thrift Bank*	Rural and Cooperative bank*	NGO**	Cooperatives***
2009	38	73	674	N.A	N.A.
2010	38	73	647	25	N.A.
2011	38	71	617	N.A	16674
2012	37	70	589	N.A.	17248
2013	36	71	566	N.A	17681
2014	36	69	543	N.A	18106
2015	40	68	524	23	13621

Source: * Bangko Sentral ng Pilipinas. 2018. *Fact Book of the Philippines Banking System*.

**Microfinance Council of the Philippines, Inc. 2016. *Philippines Social Performance Country Report 2016*, and Microfinance Council of the Philippines, Inc. 2010. *Microfinance Industry Report*.

***Cooperative Development Authority, *Selected Statistics*.

Table 4: Loan Portfolio and Outreach of the Philippines Banking System

	2010			2015		
	No. Reporting	No. of Borrowers (in Millions)	Amount of Outstading Loans (in Millions of Peso)	No. Reporting	No. of Borrowers (in Millions)	Amount of Outstading Loans (in Millions of Peso)
Microfinance NGOs*	25	1.77	10,122 (USD 230 Million) 6,716	23	3.15	19,890 (USD 397 Million) 11,400
Microfinance Bank*	200	0.88	(USD 153 Million)	176	1.23	(USD 228 Million)
Cooperatives*	14936	2.46	N.A.	N.A	N.A	N.A
Universal and Commercial Banks**	38	N.A	2,706,671 (USD 61,641 Million) 345,360	40	N.A	5,590,445 (USD 111,585 Million) 665,967
Thrift Bank**	73	N.A	(USD 7,865 Million) 109,420	68	N.A	(USD 13,292 Million) 109,330
Rural and Cooperative Bank**	647	N.A	(USD 2,592 Million)	524	N.A	(USD 2,182 Million)

Source:

* MCPI (2010, 2016).

** Bangko Sentral ng Pilipinas.

Note: Microfinance Banks and NGOs represent the banks and NGOs which are registered with the MCPI. Microfinance Banks are also included in Thrift Banks and Rural and Cooperative Banks.

Table 5: Financial Inclusion in Cambodia and the Philippines

	2011	2014	2017		2011	2014	2017
<i>Account (% age 15+)</i>				<i>Account, female (% age 15+)</i>			
Phillipines	26.6	31.3	34.5		33.7	37.9	38.9
Cambodia	3.7	22.2	21.7		3.7	20.5	21.5
<i>Borrowed any money in the past year (% age 15+)</i>				<i>Borrowed any money in the past year, female (% age 15+)</i>			
Phillipines		70.1	58.6		71.0	59.6	
Cambodia		62.1	58.7		65.1	59.4	

Source: World Bank, *Global Findex*.

Table 6: Management indices of MFIs in Cambodia and the Philippines

Microfinance institutions	Total assets	No. of staff	Personnel Expenses	Non-personnel Expenses	Asset/Staff	Wage (Personnel/Staff)	Non-Personnel Expenses/Staff
Cambodian MFIs							
PRASAC(NBFI)	701292	4100	22112	11370	171	5.4	2.8
Sathapana Limited(NBFI)	362535	2469	11957	8770	146.8	4.8	3.6
AMRET(NBFI)	345280	2900	17147	11465	119.1	5.9	4
HKL(NBFI)	316363	1911	10838	8771	165.5	5.7	4.6
LOLC(NBFI)	134253	1156	6472	3624	116.1	5.6	3.1
KREDIT(NBFI)	121526	1265	7533	4176	96.1	6	3.3
AMK(NBFI)	119155	1740	8917	7486	68.5	5.1	4.3
VisionFund Cambodia(NBFI)	105882	1181	6391	5505	89.7	5.4	4.7
LY HOUR(NBFI)	32876	307	1278	877	107.1	4.2	2.9
AEON (NBFI)	26447	396	1643	1959	66.8	4.1	4.9
First Finance(NBFI)	19601	46	346	393	426.1	7.5	8.5
SAMIC Plc(NBFI)	13219	210	1193	608	62.9	5.7	2.9
IPR(NBFI)	9434	99	459	370	95.3	4.6	3.7
CCSF(NGO)	7099	61	279	318	116.4	4.6	5.2
Maxima(NBFI)	5159	86	369	191	60	4.3	2.2
Average	154675	1195	6462	4392	127	5.3	4.5
Philippine MFIs							
1st Valley Bank(RB)	151374	666	3337	6801	227.3	5	10.2
CARD Bank(RB)	137719	2401	14050	16935	57.4	5.9	7.1
CARD NGO(NGO)	133169	3823	23044	13868	34.8	6	3.6
ASA Philippines(NGO)	88912	4024	17043	12295	22.1	4.2	3.1
GM Bank of Luzon(RB)	71785	.	4548	5738	.	.	.
ASKI(NGO)	55441	1020	3854	3427	54.4	3.8	3.4
Bangko Kabayan(RB)	55233	331	2010	2687	166.9	6.1	8.1
Cantilan Bank(RB)	44687	508	1936	2950	88	3.8	5.8
TSPI(NGO)	43627	1995	10826	4631	21.9	5.4	2.3
TSKI(NGO)	40871	2469	7498	4648	16.6	3	1.9
NWTF(NGO)	39190	1224	5086	3003	32	4.2	2.5
Pagasa(NGO)	32246	1049	3613	3777	30.7	3.4	3.6
Bangko Mabuhay(RB)	27766	136	1134	1136	204.2	8.3	8.4
RB Camalig(RB)	22669	189	838	1205	119.9	4.4	6.4
Paglaum Cooperative(CU)	16192	390	1485	1110	41.5	3.8	2.8
ASHI(NGO)	11489	260	1449	844	44.2	5.6	3.2
RSPI(NGO)	8267	338	1926	757	24.5	5.7	2.2
RB Guinobatan(RB)	8167	141	534	531	57.9	3.8	3.8
Milamdec(NGO)	6307	208	897	600	30.3	4.3	2.9
ECLOF - PHL(NGO)	5676	113	597	474	50.2	5.3	4.2
Kasagana-Ka(NGO)	4589	227	1039	698	20.2	4.6	3.1
Dungganon Bank(BK)	3740	51	288	370	73.3	5.6	7.3
Kazama Grameen(NGO)	3724	171	672	590	21.8	3.9	3.5
JVOFI(NGO)	488	.	88	19	.	.	.
Average	42222	988	4491	3712.3	65	4.8	4.0

