

# Financial Efficiency of Microfinance Institutions in the Event of Pre and Post Financial Crisis

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## Abstract

*The 2008 financial crisis hits economic growth particularly in banking sector. The impacts also not spared to Microfinance Institutions' (MFIs) since MFIs nowadays become integral part in financial system. This paper aims to evaluate financial efficiency of the MFIs in the period of pre and post-financial crisis in first objective. Next, to examine impact of firm characteristics and economic determinants on financial efficiency within the similar period. Total of 166 MFIs from ASEAN 4 countries were selected which include Vietnam, Cambodia, Indonesia, and the Philippines between pre-crisis years, 2000–2007 and post-crisis years, 2010–2017. Using Data Envelopment Analysis, first stage analysis estimates level of financial efficiency of MFIs. In second stage, application of Multivariate Panel Regression Analysis evaluates the effects of firm characteristics and economic determinants on financial efficiency level of the MFIs. Result on first stage revealed the post-crisis efficiency score higher than the pre-crisis efficiency score and this implies financial crisis does not financially affected the MFIs hence appear to be sustainable in the long-run. The findings in the next stage reveal firm characteristics and economic determinants mostly found insignificant for post-crisis period while significant in the pre-crisis. The insignificant outcomes prove the crisis has resulted some variables being unable to explain variation in financial efficiency of the MFIs. Generally, the microfinance industry will be benefited from this study as an input for any concurrent crisis in the future. This is vital since the MFIs is the only financial institutions that provide financial access to the poor.*

**Keywords:** Financial Efficiency; Economic Crisis; Firm Characteristics; Economic determinants; Data Envelopment Analysis; Panel Regression

## 1. Introduction

In emerging financial developments, Microfinance Institutions (MFIs) experience progressive changes when they began to offering banking services to the poor or 'unbankable'. Professor Muhammed Yunus, an economist from Bangladesh, has succinctly established Microfinance Institutions (MFIs) namely Grameen Bank, intending to provide a social-oriented business to the lowest levels of society (Dokulilová et al., 2009). Grameen Bank has been able to provide microcredit loans to 86 percent of Bangladeshi villages since its establishment in 1976, with a total value of Taka 290.03 billion. As one of the world's most successful MFIs, Grameen Bank, which primarily provides microcredit, has succeeded in eradicating critical poverty among more than half of Bangladesh's borrowers, who number close to 50 million (Sarkar, 2008).

MFIs have been identified as organisation that generally supply a credit distribution mechanism to the needy at an early level. Microfinance was entirely perceived as an tool for poverty eradication with the cooperation of governments and specific funders. Microfinance was no longer a subsidy beneficiary over

time, and in the 1990s, it transitioned from the subsidy system to full-scale banking products. It was eventually expanded to a wide range of financial products such as money transfer, insurance, savings, and many others. Analysis of Hasan et al., (2009) in Bangladesh to a prominent microfinance institution has shown that MFIs have achieved success from 2001 to 2005 with regard to outreach and sustainability but in 2006 and 2007, that trend has deteriorated. The analysis indicates that MFIs should concentrate on increasing financial efficiency and reducing subsidy dependency.

Financial efficiency is intended to be a proxy in this study to demonstrate the performance of MFIs as a whole. It is growing a standard for assessing the performance of MFIs in the context of financial efficiency, as claimed by Vanroose and D'Espallier (2013). The social role of MFIs in eliminating poverty could be maintained, and simultaneously, the operation of the MFIs also could be sustained over the long run. Therefore, financial efficiency measures for sustainability could be regarded as the reliable practice that agrees with the nature of MFIs as proven by numerous of the earlier studies (Haq et al., 2010).

Given the financial crisis in 2007 until 2009, the soaring

default rate in the subprime home mortgage sector of the United States was the developing factor conducting to the crisis, causing many home mortgage borrowers to fail to perform regular payments. The crisis drove the failure of essential businesses, a critical fall in consumer income, had further deterioration in economic activity that immediately crashed and affecting the Association of Southeast Asian Nations (ASEAN) markets, as claimed by Singhania and Anchalia (2013). Numerous studies have proved the banking sector has undergone negative impacts from the financial crisis (Beltratti & Stulz, 2012; Berger & Bouwman, 2013; and Dietrich & Wanzenried, 2011). As the MFIs now form an integral part of the financing structure, the effect of the crisis on the operations of the MFIs is not excluded. Even Lützenkirchen and Weistroffer (2012) reported that, in 2007, the first major disruption of microfinance had occurred.

The performance of MFIs was found to be impacted by the crisis in Ngo, Mullineux, and Ly (2014), with many poor debtors undergoing loan repayment problems, and hence reduce the reliability of their loan portfolios. Savings were required to be deducted and the majority of customers have been difficult to afford repayment. (Stephen, 2013). This shows that MFIs face profound barriers to profitability and sustainability as they unable to manage loan portfolios effectively. The crisis event explains why MFIs have slowed the growth of gross loan portfolios after ten years of a remarkable evolution (CGAP, 2011). Moreover, the financial revenue from the loan portfolio, as implied by Mohammed and Farouq (2018), is the main source of income for sustainable MFIs, and this describes why existing studies (Piot-Lepetit & Nzongang, 2014 and Wijesiri et al., 2015) have considered revenue as a means of assessing MFIs' efficiency.

Many past research focused on the performance of MFIs in terms of social goals, whereas nowadays, microfinance has become part of the financial system, hence it is no longer suitable to evaluate MFI's performance solely on the basis of social goals. MFIs performance must be directed toward financial goals in order to ensure long-term sustainability in offering financial services. That being said, there has been limited work in research to assess the significant changes in financial efficiency among the MFIs, related to the global financial crisis (Di Bella, 2011; Aemiro & Mekonnen, 2012; and Sainz-Fernandez, Torre-Olmo, López-Gutiérrez, & Sanfilippo-Azofra, 2015; Aemiro & Mekonnen, 2012), because most of them concentrate on the performance of banks, as well as extremely little relevant research on the efficiency of the MFIs particularly in ASEAN countries (Tahir & Tahrir, 2013). This issue basically able to addresses the ability of the MFIs to sustained during pre and post-financial crisis in terms of financial efficiency.

