



Impact of Macroeconomic Conditions on Financial Efficiency of Microfinance Institutions: Evidence from Pre and Post- Financial Crisis

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Abstract

Since the financial crisis of 2007–2009, a very tough situation has been encountered across the financial sector. The crisis has shown that it has hampered economic development, including banking institutions. The effect of the crisis is not excluded from the operations of the Microfinance Institutions (MFIs), as it today constitutes an integral part of the financial system. This paper intends to analyse the pre-crisis and post-crisis financial efficiency levels of the MFIs as the first objective. Next, to examine the effect on the financial efficiency level in both crisis periods upon macroeconomic conditions. Data were collected from 166 MFIs of ASEAN 4 countries from 2000-2007 (pre-crisis) and 2010-2017 (post-crisis), comprising Philippines, Vietnam, Cambodia, and Indonesia. The first phase of the

analysis uses Data Envelopment Analysis to determine financial efficiency levels. The second phase employs Multivariate Panel Regression Analysis to examine the effect of macroeconomic conditions towards the level of financial efficiency obtained in the first phase. The first-phase result reveals the post-financial crisis efficiency score is barely higher than the pre-crisis efficiency score. This indicates that MFIs are financially efficient during crisis occurrences and afford to support the operation over a long-term basis. In the second phase, the regression analysis provides mixed findings, both significant and insignificant macroeconomic conditions affecting the financial efficiency of MFIs. The insignificant results show the consequences of the crisis explain some variables were unable to clarify the variation of the first-phase financial efficiency score of MFIs. Generally, the findings of this study will assist the microfinance industry to prepare itself for any potential crisis. This is important with the role of the MFIs in assisting the poor to ensure they are pulled out of a circle of poverty.

Keywords

Financial Crisis; Financial Efficiency; Macroeconomic Conditions; Data Envelopment Analysis; Panel Regression.

Introduction

In this study, financial efficiency fulfills as a proxy to display the performance of MFIs. According to a study conducted by Vanroose and D'Espallier (2013), they have found that it is growing a norm for assessing the performance of MFIs in the view of financial efficiency. It retains the MFIs' social position in poverty eradication while simultaneously striving to sustain business activities for a longer period. As several of the earlier studies revealed, financial efficiency approaches for sustainability could be regarded as exemplary practices that coincide with the principle of MFIs (Haq et al., 2010).

In revising the root of the financial crisis from 2007 until 2009, the high default rate in the United States subprime home mortgage business was the evolving factor that contributes to the crisis, since most home creditors were not paying regularly.

According to Singhania and Anchalia (2013), the crisis caused a collapse in most of the business, a significant decrease in consumers' incomes, and also a downturn in economic activities, which directly hampered and disrupted ASEAN markets. Numerous researches have reported that the financial crisis has adversely affected the banking industry (Beltratti & Stulz, 2012; Berger & Bouwman, 2013; Dietrich & Wanzenried, 2011). As MFIs today form an essential part of the financial system, the implication also not excepted from the activity of the MFIs. In fact, Lützenkirchen and Weistroffer (2012) have discovered the first crucial hindrance in microfinance in 2007.

The performance of MFIs by T. V. Ngo (2013) is being affected by the crisis since most poor borrowers are facing challenges in payment of the monthly loan and leading to a decrease in loan portfolio reliability. Savings had to be deferred

and many consumers had difficulties paying back Stephen (2013). This shows that MFIs face major challenges in their profitability because they cannot manage loan portfolios effectively. That explains why MFIs have declined over ten years the growth in the gross loan portfolio (CGAP, 2011).

According to Mohammed and Farouq (2018), the most significant source of income for sustainable MFIs is financial revenue from the loan portfolio, which explains why prior literature (Piot-Lepetit & Nzongang, 2014; Wijesiri et al., 2015) included financial revenue as an indicator to measure MFI's performance. Despite this, the drastic decrease in financial revenue of the MFIs from 2007 until 2009 is observable, as shown in Figure 1 reported by the World Development Indicators. The percentage of financial revenues reported in 2007 was 18.34%, with the figure quickly falling to 16.04% in 2009.