Source: Compiled from the MIX Market 2015 database.

Notes: Unit of value: 1,000 US dollars; Revenue = interest income + commission income;

Non-personnel expenses = administrative expense + depreciation expense;

(NBFI) non-bank financial institutions, (Other) others, (BK) bank, ((RB) rural bank, (NGO) non-government organization, (CU) credit union or cooperative.

Table 7: Input and output of MFIs

Input	Output
Input A: Personnel expenses (US dollars)	Output 1: Number of active borrowers
Input B: Non-personnel expenses (US dollars) (Operating Expenses – Personnel Expenses)	Output 2: Gross Loan Portfolio (US dollars) Output 3: Revenue (US dollars) (Interest income + Non-Interest Income)

Table 8: Number of MFIs sampled in the MIX Market Database

MIX Sample					Phillipines			
Cambodia					Credit Union and Cooperatives			
Year	Bank	NBFI	NGO	Other	Bank	NGO	Rural bank	
2009	1	15	1	0	2	1	21	31
2010	1	15	1	0	1	7	23	19
2011	1	14	1	1	1	8	21	12
2012	1	15	0	1	0	0	8	3
2013	1	14	1	1	1	0	10	7
2014	1	16	1	1	1	1	17	8
2015	1	16	1	1	1	1	15	8
Total	7	120	6	6	7	18	115	88

Source: MIX Market and Author's Calculation.

Table 9: Results of PCA for the MFIs from 2009 to 2015

Variable	VRS		
	PC1	PC2	PC3
a1	0.180	0.337	-0.181
a12	0.243	0.095	-0.278
a123	0.240	0.096	-0.278
a13	0.235	0.131	-0.265
a2	0.186	-0.287	-0.255
a23	0.223	-0.163	-0.260
a3	0.220	-0.164	-0.256
ab1	0.170	0.388	-0.014
ab12	0.260	0.081	-0.101
ab123	0.264	0.032	0.094
ab13	0.258	0.061	0.124
ab2	0.195	-0.310	-0.128
ab23	0.221	-0.251	0.123
ab3	0.203	-0.271	0.166
b1	0.164	0.394	0.100
b12	0.244	0.150	0.122
b123	0.226	0.115	0.307
b13	0.215	0.142	0.330
b2	0.199	-0.261	0.044
b23	0.210	-0.133	0.310
b3	0.186	-0.158	0.355
Eigenvalues	11.670	3.667	3.080
Cumulative percentages of total variation	55.6%	73.0%	87.7%

Source: MIX Market and Author's Calculation.

Note: We use data from individual MFIs from 2009 to 2015 as pooled data. Sample size in the PCA is 340.

Table 10: Average of Principal Component Scores by Countries

	Cambodia			Philippines			Philippines (NGO only)		
	PC1	PC2	PC3	PC1	PC2	PC3	PC1	PC2	PC3
2009	1.77	-0.98	1.42	-1.90	-0.33	0.20	-1.48	0.89	0.51
2010	0.03	-0.92	2.52	-2.00	-0.17	1.32	-1.19	0.67	1.62
2011	1.59	-0.94	0.33	-0.34	0.15	-0.79	0.09	1.41	-0.27
2012	2.34	-0.53	0.67	1.37	1.11	-0.61	1.37	1.90	-0.06
2013	2.76	-0.57	0.12	0.89	0.48	-0.78	2.56	1.35	-0.01
2014	2.55	-0.66	-1.01	-0.28	1.54	-1.29	0.38	2.55	-0.60
2015	1.59	-0.76	-0.96	-0.23	1.74	-1.36	-0.04	2.81	-0.61
Total	1.80	-0.77	0.41	-0.88	0.38	-0.20	-0.12	1.55	0.20

Source: MIX Market and Author's Calculation.