Further to that, Ngo (2012) has recognised few internal factors of firm characteristics to give impact on financial performance of MFIs. This includes size, age, and financial leverage which represent the variables of firm characteristics. Even so, the results are ambiguous and the researchers create several disagreements to decide the absolute factor involved. Notwithstanding the number of studies in determining the variables that had affected MFIs, still they produced mixed outcomes.

In addition to these concerns, the economic determinants in the microfinance sector have not been empirically studied (Donou-Adonsou and Sylwester, 2015). The same concern was also expressed by Buera, Kaboski, and Shin (2012) when the economic impact of microfinance were scarcely discovered. Thus, the changes in external factors of macroeconomic variables that influence the MFI's financial efficiency in pre and post-financial crisis are undeniably important to examine.

To satisfy the issue, this research aims to study the level of financial efficiency of MFIs in times of pre and post-financial crisis as the first objective. Next, to study the effects of firm

characteristics in the pre and post-financial crisis on financial efficiency level. Lastly, is to investigate the economic impact on financial efficiency of the MFIs during the pre and post-financial crisis. The rest of the paper is organised accordingly. Section 2 provides an overview of the relevant theoretical and literature and also the factors that contribute to the financial efficiency of MFIs. The data and estimation method and model are described in section 3. The empirical findings are presented in section 4 and the summary and conclusions in section 5.

## 2. Theoretical and Literature Framework

After the introduction by Charnes, Cooper, and Rhodes (1978) and Banker, Charnes, and Cooper (1984), most scholars and practitioners carrying out their assessment on the performance of financial institutions with the Data Envelopment Analysis (DEA), and this including MFIs. The MFIs were known as microcredits at an early stage, which usually provides credit distribution to the poor. Wagner and Winkler (2013) confirmed that microfinance started to function as a subsidies-dependent institution with specific donors and government's structure appealing funds. In the 1990s, microfinance had no longer been as subsidy receiver and was marketed in full-scale banking products from a subsidy scheme. It has finally been expanded to a large range of financial products, including money transfers, insurance, investments, and many others.

Nowadays, the need for financially sustainable MFIs is a way to provide poor people with lasting financial services. The term financially stable in MFIs varies from other financial institutions, as Wijesiri, Yaron, and Meoli (2015) indicate it demonstrates the ability of MFIs to release and reinforce their dependence on subsidies by providing financial services to an enormous number of the poor.

In recent decades there has been a thorough, detailed study of the efficiency of financial institutions. Theoretically, efficiency can be expressed as an output-to-input ratio, which means more output by input unit means more efficiency, whereas maximum output per input unit is optimal (Othman et al., 2016). Mohd Noor et al., (2020) assert that efficiency assessments determine whether the institution can maximise its output and revenue and reduce its expense at the same time. Othman et al., (2016) have identified the four elements of the efficiency measurement as a basis for overall productivity for the institution; (i) technical efficiency, (ii) efficiency scale, (iii) price efficiency, and (iv) allocative efficiency. Financial efficiency, as stated by Zainal et al., (2019), is seen as a measurement of technical efficiency (TE), by measuring a reasonable reduction from the use of inputs that can be attained when the business is operating on an efficient frontier, or using a minimum set of inputs to maximise its output.

At any rate, the following studies indicate that during the pre-financial crisis, the performance of MFIs was strong and sturdy before the crisis seriously affected them. This involves analysis by Silva and Chávez (2015), which discovered that MFIs are more resilient to the financial crisis and assert that governments help them attain better access to funding and sustainability. Khan, Mustafa, and Khurshid (2018) found a drop in the ratio analysis, indicating that MFI performance improved in the years preceding the crisis. Wagner and Winkler (2013) finding shows that MFIs have been active on domestic and global capital markets during the pre-crisis era, with the result of increased credit growth. Not just that, Daher and Le Saout (2012) revealed the results between profitability and pre-crisis years to be statistically significant and positive relationship. All their findings have shown the consistent findings, that the MFIs have been hit badly by the crisis given their better performance in the years before the crisis.

In the meantime, existing literature in the post-crisis years has shown that there are mixed outcomes resulted the financial crisis. Khan et al., (2018) found a decline in the ratio assessment, which showed an improvement in MFIs performance in the post-crisis years. Meanwhile Silva and Chávez (2015) reported that MFIs are more resilient to the global economic crisis and governments are assisting countries with better developed financial structures to gain greater access to finance and sustainability. Wijesiri (2016) has acknowledged disparities with the least impacted non-government organizations (NGOs) and cooperatives in the MFIs' productivity response to the financial crisis, while the crisis has most affected microfinance banks and NBFIs. The latter is consistent with the research conducted by Daher and Le Saout (2012) and Wagner and Winkler (2013), which their findings after the crisis were too profound to survive for microentrepreneurs.

Thus, the study suggests:

H1: Financial efficiency levels vary significantly between MFIs in ASEAN 4 countries during pre and post-financial crisis.

Additionally, the empirical literature indicates size to be remarkably important to influence MFIs. For instance, Singh et al., (2013), and Wijesiri et al., (2015) have confirmed that operating size is related to the efficiency of the MFIs and agree that larger MFIs work in more cost-effective and advanced technologies. In contrast, MFI sizes have been found to be adversely associated with financial efficiency in Yenesew (2014) and Widiarto and Emrouznejad (2015) Noor et al (2020), which suggests that major MFIs in the industry have failed to enjoy the maximum economies due to their lack of experience and the lack of expertise to deal with the problems.

Furthermore, the number of years operation also allows the efficiency level of the MFIs to be defined. Among others the study from Wijesiri et al., (2015), found that the older the MFIs, the higher the financial sustainability, as matured MFIs use the conservative time to conquer the markets. Indeed in the age and financial performance of the MFIs, Yenesew (2014) also noted positive relationships. Assefa et al., (2013), however, found that the MFIs are aging and reduce financial results, which has been reaffirmed by Widiarto and Emrouznejad (2015) findings that young MFIs have shown greater performance due to capability of the management to adapt vast technology that enhance the operation.