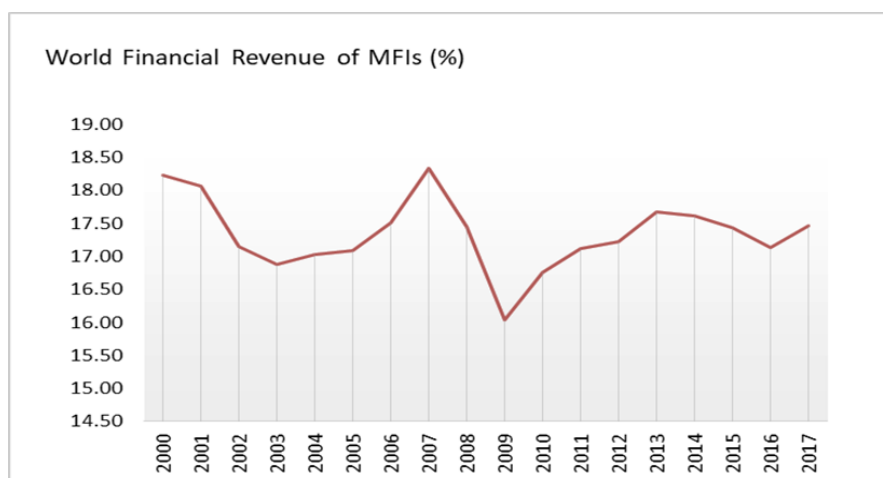


Figure 1 Financial Revenue of Microfinance Institutions
Source: The World Bank (2015) – World Development Indicator

Even so, there was a minimal attempt to examine the significant differences in the financial performance of MFIs associate with the economic crisis (Aemiro & Mekonnen, 2012; Di Bella, 2011; Sainz-Fernandez et al., 2015) as many are targeted at banks and have very few empirical findings available on efficiency in ASEAN countries (Tahir & Tahrim, 2013). With regards to financial efficiency, the novelty of this study is to addresses the ability of the MFIs to undergone pre and post-financial crisis specifically in South East Asia region.

On top of that,Donou-Adonsou and Sylwester (2015) issued the concern that the macroeconomic effects of microfinance have not been previously empirically examined. This was supported by Zainal et al. (2021) which also issued the same concern where the study of macroeconomic effects of economy-wide microfinance is largely undiscovered. This announces the next issue where the macroeconomic effects on the financial performance of microfinance throughout the crisis have been enormously unexplored. Therefore, it is undeniably necessary to investigate the shifts in external factors of macroeconomic variables that affect the financial efficiency of the MFIs during pre and post-financial crisis.

To rectify the issue adequately, the study aims at analyzing the financial

performance of the MFIs as its first objective in the setting pre and post the financial crisis. Following that, the study also aims to examine the effect of macroeconomic conditions on financial efficiency level during the period of pre and post-financial crisis. The rest of this paper is arranged accordingly. Section 2 includes a review of the theoretical and prevailing literature concerning the financial performance of MFIs and the factors involved. The data, the estimation method, and the model are outlined in Section 3. The conceptual findings are contained in Section 4, and the summaries and conclusions in Section 5.

Theoretical and Literature Framework

Since the introduction by Charnes et al. (1979), which later was extended by Banker et al. (1984), most researchers and practitioners have taken Data Envelopment Analysis (DEA) as their approach to carrying out evaluations in financial institutions, including in MFIs. In the beginning period, the MFIs were recognized as microcredits, providing a credit delivery system for the poor in general. Wagner and Winkler (2013) disclosed that microfinance began functioning as an institution of subsidy dependence where the allocated funds were regulated by specific donors and administrations. Over the years, microfinance was no more a subsidy receiver and was commercialized in the 1990s from the subsidy scheme to full-scale banking businesses. It was eventually expanded to include a wide range of financial products such as money transfers, insurance, and investments.

Presently, the requirement for MFIs has been financially stable to cater to poor households with continued financial services. The concepts of financially stable in MFIs are different from other financial institutions Ponce et al. (2021) since they demonstrate the capability of MFIs to alleviate subsidy dependency and reinforce their scope by providing financial services to an enormous number of the poor. The study conducted by Hussain et al. (2020) has shown that MFIs progressed towards achieving outreach and sustainability between 2001 and 2005, but the trend had worsened in 2006 and 2007. The study indicates that MFIs must concentrate on enhancing financial performance and reducing subsidy reliance.

In recent decades, there has been a comprehensive and thorough study of efficiency for financial institution. Efficiency in definition as described by Othman et al. (2016) is the ratio of output to input, whereas more output per input unit means better efficiency, meanwhile, maximum output per input unit is optimum efficiency. Noor et al. (2020) reported that efficiency measuring recognized the company's ability to maximize production and income and minimize its cost at the same time. Othman et al. (2016) stated that the institution's total performance depending on the four aspects for an efficiency assessment; (1) technical efficiency, (2) efficiency scale, (3) price efficiency, and (4) allocative efficiency. Financial efficiency, as claimed by Al-Azzam (2019), shall be seen as a measure of technical efficiency (TE), which assesses a reasonable reduction in the use of input, which can be achieved when the business operates at an optimal frontier, or when the effectiveness of a minimum set of inputs is used to obtain maximum output.