Table 11: Estimation of the determinants of PCA Scores

	PC1	PC2	PC3
	Fixed Effect	Fixed Effect	Fixed Effect
Bank deposits to GDP (%)	-0.261*** (-4.55)	0.006 (0.30)	0.138*** (4.01)
Initial Condition of Deposit to GDP Ratio # Time Trend	-0.033*** (-4.34)	0.010*** (3.52)	0.025*** (5.36)
Time Trend	2.342*** (4.85)	-0.200 (-1.08)	-1.855*** (-6.41)
GDP Growth	-0.173*** (-4.03)	-0.015 (-0.89)	0.174*** (6.75)
Constant	10.975*** (4.56)	-1.052 (-1.14)	-5.332*** (-3.69)
R-Squared Adjusted	0.742	0.88	0.596
R-Squared	0.815	0.914	0.705
Observations	340	340	340

Source: MIX Market and Author's Calculation.

Note: *, **, and *** represent statistical significance at 10%, 5% and 1%, respectively. We use the MFI sample from MIX during 2009-2015. PC1, PC2, and PC3 are scores obtained from PCA in Step 1. PC1 stands for overall efficiency., PC2 stands for outreach-oriented operation, and PC3 stands for labor-intensity.

Appendix Table: Summary Statistics

Variable	Obs	Mean	Std. Dev.
PC1	340	0.00	3.42
PC2	340	0.00	1.91
PC3	340	0.00	1.76
Number of Active Borrowers	340	84,862	147,643
Gross Loan Portfolio	340	36,700,000	81,100,000
Revenue	340	9,451,950	16,800,000
Personnel Expenses	340	3,042,028	4,620,613
Non-personnel expenses	340	2,436,089	3,502,219
GDP Changes	340	8.06	2.83
Deposit-to-GDP Ratio	340	49.20	9.56
Initial Deposit-to-GDP Ratio	340	43.87	12.32
<i>Cambodia</i>			
PC1	112	1.80	3.12
PC2	112	-0.77	1.83
PC3	112	0.41	1.65
Number of Active Borrowers	112	83,235.67	98,569.73
Gross Loan Portfolio	112	72,900,000.00	128,000,000.00
Revenue	112	15,700,000.00	24,500,000.00
Personnel Expenses	112	4,094,729.00	5,360,182.00
Non-personnel expenses	112	2,737,849.00	3,407,294.00
GDP Changes	112	8.31	2.45
Deposit-to-GDP Ratio	112	39.25	9.63
Initial Deposit-to-GDP Ratio	112	26.32	0.00
<i>Phillipines</i>			
PC1	228	-0.88	3.21
PC2	228	0.38	1.85
PC3	228	-0.20	1.77
Number of Active Borrowers	228	85,660	166,735
Gross Loan Portfolio	228	18,900,000.00	28,200,000.00
Revenue	228	6,380,544.00	9,876,250.00
Personnel Expenses	228	2,524,912.00	4,125,446.00
Non-personnel expenses	228	2,287,857.00	3,545,884.00
GDP Changes	228	7.94	2.99
Deposit-to-GDP Ratio	228	54.09	4.26
Initial Deposit-to-GDP Ratio	228	52.50	0.00

Abstract (in Japanese)

要約

東南アジア地域の中でカンボジアとフィリピンはマイクロファイナンス機関が非常に発達している国であるが、両国のマイクロファイナンス機関が置かれた経営環境は大きく異なる。本研究では、2009年から2015年の間の両国のマイクロファイナンス機関の経営特性と経営効率性の違いについて、データ包絡線分析(Data Envelopment Analysis)と主成分分析(Principal Component Analysis)を組み合わせた方法を用いて分析を試みた。分析の結果、カンボジアのマイクロファイナンス機関はサステナビリティ指向が強く、フィリピンのマイクロファイナンス機関はアウトリーチ指向が強い傾向にあることが分かった。また、フィリピンのマイクロファイナンス機関は観測期間を通じてよりアウトリーチ指向が強くなっていく傾向も見られた。さらに、両国の経営の資本集約度には大きな違いは見られなかつたが、両国とも資本集約度が高くなっていく経年変化が見られた。最後に、回帰分析を用いて、経営特性と効率性の変化の要因を分析したところ、初期段階の預金のGDP比率とアウトリーチ指向、資本集約度、効率性がそれぞれ統計的に有意に相關していたことがわかつた。これは、マイクロファイナンス機関の発展には、発展初期段階のその他の伝統的な金融機関がどれだけ発展していたかが関連していたことを示唆する結果であると考えられる。

キーワード:カンボジア、フィリピン、マイクロファイナンス機関、経営特性、データ包絡線分析(Data Envelopment Analysis)、主成分分析(Principal Component Analysis)



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