Not only that, the previous study found that the Debt-to-Equity Ratio (DER) is calculated as a proxy for implementing the firm's financial leverage. Kar (2012) studies found that the relationship between financial leverage and the MFI's sustainability level was positive. This is due to the result from the offering debt activities, therefore the MFIs are able to continue to be viable and sustainable. The study by Ngo (2012), on the other hand, believes many MFIs to have negative effect because they are struggling to generate sufficient revenue to cover total costs, and this corresponds with Abrar and Javaid (2016) viewpoints, as DER is high, there is a greater risk. On the other hand, the Quayes (2015) and Yenesew (2014) findings did not have a statistically significant effect on the financial performance of the MFIs with the DER. The results make DER unusual and cause the financial efficiency differences to be unjustifiable.

Thus, the study suggests:

H2: Firm characteristics have a different significant effect on financial efficiency of the MFIs in ASEAN 4 countries during pre and post-financial crisis.

On top of that, numerous researchers have displayed real GDP per capita as the indicator of economy growth in their analysis. Studies carried out by Vanroose and D'Espallier (2013) claims, advancing economy growth improves the performance of MFIs since it minimises the risk of loan repayment. Kar and Bali Swain (2018) agrees it stimulates demand for microcredit

among the 'unbankable' and helps MFIs reduce operating expenses. Assefa et al., (2013) showed that GDP has a positive impact which encouraging more MFIs to provide more loan for poor people. This encourages the establishment of small companies by poor people, which would progressively produce revenues. Notwithstanding, the negative relationship, which implies an improvement in the GDP produces a reduction in the financial performance of the MFIs, and this has been revealed by Ngo (2012) immediately after poor households became high-income and poverty-stricken. They appear to entitle to taking part in the commercial banks since they started to own a stable income. This results in fewer borrowers and consequently has a disadvantageous effect on MFIs' income. Whereas Alimi (2015) found no connection between financial performance and economy growth, reacting to statistical problems in the data, that the result was insignificant.

To add, basically inflation shows the purchasing power of money and measures over a period of time by an analysis of the Consumer Price Index (CPI). A positive correlation has been found between inflation and performance of MFIs in Assefa et al., (2013), which reveals that in the high inflation period, MFIs hardly ever had a negative impact since MFIs most certainly not operated in the financial market. Promoting economy activity leads to lower unemployment and facilitates the balance of payments issues. On contrary, Cull, Demirgüç-Kunt, and Morduch (2011) show inflation to have a negative relationship with the financial performance since MFIs are now more financially active, which means that high inflation will impact the higher input price thus lead to a lower income level. The results are also supported by Daher and Le Saout (2012) since MFIs do not properly foresee growth in inflation in the face of a rise in expenditure, which would jeopardise their profitability. Ngo (2012) however has provided evidence that MFIs' performance was insignificant for inflation and the data inferred were unusual, thus this explains why financial performance fluctuations were unjustified.

Further to that, fundamentally foreign direct investment (FDI) does not relate to changes of ownership only, they usually include respectful transfers of resources, including the development of organisational skills, management, and enhancement of technology. Vanroose and D'Espallier (2013) have shown that FDI is an important factor in the development of the performance of MFIs, which helps to increase the profits performed by higher FDI. Meanwhile, Seng et al., (2019) and Hermes, Lensink, and Meesters (2011) had made dissimilar findings where the findings showed that FDI was negatively affected financial efficiency of MFIs. The huge scale, technological betterment, and skilled labour which the FDI benefits, create problems for the MFIs to compete. In spite of, Forkusam (2015) interprets FDI to be insignificantly associated with MFIs' financial performance. The financial performance of MFIs does not depend upon variations in FDI, be it higher and lower FDI.

Thus, the study suggests:

H3: Macroeconomic conditions provides a different significant impact to the level of financial efficiency of the MFIs in ASEAN 4 countries during pre and post-financial crisis.

From the review of the literature above, the effect from the financial crisis has been found largely in banking institutions. There are limited studies has been investigating the impact on the performance of the MFIs. The previous studies conducted in Microfinance industry were also provide a mixed finding. This research gap will be bridge with the proposed objectives in the study. Furthermore, the novelty has been found when the main purpose in this study is to focus on the financial performance of the MFIs particularly in ASEAN countries as well as to differentiate the internal and external impacts between the period of pre and post crisis.



### 3. Data and Research Methodology

Data from MFIs were provided on the portal of the World Bank, an online database containing financial information from global MFIs (Vanroose & D'Espallier, 2013; Assefa et al., 2013; and Widiarto & Emrouznejad, 2015). In addition, data on macroeconomic conditions were retrieved from the World Development Indicators (WDI). The data has been published and accessed in the World Bank database. The World Bank is the biggest database available for MFIs and has been widely used for microfinance analysis, as agreed by Vanroose and D'Espallier (2013).

Data from the selected Association of Southeast Asian Nations, appointed as ASEAN 4 in this study, typically consists of Vietnam, Indonesia, Cambodia, and the Philippines. Main reason to include these countries as a sample study due to they own highest number of MFIs among ASEAN countries. Most of them are mainly developing countries with significant amounts of poor people served by the MFIs, henceforward included in the data analysis.

As defined by Hassan et al., (2012), over 4000 MFIs from nine regions worldwide were reported in the World Bank database. As such, the samples in this analysis were 166 MFIs of ASEAN 4 countries, be composed of data in between pre-crisis years, 2000–2007 and post-crisis years, 2010–2017. Inevitably, the analysis contained a total of 1328 observation data.

#### 3.1. First Stage: Data Envelopment Analysis (DEA)

The DEA was initiated by Charnes, Cooper, and Rhodes for the first time in 1978, with a simplified approach based on their names as a CCR model, in line with the suggestion by Farrell (1957) in the generalisation of efficiency. The CCR model was estimated appropriately on the basis of constant returns to scale (CRS). The CCR model assumes that there is no significant connection between the operational scale and efficiency by using the CRS, where the overall technical efficiency (OTE) is achieved. It is only justifiable to assume CRS if all DMUs operate

to an optimal degree. However, in reality, businesses and DMUs might experience economies or diseconomies of scale (Zainal, 2019). Accordingly, if one believes that CRS does not operate in the optimal scale, the OTE measurements computed would have a bias impact by the scale of inefficiency (SIE). This presumption was not valid in imperfectly competitive markets.