On another note, prior studies show that before disruptions from the crisis

made a hard hit, MFIs' performance was stable. These included studies conducted by M. Wijesiri (2016) Khan et al. (2018) and Singhanian and Anchalia (2013) that showed the recession's severe impact from MFIs including banking and non-banking financial institutions (NBFIs), an absolute gap before the crisis. Taking into account their success years before the crisis, all findings have shown that the MFIs have been in good shape and at their best performance. In parallel, Wagner and Winkler (2013) findings showed that MFIs are heavily involved in the domestic and global capital markets in the pre-crisis years that they achieve higher credit growth. Daher and Le Saout (2015) as well recorded the results in profitability and the years before the crisis of a statistically significant and positive relationship.

Eventually, in the years after the crisis, recent research has shown mixed findings. A decrease in ratio analysis was found by Khan et al. (2018), which indicates an improvement in the performance of MFIs in years after the crisis. Contrary to banks, Silva and Chávez (2015) reported that MFI's were far more robust to the global financial crisis and claimed that governments are committing to ensuring greater access of countries with better-developed financial systems to financing and sustainability. M. Wijesiri (2016) described discrepancies in the productivity response of the MFI to the crisis, with non-governmental organizations (NGOs) and cooperatives less disturbed, whereas microfinance banks and NBFIs did suffer badly. The latter is consistent with the findings by Daher and Le Saout (2015) and Wagner and Winkler (2013) that their post-crisis findings were too extreme for micro-entrepreneurs to endure.

In most cases, the researchers illustrated the economic growth in terms of real GDP per capita. Studies by Kar and Bali Swain (2018), Vanroose and D'Espallier (2013) as well as Assefa et al. (2013) provided evidence that the GDP delivers a positive effect that lessens the risk of loan repayment, that the healthiness of the economy encourages more financing activities to be offered by the financial institutions, thus allows the MFIs to grant more credit to poor people. This situation facilitates poor people from setting up their small business, which then will generate returns progressively. Ngo and Trong (2012) however, had revealed the negative relationship, which signifies an increase in GDP yields to lower financial performance, immediately after poor households begin to produce a high level of income and have been destitute of poverty. They tend to enhance themselves from the incitement of the MFIs hence become part of the commercial banks. This situation deliver to a lower number of borrowers and subsequently produce an unfavourable impact on the revenue of the MFIs. While Alimi (2015) found no relation between financial performance and economic growth, which corresponds to statistical problems in the data, the insignificant result was presented.

Besides, inflation indicates the purchasing power of money and measured by studying at the Consumer Price Index (CPI) over a period of time. Assefa et al. (2013), the study found a positive correlation between inflation and the performance of MFIs which suggests the MFIs hardly ever got affected during the period of soaring inflation since the operation in MFIs unusually involved in the

financial market. Encouragement in economic activity result in reducing unemployment and facilitate the problems of balance of payment. Contrarily, Cull et al. (2011) indicates a negative relationship pertaining to inflation, since MFIs nowadays are more involved in the financial market, therefore high inflation might affect the higher cost of inputs that drives to a lower level of revenue. Daher and Le Saout (2015) supports the findings since MFIs do not appropriately forecast an increase in inflation, thus faced with an increase in expenses, which would harm their profitability. Despite that, Ngo and Trong (2012) had presented evidence that inflation is insignificant to the performance of the MFIs, and inferred data to be unusual, and that explains for fluctuations in financial performance is unjustified.

Furthermore, the foreign direct investment (FDI) is not solely on the changes of ownership, it typically involves the factors of respectful transfer to capital, including organisational skills, management, and technology enhancement. Vanroose and D'Espallier (2013) revealed that FDI is a significant factor to develop the performance of MFIs, through which a higher FDI contributes to the greater level of profitability of MFIs performance. In the meantime, Hermes et al. (2011) and Roslan et al. (2019) had provided different findings where the results displayed FDI to be negatively and significantly affecting the financial efficiency of MFIs. The large size, technology advancement, and skilled labour that are benefited by the FDI make the situation to be difficult for the MFIs to compete. Daher and Le Saout (2015) also adds, it develops the most significant external risk for MFIs profitability, outstandingly in the appearance of inappropriate asset-liability management. Notwithstanding, Forkusam (2015) found that FDI to be insignificantly related to the financial performance of MFIs. Any differences in the FDI, whether higher or lower FDI, does not affect the financial performance of MFIs.

Accordingly, the study suggests the following hypotheses from the literature:

- H1: The level of financial efficiency differs significantly between microfinance institutions in ASEAN 4 countries during pre and post-financial crisis.
- H2: Macroeconomic conditions provides a significant different effect to the level of financial efficiency of the MFIs during pre and post-financial crisis.

Data and Research Methodology

The MFI data has been obtained from the Microfinance Info Exchange (MIX) website, which contains detailed financial information from worldwide MFIs (Assefa et al., 2013; Vanroose & D'Espallier, 2013; Widiarto & Emrouznejad, 2015). According to Vanroose and D'Espallier (2013), the MIX market has been widely used in microfinance studies as the largest available database of MFIs.

Data were obtained from targeted South East Asian countries (ASEAN 4) comprising the Philippines, Vietnam, Cambodia, and Indonesia. The main reason for the inclusion of ASEAN 4 in the data analysis because it comprises of developing countries that own significant number of vulnerable people served by MFIs.

Across nine regions worldwide, over 4,000 MFIs have been recorded to the

MIX Market Database, as indicated by Kabir Hassan et al. (2012). Despite that, 166 ASEAN 4 MFIs from 2000 to 2007 (pre-crisis) and from 2010 to 2017 (post-crisis) were presented for this study. This time was chosen based on how MFIs work in pre and post-financial crisis situations. Ultimately, the analysis would contain a total of 1328 observation data.

First Stage: Data Envelopment Analysis (DEA)

As Farrell (1957) proposed the generalisation of efficiency, Charnes et al. (1979) presented the DEA for the first time and simplified it according to their names as the model of the CCR. The CCR model has been evaluated based on constant returns to scale (CRS). The CCR model assumes that the application of the CRS does not have a significant connection between the operation scale and efficiency, where the overall technical efficiency (OTE) is achieved. The assumption of CRS would be acceptable only if all DMUs operated on an optimal scale. But, in practice, institutions or DMUs may face economies or diseconomies of scale (Roslan et al., 2019). Hence, if it is beliefs CRS, when not all DMUs are running at optimal scale, the evaluated OTE will have a negative impact by scale inefficiency (SIE). This presumption was not relevant in imperfectly competitive markets.

Later, in 1984, the improvement in the CCR model has been made by Banker, Charnes, and Cooper with an extended version model that minimises the CRS assumptions. The generalization derived from their names was the BCC model, which used the variable returns to scale (VRS) to calculate the efficiency of the DMU. The VRS assumptions include the score of total efficiency (TE) and segmented into PTE and SE. Roslan et al. (2019) suggested that the PTE tests the DMU from the perspective of managerial efficiencies in terms of financial efficiency without being corrupted by scale. In the meantime, the SE determines the appropriate size of the DMU to operate in the form of financial efficiency. The VRS results could thus produce accurate DMU efficiency results in comparison with CRS (Coelli et al., 1988; Sufian, 2004). In this study, the TE is used to calculate the financial efficiency for the MFIs, which reflects the overall score of efficiency.

In the course of CRS and VRS assumptions, Coelli et al. (1988) suggests that DMU has Scale Inefficiency (SIE) if there are inconsistencies in the scores for a given DMU in the TE. In brief, the SIE is calculated on the basis of the variations between the score of VRS PTE and the score of CRS TE. Indeed, the existence of SIE under VRS, which partially due to an increasing return to scale (IRS) or decreasing return to scale (DRS), is determined by additional DEA problems together with non-increasing return to scale (NIRS) (Kamarudin et al., 2015).

Charnes et al. (1979) implied that DEA identifies units that can describe various inputs and outputs appropriately. DEA encourages the selection of its own proper weights for each DMU to optimize its efficiency. Therefore, the efficiency of Unit j must be less than or equivalent in order to maximize its efficiency. It should be evaluated as (Bader et al., 2008):

$$\begin{aligned}
 \text{Maximise efficiency of unit } j &= \sum_{r=1}^s u_r y_{rj} & (1) \\
 \text{Subject to} & \sum_{i=1}^m v_i x_{ij} = 1 \\
 & \sum_{i=1}^m v_i x_{ij} - \sum_{r=1}^s u_r y_{rj} \leq 1 & j=1, 2, \dots, n \\
 & u_r \geq \varepsilon & r=1, 2, \dots, s \\
 & v_i \geq \varepsilon & i=1, 2, \dots, m
 \end{aligned}$$

As described, financial revenues are the metric used to measure financial efficiency. Table 1 best explains the variables involved in assessing financial efficiency:

Table 1 Input and Output Variables for Financial Efficiency, (y_2)