Banker, Charnes, and Cooper (1984) subsequently extended the CCR model to minimise the CRS assumption by modifying the CCR model. The extension derived from their names developed the BCC model, in which the DMU's efficiency was measured with a variable return to scale (VRS). Technical efficiency (TE), which is divided into pure technical efficiency (PTE) and scale efficiency (SE), is included in the VRS assumptions. Accordingly, Zainal et al., (2020) mentioned that the PTE tests the DMU from a managerial efficiency perspective, with no scale contamination. In the meantime, the SE shows the right size in terms of financial efficiency for the DMU to operate. Consequently, VRS results may provide reliable data on DMU efficiency besides CRS (Vianneca W. Jubilee et al., 2020; and Coelli, Prasada Rao, & Battese, 1998). With regard to this analysis, the TE is used to calculate the financial efficiency of the MFIs, which reflects the overall efficiency score.

By chance, if there are inconsistencies in the TE scores for a particular DMU using CRS and VRS assumptions, Coelli et al., (1998) shows that DMU carries a Scale of Inefficiency (SIE). In other words, SIE is calculated on the basis of variations between the VRS PTE score and the CRS TE score. The existence of SIE under VRS, partly due to increasing returns to scale (IRS) or decreasing returns to scale (DRS), is discovered by carrying out additional DEA problems and the non-increasing returns to scale (NIRS) (Kamarudin, Sufian, Md. Nassir, & Mohamad Anwar, 2015).

Charnes et al., (1978) proposed that DEA select units that are able to correctly identify inputs or outputs. DEA facilitates the choice of its own specific weights for each DMU in order to maximise its efficiency level. Therefore, the efficiency of all units must be lower or equal to 1, in order to maximise unit *j* efficiency. The following measures can be taken (Bader et al., 2008):

$$\text{Maximise efficiency of unit } j = \sum_{r=1}^s u_r y_{rj} \quad (1)$$

$$\text{Subject to } \sum_{i=1}^m v_i x_{ij} = 1$$

$$\sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s u_r y_{rj} \leq 1 \quad j = 1, 2, \dots, n$$

$$u_r \geq \varepsilon \quad r = 1, 2, \dots, s$$

$$v_i \geq \varepsilon \quad i = 1, 2, \dots, m$$

As described, financial revenue is the metric used in determining financial efficiency. The variables that measure

financial efficiency performance are best represented in Table 1:

# GENERAL MANAGEMENT

Variables	Mean	Min	Max	SD	No. of DMU
Pre-Crisis Events					
Inputs of MFIs					
Total assets (USD million)	14.786	10.507	21.534	1.553	608
Operating expense (USD million)	12.783	8.236	18.081	1.542	608
Personnel expense (USD million)	12.362	8.494	17.527	1.510	608
Output of MFIs					
Financial revenue (USD million)	13.309	6.762	18.628	1.478	608
Post-Crisis Events					
Inputs of MFIs					
Total assets (USD million)	15.932	8.524	22.786	2.325	720
Operating expense (USD million)	13.900	7.662	19.314	2.251	720
Personnel expense (USD million)	13.376	6.999	18.579	2.192	720
Output of MFIs					
Financial revenue (USD million)	14.371	5.106	20.302	2.367	720

Table 1: Input and Output Variables for Financial Efficiency, ( $y_2$ )  
Notes: All sources from World Bank database ([www.data.worldbank.org](http://www.data.worldbank.org))

Indeed, the number of input and output variables in the study adopts Cooper et al., (2007) rule of thumb. Since in both cases of crisis, 166 MFIs exceed the number input and output variables of financial efficiency, the selection of variables is reasonable as they meet the requirements of  $m$  and  $s$  inputs and  $n$  DMUs,  $m \times s \leq n$ , where  $15(3 \times 2)$ , and  $15(3 \times 1)$  (Bousofiane et al., 1991). This confirms the choice of variables in the study for the efficiency measurement of DMUs.

### 3.2. Second Stage: Multivariate Panel Regression Approach (MPRA)

In the second stage of the MPRA, the methods consist of the pooled Ordinary Least Square (OLS), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Regression models, as stated in McDonald (2009), are based on White (1980) transformation.

The panel data showed a number of estimation and inference problems, as Gujarati (2004) revealed, since these

data include the cross-sectional and time dimensions, problems such as heteroskedasticity and autocorrelation should be completely recognised. There are a variety of available problems, such as cross-correlation of single in a particular time. Multiple methods for computing these issues are then used to solve these problems. The two most important are FEM and REM. Hausman's test statistics include the asymptotic distribution of Chi-Square. If the null hypothesis is rejected (at 1% to 5% significant levels), FEM is more appropriate to undertake than REM. If, however, a null hypothesis is failed to reject, or is of significance at 10%, REM is most appropriate for use.

In line with Quayes (2015), Nhung and Okuda (2015), Assefa et al., (2013), and Wijesiri et al., (2015), the present study proposes the size, age, and financial leverage to be used in the estimation model as a proxy to the firm characteristics. Information of the firm variables that affect the performance of the MFIs are presented in Table 2.

Variables	Descriptions
Dependent	
Financial Efficiency (fe)	Financial efficiency score in DEA
Independent	
Size of operation (ta)	Net assets consist of loan loss reserve and accumulated depreciation
Age of operation (age)	Number of years since establishment
Financial leverage (der)	Weightage of equity financing over debt financing in MFIs

Table 2: Details on the Variables of Firm Characteristic of MFIs  
Notes: All sources from World Development Indicator (WDI), World Bank database ([www.data.worldbank.org](http://www.data.worldbank.org))

Meanwhile, existing research has shown that macroeconomic conditions are focused mainly on economic tradition in which they highlighted the significance of external market factors for assessing an institution's performance. Among others are inflation, Gross Domestic Product (GDP) per capita, population, unemployment, and interest rates are usually included as external variables. The empirical research encompasses the macroeconomic conditions has examined the impact of per capita GDP growth and inflation on MFIs'

performance (Ngo, 2012). Thus, the present study will persevere the previous research (Ahlin, Lin, & Maio, 2011; Vanroose & D'Espallier, 2013; Obi et al., 2009; and Assefa et al., 2013) to determine the degree of financial efficiency of MFIs by recognising growth in economy, inflation, and foreign direct investment as external factors. The information on external determinants affecting the efficiency of the MFIs is shown in Table 3.