Variables	Mean	Min	Max	SD	No. of DMU
Pre-Crisis Events					
Output of MFIs					
Financial revenue (in million USD)	13.309	6.765	18.628	1.478	608
Inputs of MFIs					
Total assets (in million USD)	14.786	10.507	21.534	1.553	608
Operating expense (in million USD)	12.783	8.236	18.081	1.542	608
Personnel expense (in million USD)	12.362	8.494	17.527	1.510	608
Post-Crisis Events					
Output of MFIs					
Financial revenue (in million USD)	14.371	5.106	20.301	2.367	720
Inputs of MFIs					
Total assets (in million USD)	15.932	8.524	22.786	2.325	720
Operating expense (in million USD)	13.900	7.662	19.314	2.251	720
Personnel expense (in million USD)	13.376	6.999	18.579	2.192	720

Notes: All sources from MIX Market database (www.mixmarket.org)

Undoubtedly, the number of input and output variables adopted in the analysis is consistent with the (Cooper et al., 2007) rule of thumb. In both crisis, 166 MFIs surpass financial efficiency input and output variables, the choice of variables is justifiable as m and s inputs and n DMUs, $m \times s \leq n$, where $15(3 \times 2)$, and $15(3 \times 1)$ (Boussofiane et al., 1991). This confirms the choice of variables for analysing the efficiency of DMUs in the study.

Second Stage: Multivariate Panel Regression Approach (MPRA)

The estimation methods employed in the second stage of MPRA shall involve the pooled Ordinary Least Square (OLS), the Fixed Effect Model (FEM), and the Random Effect Model (REM). Regression models, as reported in McDonald (2009), emanate from the White (1980) transformation. Only when the distribution of

disturbances is present in regression analysis, which involves the dependent variable of the DEA score, this model is declared strong for heteroskedasticity. However, the Breusch Pagan (BP) and Lagrangian Multiplier (LM) tests should be performed to decide whether the data is suitable for pooling or paneling before the results have been fully focused according to the estimate of pooled OLS approach. Thus, when the p-value of the Breusch and Lagrangian Chi-Square (X^2) multipliers are relevant at 5%, panel data from pooling should be more acceptable (Roslan et al., 2019).

Gujarati (2004) showed that the panel data revealed a wide range of estimates and inference problems. Because these data include both the cross-sectional and time dimensions, problems such as heteroskedasticity and autocorrelation should be thoroughly recognised. There are various possible problems such as the cross-correlation at the same time of individual units. Therefore, different methods for estimating one of these problems are used to address. The two most important are FEM and REM. Hausman's testing figures include the asymptotic distribution of Chi-Square (X^2). As the null hypothesis is rejected (at 1% to 5% significant levels), it is best suited to use the FEM rather than the REM. However, when the null-hypothesis fail to reject, or at 10% significance, the REM is most suitable to use.

Previous empirical studies suggested that macroeconomic variables were primarily based on economic tradition, where they stressed the importance of external market factors in determining the success of a firm. They generally include inflation, Gross Domestic Product (GDP) per capita, population, unemployment, and interest rates as the external variables. The typical approach to explore the effect of macroeconomic conditions has been examining the influence caused by GDP growth per capita and inflation on the performance of MFIs Ngo and Trong (2012). The current study will, therefore, pursue previous studies (Ahlin et al., 2011; Assefa et al., 2013; Obi et al., 2009; Vanroose & D'Espallier, 2013) to recognise economy growth, inflation, and foreign direct investment as external factors that have specific effects on the degree of financial efficiency of MFIs. Table 2 displays all the details of external determinants that affect the efficiency of the MFIs.

Table 2 Details on the Variables of Macroeconomic Conditions of MFIs

Variables	Descriptions
<i>Dependent</i>	
Financial Efficiency (<i>lfe</i>)	The level of financial efficiency in DEA
<i>Independent</i>	
Economy growth (<i>lgdp</i>)	The real GDP growth per capita
Inflation (<i>linf</i>)	The percentage change in the general level prices of goods and services
Foreign direct investment (<i>lfdi</i>)	Measures as a net outflow of inflow as percentage of GDP

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

Hence, the general estimation models are then expressed as follows:

$$Financial\ efficiency_{i,t} = \beta_{i,t} \left(\sum Macroeconomic\ Conditions_t \right) + \varepsilon_{i,t} \quad (2)$$

(Pre-crisis) $lfe_{i,t} = \beta_0 + \beta_1 lgdpt + \beta_2 linft + \beta_3 lfdit + \varepsilon_{i,t} \quad (3)$

(Post-crisis) $lfe_{i,t} = \beta_0 + \beta_1 lgdpt + \beta_2 linft + \beta_3 lfdit + \varepsilon_{i,t} \quad (4)$

Results and Discussions

Financial Efficiency Score between Pre-Financial Crisis and Post-Financial Crisis Events

Table 3 Financial Efficiency Score of MFIs in ASEAN 4 Countries during Pre Financial Crisis (2000–2007) and Post-Financial Crisis (2010–2017)

Efficiency Measures	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
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

This section first presents the pre and post-financial crisis results obtained

by the DEA analysis of the financial efficiency score. The section will then go through parametric and non-parametric robustness tests before the panel regression is finally carried out.