Variables	Descriptions
Dependent	
Financial Efficiency (fe)	Financial efficiency score in DEA
Independent	
Economy growth (gdp)	Real GDP growth per capita

# GENERAL MANAGEMENT

Inflation (inf)	Changes in the general level prices of goods and services
Foreign direct investment (fdi)	Net outflow of inflow as percentage of GDP

Table 3: Details on the Variables of Macroeconomic Conditions of MFIs

Notes: All sources from World Development Indicator (WDI), World Bank database ([www.data.worldbank.org](http://www.data.worldbank.org))

Therefore, the general estimation models are expressed in the following equation:

$$\begin{aligned} \text{Financial efficiency}_{i,t} &= \beta_{1,t} \left( \sum \text{Firm Characteristics}_{i,t} \right) \\ &+ \beta_{2,t} \left( \sum \text{Macroeconomic Conditions}_t \right) + \varepsilon_{i,t} \end{aligned} \quad (2)$$

$$\text{(Pre-crisis)} \quad fe_{i,t} = \beta_0 + \beta_1 ta_{i,t} + \beta_2 age_{i,t} + \beta_3 der_{i,t} + \beta_4 gdp_t + \beta_5 inf_t + \beta_6 fdi_t + \varepsilon_{i,t} \quad (3)$$

$$\text{(Post-crisis)} \quad fe_{i,t} = \beta_0 + \beta_1 ta_{i,t} + \beta_2 age_{i,t} + \beta_3 der_{i,t} + \beta_4 gdp_t + \beta_5 inf_t + \beta_6 fdi_t + \varepsilon_{i,t} \quad (4)$$

## 4. Results and Discussions

### 4.1. Financial Efficiency Score between Pre-Financial Crisis and Post-Financial Crisis Events

The analysis begins with the presents of financial efficiency score between pre and post-financial crisis derived from the DEA analysis. The analysis is then tested parametrically and non-parametrically before panel regression actually takes place.

Table 4 provides the cumulative mean TE in the pre-financial crisis and post-financial crisis period for the financial efficiency score of the MFIs in ASEAN 4 countries. The mean TE for financial efficiency during the post-crisis period equivalent to 83.4% can be seen for all years (refer Panel R of Table 4), being only marginally higher than the pre-crisis period, where the mean TE for financial efficiency amounted to 82.3% (refer Panel I of Table 4). Before the crisis period (17.7%), the wastage generated by financial efficiency is slightly high, compared with the wastage generated by the post-crisis period (16.6%). Table 4 concluded that, despite the optimum efficiency scale in all

MFIs in ASEAN 4 countries, both study periods were greatly influenced by managerial inefficiency in the use of their resources to the full (since, pre-crisis period PTIE = 10.6% > SIE = 7.7% and post-crisis period PTIE = 10.8% > SIE = 6.4%).

The MFIs in ASEAN 4 countries did not see a major change in the score for their financial efficiency after the crisis, when they only increased by 1.07 percent over their pre-crisis rate. For both crisis events, MFIs are consistent with maintaining the scores of financial efficiencies about 80%. This means, the MFIs in ASEAN 4 are financially efficient thus indicate the crisis does not hamper them to provide financial services to the poor in the long run.

In ASEAN 4 countries, the MFIs are proven to be resilient, because the economic crisis does not impact their financial performance significantly. This shows that the MFIs in ASEAN 4 are excellent in focusing more on producing financial products in both crisis periods to sustain their financial performance. This means that the MFIs are financially secure for the long term (Nanayakkara, 2012), unveiling MFIs' ability to break away from subsidy dependence and increase their scope through the provision of financial services to a tremendous number of the poor (Wijesiri et al., 2015).

Measure of Efficiency	Pre-Financial Crisis		Post-Financial Crisis	
	No. of DMU	Mean	No. of DMU	Mean
	Panel A: All Firms 2000		Panel J: All Firms 2010	
Technical Efficiency	76	0.848	90	0.843
Pure Technical Efficiency	76	0.909	90	0.897
Scale Efficiency	76	0.934	90	0.941
	Panel B: All Firms 2001		Panel K: All Firms 2011	
Technical Efficiency	76	0.830	90	0.804
Pure Technical Efficiency	76	0.901	90	0.878
Scale Efficiency	76	0.923	90	0.911
	Panel C: All Firms 2002		Panel L: All Firms 2012	
Technical Efficiency	76	0.802	90	0.816
Pure Technical Efficiency	76	0.891	90	0.876
Scale Efficiency	76	0.902	90	0.935
	Panel D: All Firms 2003		Panel M: All Firms 2013	
Technical Efficiency	76	0.795	90	0.821
Pure Technical Efficiency	76	0.882	90	0.869
Scale Efficiency	76	0.906	90	0.947
	Panel E: All Firms 2004		Panel N: All Firms 2014	
Technical Efficiency	76	0.796	90	0.841
Pure Technical Efficiency	76	0.885	90	0.900

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Scale Efficiency	76	0.903	90	0.936
	Panel F: All Firms 2005		Panel O: All Firms 2015	
Technical Efficiency	76	0.826	90	0.833
Pure Technical Efficiency	76	0.876	90	0.902
Scale Efficiency	76	0.947	90	0.923
	Panel G: All Firms 2006		Panel P: All Firms 2016	
Technical Efficiency	76	0.829	90	0.854
Pure Technical Efficiency	76	0.897	90	0.902
Scale Efficiency	76	0.928	90	0.949
	Panel H: All Firms 2007		Panel Q: All Firms 2017	
Technical Efficiency	76	0.859	90	0.859
Pure Technical Efficiency	76	0.914	90	0.911
Scale Efficiency	76	0.942	90	0.945
	Panel I: All Years (2000–2007)		Panel R: All Years (2010–2017)	
Technical Efficiency	608	0.823	720	0.834
Pure Technical Efficiency	608	0.894	720	0.892
Scale Efficiency	608	0.923	720	0.936

Table 4: Financial Efficiency Score of MFIs in ASEAN 4 Countries during Pre-Financial Crisis (2000–2007) and Post-Financial Crisis (2010–2017)