Table 3 provides the average mean TE for ASEAN 4 countries of their financial efficiency score in the period of pre and post-financial crisis. The average TE of financial efficiency during the post-crisis period equivalent to 83.4% is marginally higher for the whole year (see Table I and Panel R in Table 3) than the pre-crisis period, with TE of financial efficiency was 82.3%. In the pre-crisis period, there is undeniably a slightly high wastage generated, with a total of 17.7% wastage, compared to wastage for the post-crisis period, a total of 16.6% on producing financial efficiency. Table 3 further indicates that both crisis cycles were severely affectable to the management's inefficiency, despite the optimum efficiency of all MFIs in ASEAN 4 countries (as pre-crisis PTIE = 10.6% > SIE = 7.7%, and post-crisis PTIE = 10.8% > SIE = 6.4%).

The MFIs were able to record no major differences in the financial efficiency score in ASEAN 4 countries after the financial crisis, with an improvement of 1.07% compared with their levels before the crisis. The MFIs maintain the score for both crisis periods at around 80%. This implies ASEAN 4 MFIs are financially efficient, in terms of sustaining operation in the long term and providing financial services to poor people during the pre-crisis period (2000–2007) and the post-crisis period (2010–2017).

In fact, in ASEAN 4 countries, MFIs have been proven resilient to the economic crisis since they are not significantly affect their financial efficiency. This condition is demonstrated by an excellent performance of MFIs in ASEAN 4 countries by concentrating more on the production of financial services and products that lead to well-maintained and higher financial efficiency during both crisis periods. This approves that MFIs are financially stable (Nanayakkara, 2012) in ASEAN 4 countries for a longer time and show the ability of the MFI to free themselves from the reliance on subsidies and to strengthen their reach by providing financial services for a large number of poor people (Wijesiri et al., 2015).

Table 4 provides the robustness tests in pre and post-financial crisis times for the financial efficiency of MFIs in ASEAN 4 countries. Parametric t-test results show that the post-crisis TE for financial efficiency is exceeding the TE for pre-crisis (TE post-crisis = 0.834 > TE pre-crisis = 0.823), whereas the pre-crisis PTE is surpassing the PTE for the financial efficiency of post-crisis (PTE pre-crisis = 0.894 > PTE post-crisis = 0.892), and there is no statistically significant correlation between the pre-crisis and post-crisis periods for both TE and PTE measurements. In the meantime, the SE for financial efficiency after the crisis is higher than the SE before the crisis period and differs significantly at 1% (SE post-crisis = 0.936 > SEpre-crisis = 0.923). Further confirmations of the parametric t-test results were made from the non-parametric tests of Mann-Whitney and Kruskal-Wallis. In short, the findings show that no significant difference between the pre-crisis and post-crisis levels of efficiency; the study concluded that the post-crisis period of MFIs in ASEAN 4 countries is not very much affected by the crisis and the score is a little higher than that in the period before the crisis. The following analysis will evaluate

the related factors affecting the level of financial efficiency.

Table 4 Robustness Tests for Financial Efficiency Score of MFIs in the Event of Pre and Post-Financial Crisis

Test Statistics		Parametric Test		Non-parametric Test			
		<i>t</i> -test		Mann-Whitney Test		Kruskall-Wallis Test	
		$t(Prb > t)$		$Z(Prb > z)$		$x^2(Prb > x^2)$	
		Mean	<i>t</i>	Mean Rank	<i>z</i>	Mean Rank	x^2
Efficiency Measures	In Times of						
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	

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

Findings of the panel static regression analysis in times of pre-crisis for the financial efficiency of MFIs are recorded in Table 5. All results are reported based on the Hausman test that appear a significant relationship thus confirm to rely on Fixed Effect Model (FEM). The table shows that economic growth (*lgdp*) and inflation (*linf*) are negatively significant at a 1% level in relation to the financial efficiency score based on a panel-static regression analysis. Unlike foreign direct investment (*lfdi*), it presents no significant relationship to explain the financial efficiency of MFIs during the pre-crisis period.