The robustness test for financial efficiency of the MFIs in ASEAN 4 countries is presented in Table 5 for pre and post-financial crisis. The TE for financial efficiency during the post-crisis is found to be higher than the TE during the pre-crisis ( $TE_{\text{post-crisis}} = 0.834 > TE_{\text{pre-crisis}} = 0.823$ ) in the findings, while PTE for the financial efficiency during the pre-crisis is higher than the PTE during the post-crisis ( $PTE_{\text{pre-crisis}} = 0.894 > PTE_{\text{post-crisis}} = 0.892$ ), and both TE and PTE measurement shows insignificant correlation between the pre-crisis period and the post-crisis period. Meanwhile, it shows a significant difference at 1% ( $SE_{\text{post-crisis}} = 0.936 > SE_{\text{pre-crisis}}$

$= 0.923$ ) during post-crisis period which is the SE for financial efficiency is higher than SE during the pre-crisis. In addition, the findings from the parametric t-test is further confirmed by non-parametric Mann-Whitney and Kruskal-Wallis tests. For sum up, the results portrays no significant difference between the efficiency levels in the pre-crisis and post-crisis period eventhough the score is slightly higher than the pre-crisis period. The following analysis will proceed with the correlation of the internal and external variables that affect the financial efficiency levels of the MFIs in ASEAN 4 countries.

Test Statistics		Parametric Test		Non-parametric Test			
		t-test		Mann-Whitney Test		Kruskall-Wallis Test	
		t(Prb > t)		Z(Prb > z)		$\chi^2(\text{Prb} > \chi^2)$	
Measure of Efficiency	Period	Mean	t	Mean Rank	z	Mean Rank	$\chi^2$
TE	Pre-Crisis	0.823	-1.251	646.430	-1.584	646.430	2.510
	Post-Crisis	0.834		679.760		679.760	
PTE	Pre-Crisis	0.894	0.333	663.870	-0.057	663.870	0.003
	Post-Crisis	0.892		665.040		665.040	
SE	Pre-Crisis	0.923	-2.062***	635.740	-2.527***	635.740	6.384***
	Post-Crisis	0.936		688.790		688.790	

Table 5: Robustness Tests for Financial Efficiency Score of MFIs in the Event of Pre and Post-Financial Crisis

## 4.2. Impact of Firm Characteristics on Financial Efficiency of MFIs during the Pre-Crisis Period (2000–2007)

Table 6 documented the results of the panel static regression analysis of the financial efficiency of the MFIs during the pre-crisis period. It shows a positive relationship for the size (ta) and age (age) of the MFIs during the pre-crisis period with financial efficiency. This is opposite with leverage (der) where it shows a negative relation with the MFIs' financial efficiency. These findings are all relevant at a significant level of 1%.

The findings show that the size of MFIs is positively significant to the financial efficiency level, implying that larger (smaller) MFIs contribute to higher (lower) financial efficiency. As MFIs went commercialised, they broaden the variety of banking products accessible, including investments, money transfers, insurance, and deposits, as well as increase number

of microcredits to the poor borrower. Concisely, when MFIs grow in size, the institution concentrates on financial efficiency. The MFIs most likely utilise high technology to support their daily operation, like the use of online and mobile banking, to operate for the institution, and to work efficiently rather than relying on labour and outdated time-intensive methods. The results are agreeing with past studies such as Wijesiri et al., (2015), Imai et al., (2011), and Singh et al., (2013).

Within the similar period before the crisis, the relation between the operating age (age) and financial efficiency were a positive relationship at 1% significant level. This shows that older (younger) MFIs generate higher (lower) financial efficiency as compared to the younger (older) MFIs. This indicates the longer operation of the MFIs can be related with firm experience, that investing time in the market with mature MFIs, could enhance the opportunity of succeeding in financial sustainability. This result is in line with previous studies by Yenesew (2014)



and Wijesiri et al., (2015).

Table 6 indicates a negative relationship and significant between financial leverage (der) and financial efficiency of the MFIs during the pre-crisis period, at a 1% level. This leads to a concern that higher (lower) leverage causes the financial performance of the MFIs to deteriorate (increase). The theory proposed by Ngo (2012) recommends a situation of higher leverage can cause total liabilities to exceed total assets, which implies that many MFIs have negative effect as they struggle to produce adequate revenue to cover total costs. This proves that the MFIs hardly recover money from debt and unable to pay income to their shareholders. Whereas it is extremely unsustainable for a high DER, though it compromises the relative flow of sales. This is because the risk becomes high as DER is higher (Abrar & Javaid, 2016), due to reliance on the debt that yields a negative effect on the MFIs credit rating. This negative result reflects to Ngo (2012).

### 4.3. Impact of Macroeconomic Conditions on Financial Efficiency of MFIs during the Pre-Crisis Period (2000–2007)

From the Table 6, it can be found the result of the panel static regression between macroeconomic conditions towards financial efficiency of MFIs in times of pre-crisis period. Based on a panel data regression analysis, the results reveal that economy growth (gdp) and inflation (inf) are both negatively significance at 1% efficiency level, contradict to the foreign direct investment (fdi) where there is no significant relationship to explain the financial efficiency of MFIs during the pre-crisis period.

Between economy growth (gdp) and the financial efficiency of the MFIs, it reveals a negative and significant correlation among them. During the pre-crisis period, the result suggests, high (low) GDP growth has decreased (increases) the score of

financial efficiency of the MFIs. The outcome shows that poor households appear to become part of commercial banks as they start to generate high incomes and have been deprived of poverty because many of the advantages in terms of financial products have been offered to them by banks as compared to MFIs. This eventually will slow down MFIs' demand for microcredit and distracts funding initiatives, thus reducing financial system liquidity. In brief, agreeing with Ngo's (2012) findings, the results recommended the increase of economy growth will bring a negative effect on the financial performance of MFIs.

The correlation between inflation (inf) and the financial efficiency of MFIs is negative and significant as in Table 6. This suggests that the high (low) rate of inflation tends to yield a lower (higher) financial efficiency prior to the crisis. The expenses of the MFIs and the cost of capital are projected to increase during a high inflation condition due to rises in prices for all commodities. The revenue will be decreased and MFIs funding operations will be distracted when there are increases in expenditures and capital costs. For the borrowers, they will face problems to repay the loan when the higher price in general goods are not tally as their incomes remain stagnant. As consequence, it lead to failed in loan repayment and have impacted the financial performance of the MFIs. Researches by Cull et al., (2011), Daher and Le Saout (2012) and Ngo (2012) documented the same results

On the contrary, there is no significant connection between the foreign direct investment (fdi) to the improvement on financial efficiency in the MFIs that occurred prior the crisis (refer Table 6). This result suggests that the financial performance of MFIs is not affected by any intervention of FDI. The finding of this insignificant correlation is consistent with research done by Forkusam (2015) and Claessens et al., (2001).

Variables	Model 1a			Model 2a		
	OLS	REM	FEM	OLS	REM	FEM
Constant	-1.640	-5.250	-7.460	-2.130	-5.210***	-8.020***
	(-0.189)	(0.204)	(0.247)	(0.195)	(0.205)	(0.248)
Firm Characteristic Variables						
ta	1.510	4.530***	6.380***	1.310	4.440***	7.020***
	(0.007)	(0.011)	(0.016)	(0.007)	(0.011)	(0.016)
age	6.650***	5.050***	3.510***	6.690***	4.780***	4.950***
	(0.012)	(0.018)	(0.027)	(0.013)	(0.019)	(0.033)
der	-1.530	-0.780	-0.820***	-1.500	-0.820	-0.690
	(0.056)	(0.049)	(0.050)	(0.056)	(0.049)	(0.049)
Macroeconomic Condition Variables						
gdp				2.210***	-0.410	-2.940***
				(0.019)	(0.017)	(0.020)
inf				1.640	0.240	-2.020***
				(0.023)	(0.021)	(0.023)
fdi				-0.390	-0.150	-1.280
				(0.028)	(0.026)	(0.028)
Adjusted R2	0.083	0.072	0.053	0.091	0.071	0.057
BP & LM x2		326.690***			303.000***	
Hausman x2		32.140***			36.330***	
Mean VIF	1.110			1.200		
No. of Obs.	608	608	608	608	608	608
Notes: *** indicates significance at the 1% levels. Figure in parentheses ( ) are standard error.						

Table 6: Result of Panel Static Regression Analysis on Financial Efficiency in the Event of Pre-Financial Crisis (2000–2007)



#### 4.4. Impact of Firm Characteristics on Financial Efficiency of MFIs during the Post-Crisis Period (2010–2017)

It shows the performance of the static panel regression analysis on the impact of firm characteristics to affect the financial efficiency for post-crisis of the MFIs in Table 7. There is a similar trend, where the size (ta) and age (age) of MFIs influence financial efficiency positively at 1% in the post-crisis period. The leverage (der) however, was not significant or related to the financial efficiency of the MFIs.

Findings from the size (ta) describes larger (smaller) MFIs with a propensity to have higher (lower) financial efficiency levels portrays a positive relationship in Table 7. This is because, as MFIs went commercialised, they grow in size where they are not only to offer microcredits as previous but to broaden the range of banking products including investments, money transfer, insurance, and deposits. In brief, since the MFI is on a larger scale, the operation is more oriented on financial efficiency. Besides, more latest technology is provided in large MFIs to each of the participating institutions, for example using mobile and online banking, to operate more cost-effectively than smaller MFIs that rely on old and time-consuming approaches. This positive relationship with the financial performance shown by past studies, such as those by Singh et al., (2013), Imai et al., (2011), and Wijesiri et al., (2015).

Similarly, a positive relationship can also be seen between the age of operation (age) and financial performance during the post-crisis period at a 1% significance level. This clearly proves the score of financial efficiency for older (younger) MFIs is higher (lower) as compared to younger (older) MFIs. This is due to all operations related to microcredit issuance are steadily increasing in control for MFIs. It may also be credited to their business expertise, that manage to improve their chances of achieving financial sustainability as mature MFIs spend conservative time to penetrate the market (Rahman et al 2016). These findings are in line with earlier studies conducted by Yenesew (2014) and Wijesiri et al., (2015).

However, in Table 7, the leverage (der) coefficient is insignificant to explain any changes to the MFI's financial efficiency in the post-crisis period. The financial efficiency of the MFIs is unable to be justified by the high (low) leverage. It describes the significant relation to affect the MFI's financial efficiency in the post-crisis period cannot be provided by debt-to-equity ratio. This discloses that certain variables appear unusual and could not explain the variation in financial efficiency of MFIs due to the impact of the crisis. This result can be related to the previous Yenesew (2014), Quayes (2015), Tamene Woldeyes (2012), and Muriu (2012) study, which indicates that

the MFIs have no significant relationship with leverage.

#### 4.5. Impact of Macroeconomic Conditions on Financial Efficiency of MFIs during the Post-Crisis Period (2010–2017)

According to the macroeconomic factors in Table 7, it appears a mixed findings where some of them is found significant and insignificant to clarify the financial efficiency of the MFI's in post-crisis period. According to Table 7, there is no significant link between economy growth (gdp) and inflation (inf) are formed in determining the score of the financial efficiency of the MFIs through the panel's static regression analysis. Besides, at a 1% significance level it shows the variance of the financial performance of the MFIs is negatively associated with the foreign direct investment (fdi).

The insignificant relationship between the economy growth (gdp) with the financial efficiency of the MFIs for the post-crisis period suggests that the higher (lower) GDP growth has failed to explain the financial efficiency of the MFIs. This result shows the changes of financial efficiency of the MFIs is unable to explain by the movement in GDP following crisis events. This elaborates that the crisis has provide unusual movement in GDP. This result supports the previous study by Alimi (2015) that discovered the same insignificant finding.

In addition, Table 7 also unveiled that there no significant relation between inflation (inf) variable and financial efficiency. This circulates that the variation in financial efficiency of the MFIs for the post-crisis period is not upheld by any increase (decreases) in inflation. The cause of the uncommon inflation data and become the reason for the variations in financial efficiency to be unjustified can be affected by the sturdy impact of the crisis. The result is found to be in line with the study from Zaidi et al., (2008) and Ngo, (2012).