There is a negative and significant correlation between economic growth (*lgdp*) and the financial performance of the MFIs. The result suggests during the pre-crisis period, high (low) GDP growth has decreases (increases) the score of financial efficiency of the MFIs. The outcome, therefore, shows that once poor households start to generate high incomes and have been deprived of poverty, they appear to become part of commercial banks because many of the advantages in terms of financial products have been offered as compare to MFIs. This situation slows down MFIs' demand for microcredit and distracts funding initiatives, thus reducing financial system liquidity. In short, in line with Ngo and Trong (2012) findings, the results suggested that increased economic growth bring a negative effect on the financial performance of MFIs.

Table 5 also reveals that the correlation between inflation (*linf*) and the financial efficiency of MFIs is negative and significant. This shows that the high (low) rate of inflation tends to yield a lower (higher) financial efficiency prior the crisis. The MFIs have been clarified that they can no longer sustain in high inflationary times, thus this condition will directly impacted both the borrowers and the MFIs. Since the high inflation situation increases prices for all commodities, the expenses of the MFIs and the cost of capital are projected to increase. The increase in expenditures and capital costs leads to lower sales, thus distracts the MFIs'

funding operations. In concern of borrowers, the high price of products creates the issue in the repayment of the borrowers' loan because their incomes remain stagnant to cover high living costs. These two situations lead to reduced financial stability and have impacted MFIs' financial performance. Similar results were provided by the research conducted by Cull et al. (2011), Daher and Le Saout (2015), Ngo and Trong (2012), and Roslan et al. (2019).

On the contrary, the information in Table 5 of the foreign direct investment (*lfdi*) coefficient does not suggest a significant connection to any financial efficiency improvements in the MFIs that occurred prior the crisis. This result indicates that any difference in the FDI, whether higher (lower) FDI, does not affect the financial performance of MFIs. The finding of this insignificant correlation coefficient is consistent with research done by Forkusam (2015) and Claessens et al. (2001).

Table 5. Result of Panel Static Regression Analysis on Financial Efficiency in the Event of Pre-Financial Crisis (2000–2007)

Variables	Model 1		
	OLS	REM	FEM
Constant	-2.130 (0.195)	-5.210*** (0.205)	-8.020*** (0.248)
<i>lgdp</i>	2.210*** (0.019)	-0.410 (0.017)	-2.940*** (0.020)
<i>linf</i>	1.640 (0.023)	0.240 (0.021)	-2.020*** (0.023)
<i>lfdi</i>	-0.390 (0.028)	-0.150 (0.026)	-1.280 (0.028)
Adjusted R^2	0.091	0.071	0.057
BP & LM χ^2		303.000***	
Hausman χ^2		36.330***	
Mean VIF	1.200		
No. of Obs.	608	608	608

Notes: *** indicates significance at the 1% levels. Figure in parentheses () are standard error.

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

The macroeconomic factors, according to Table 6, have significant as well as insignificant effects as an external factor to clarify the MFI's post-crisis financial efficiencies. The results are presented according to the Hausment test that appear a significant relationship thus confirm to rely on Fixed Effect Model (FEM). Through the panel's static regression analysis, no significant link between economic growth (*lgdp*) and inflation (*linf*) are formed in determining the score of the financial efficiency of the MFIs. Despite this, the variance of the financial performance of the MFIs is negatively associated with the foreign direct investment (*lfdi*) at a 1% significance level.

As can be seen in Table 6, the result indicates the economy growth (*lgdp*) gives no significant relationship towards the financial efficiency of the MFIs for the post-crisis period. This indicates that the higher (lower) GDP growth failed to

explain the financial efficiency of the MFIs. This result indicates that in subsequent crisis events, the effect on the financial efficiency of the MFIs was due to movement in GDP variables were unusual. The crisis is likely to cause the variance in financial performance of MFIs cannot be explained. This result is in line with Alimi (2015) that discovered the same insignificant finding.

In the same manner, Table 6 also revealed that inflation (*linf*) variable and financial efficiency are not significantly correlated. This demonstrates that, any increases (decreases) in inflation does not justify the variation in financial efficiency of the MFIs for the post-crisis period. The sturdy impact of the crisis is likely to cause the inflation data to be uncommon and become the reason for the variations in financial efficiency to be unjustified. The result is found to be similar with the study from Zaidi et al. (2008) and Ngo and Trong (2012).