On the other hand, there is a negative relationship between foreign direct investment (fdi) and MFIs' financial efficiency at 1% significant level as reported in Table 7. The result describes the more (lesser) number of the FDI being involved, the lower (higher) the score of efficiency level among the MFIs. This is because the stability of MFIs is affected as countries more opened to FDI. The MFIs face difficulties to compete with the large size, technology advancement, and skilled labour that are benefited by the FDI. Amidst constant demand, the domination of the FDI in the financial market may cause oversupply for financing products that are provided by the MFIs, that cause the sustainability of the MFIs seems can no longer be maintained in the acceleration of the FDI. Findings by Hermes et al., (2011), Ahlin et al., (2011), and Zainal (2019) supported the grounds.

Variables	Model 1b			Model 2b		
	OLS	REM	FEM	OLS	REM	FEM
Constant	-2.220*** (0.230)	-3.070*** (0.226)	-4.420*** (0.341)	-1.480 (0.242)	-2.460*** (0.235)	-4.360*** (0.361)
Firm Characteristic Variables						
ta	4.390*** (0.005)	2.860*** (0.008)	3.150*** (0.019)	3.950*** (0.005)	2.790*** (0.008)	3.420*** (0.020)
age	-0.700 (0.014)	1.830** (0.020)	3.820*** (0.032)	-0.880 (0.015)	1.440 (0.021)	4.350*** (0.034)
der	-0.100 (0.054)	0.040 (0.046)	0.100 (0.046)	0.120 (0.054)	0.210 (0.047)	0.210 (0.046)
Macroeconomic Condition Variables						
gdp				-1.480 (0.059)	-1.300 (0.048)	-1.020 (0.047)
inf				-2.340*** (0.016)	-1.140 (0.014)	0.960 (0.015)

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fdi				0.960	-0.120	-1.990***
				(0.013)	(0.017)	(0.023)
Adjusted R2	0.025	0.021	0.019	0.030	0.025	0.015
BP & LM x2		270.700***			260.670***	
Hausman x2		27.180***			32.360***	
Mean VIF	1.140			1.260		
No. of Obs.	720	720	720	720	720	720
Notes: *** indicates significance at the 1% levels. Figure in parentheses ( ) are standard error.						

Table 7: Result of Panel Static Regression Analysis on Financial Efficiency during the Post-Financial Crisis (2010–2017)

Consequently, the findings of the study achieve the following hypotheses:

H1: Financial efficiency levels vary significantly between MFIs of ASEAN 4 countries during pre and post-financial crisis.

H2: Firm characteristics have a significant different effect on financial efficiency of the MFIs in ASEAN 4 countries between pre and post-financial crisis.

H3: Macroeconomic conditions show a significant different impact to the level of financial efficiency of the MFIs in ASEAN 4 countries between pre and post-financial crisis.

## 5. Conclusions and Recommendations

The findings indicate financial efficiency levels vary significantly between the pre and post-financial crisis levels of MFIs in ASEAN 4 countries since the average TE during the post-financial crisis is much greater (83.4%) than the average TE in the post-financial crisis (82.3%). This shows that in time after the crisis, between 2010 and 2017, the MFIs in ASEAN 4 countries have been resilient therefore their financial efficiency is not affected by the economic crisis. The findings also present the input wastage in the pre-crisis years was higher compared with less input wastage in the post-crisis years for the financial efficiency of MFIs. The main cause of inefficiency in financial efficiency score was the management ineffectiveness for using resources entirely in both crisis events. However, the overall results show that all the MFIs operate in ASEAN 4 countries at optimum efficiency levels.

Furthermore, the analysis shows that overall, the firm characteristics that serve as internal determinants present a comparable vision in determining the financial efficiency of the MFIs in ASEAN 4 countries between pre and post-financial crisis. As the MFIs in ASEAN 4 countries are increasing in size and age, they perform efficiently in both pre and post-crisis periods. High financial leverage, on the other hand, is likely to degrade the financial efficiency of MFI during the pre-crisis period and have no significant influence following the crisis period. The insignificant relation implies that the crisis events may have contributed to the fact that leverage factors appear irregular and that the variance in financial efficiency of MFIs could not be defined.

Furthermore, given the macroeconomic conditions that serve as an external determinant, the study demonstrates a different direction that affects the financial efficiency of MFIs in ASEAN 4 countries before and after the financial crisis. MFIs faced difficulties to survive in the pre-crisis years under good economy growth and strong inflation, whereas foreign direct investment provides no association. Following the crisis alternatively, economy growth and inflation provide no connection while the presence of FDI distracts the efficiency of the MFIs. This result clearly shows that, as a result of the financial crisis, haywire data may have been involved, resulting in unexplainable fluctuations in financial efficiency levels.

To conclude, most of the variables delivered insignificant results after the hit of the financial crisis. The negatively correlation prior the crisis has been shifted to insignificant results

right after the financial crisis and this include leverage, growth, and inflation. The fact that impact of the crisis has resulted that certain variable appear unusual thus could not explain the movement in financial efficiency of the MFIs. By addressing those intervals in the latest literature, the results of this study provide value added to microfinance literature, in particular the absence of a complete study of MFIs' evaluation performance in ASEAN countries during and after the financial crisis. This study would provide meaningful information on the long-term sustainability of MFIs and to equip for any concurrent economic crisis in near future. This has to be done in accordance with the real purposes of the MFIs which is to eradicate poverty and provide continuous financial access to the poor.

The study also has a practical relevance for management of MFIs aimed at achieving financially efficient in the long-run. The results of this study will guide MFI management in decision making to enhance the financial performance of the MFIs. This includes the adaptation of the variables that significant to influence financial efficiency of the MFIs. It will ultimately enable institutions and bank regulators to solve some of the problems that MFIs face within the business, regardless of operational size, age, and financial leverage. Moreover, the output from this study also will provide a guideline for policy adjustment in order to enhance microfinance industry thus to have an impetus impact to economic growth.

Few suggestions for future researchers firstly, with the current global COVID-19 crisis that give impact to economic condition for most of the countries, future researcher might include this event by investigating the effect to performance of the MFIs from the perspective of health crisis. Secondly, they may study the impact of institutional risk and the effect of monetary policy on the financial performance of the MFIs. Furthermore, the further analysis shall be carried out for an intermediate approach to assess the efficiency of the MFI.

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