On the other hand, as reported in Table 6, the foreign direct investment (*ldi*) is negatively correlated to the MFIs' financial efficiency at 1% significant level. The result justifies the more (lesser) number of the FDI being involved, the lower (higher) the score of efficiency level. This is because a more open country with FDI distract the stability of the MFIs, since the large size, technology advancement, and skilled labour that are benefited by the FDI make the situation to be difficult for the MFIs to compete. Amidst constant demand, the financing product provided by the MFIs will oversupply due to the domination of the FDI in the financial market, hence, the sustainability of the MFIs seems can no longer be maintained in the acceleration of the FDI. To add, the reduction of input labour due to labour switch to join the FDI leads to inefficiency in producing outputs and eventually cause lower revenue to the MFIs, hence provide poor financial performance to the institutions. Findings by Hermes et al. (2011), Ahlin et al. (2011), and Roslan et al. (2019) supported the grounds.

Table 6 Result of Panel Static Regression Analysis on Financial Efficiency during the Post-Financial Crisis (2010–2017)

Variables	Model 2		
	OLS	REM	FEM
Constant	-1.480 (0.242)	-2.460*** (0.235)	-4.360*** (0.361)
<i>lgdp</i>	-1.480 (0.059)	-1.300 (0.048)	-1.020 (0.047)
<i>linf</i>	-2.340*** (0.016)	-1.140 (0.014)	0.960 (0.015)
<i>ldi</i>	0.960 (0.013)	-0.120 (0.017)	-1.990*** (0.023)
Adjusted R^2	0.030	0.025	0.015
BP & LM χ^2		260.670***	
Hausman χ^2		32.360***	
Mean VIF	1.260		
No. of Obs.	720	720	720

Notes: *** indicates significance at the 1% levels. Figure in parentheses () are

standard error.

Eventually, the outcomes of the study reach the following hypotheses:

H1: The level of financial efficiency differs significantly between microfinance institutions in ASEAN 4 countries during pre and post-financial crisis.

H2: Macroeconomic conditions provides a significant different effect to the level of financial efficiency of the MFIs during pre and post-financial crisis.

Conclusions and Recommendations

H1 assuming that the level of financial efficiency differs significantly between microfinance institutions in ASEAN 4 countries in the period before and after the financial crisis, is achieved when the mean financial efficiency TE is slightly higher during the post-financial crisis (83.4%) than the mean TE in the pre-financial crisis (82.3%). This verifies that, in the post-crisis period from 2010 to 2017, the ASEAN 4 MFIs are resilient and not impacted in the sense of financial performance by the 2007-2009 crisis. The outcomes also revealed that financial efficiency in pre-crisis years have a higher waste of input than inputs wastage in post-crisis periods for financial efficiency of the MFIs. In both crisis periods, the main cause of inefficiency in financial efficiency was the management's inability to fully utilise resources. When in fact, the findings demonstrate that all MFIs in ASEAN 4 countries operate at an optimum level of efficiency.

H2 is also fulfilled as macroeconomic conditions have their effects to be significantly different on the financial efficiency of the MFIs in times before and after the financial crisis. The study shows a different direction to affect the financial performance of the MFIs given the macroeconomic conditions that serve as an external determinant. The MFIs have struggled to survive in good economic conditions and high inflation during the pre-crisis period, while foreign direct investment does not provide any connection. Conversely, the presence of FDI after the crisis distracts the MFIs' output, but there is no connection between economic growth and inflation.

By addressing specific intervals in the latest literature, the results of this study will add value to microfinance sector recognition, in particular the lack of a comprehensive study into the evaluations of the MFIs in pre and post-financial crisis times in ASEAN countries. The study will provide substantial insight into MFIs' long-term sustainability and equipment to prepare themselves for the possible conflicting crisis in the future. This is crucial in continuing support for the poor, with a view to alleviating poverty among the poor, in line with the actual purpose of the MFIs.

The study also has a practical meaning for the management of MFIs that are aimed at achieving long-term financial efficiency. The results of this research will assist the management of MFIs in their decision-making to enhance the financial performance of MFIs. This includes an adjustment to the current economic situation of its macroeconomic conditions. It will eventually delivers the management of the MFIs the precautionary measures to prevent any economic vulnerability which can distract the development of microfinance. These could direct the institutions management to

follow effective policies to improve the efficiency of the institutions.

The following are the limitations of this study that offer potential research opportunities. In the case of a financial crisis, the study only analyses the impact of the macroeconomic conditions on the financial aspects of the MFIs. In this comparative financial crisis analysis, many more contributing factors could be examined. This limitation should be taken into account by future researchers, among many case studies, including the institutional risk effect and the monetary policy effect. In addition, the concept of inputs and outputs for financial efficiency analysis is based solely on a production approach that helps to ease the bias resulting. Additional research should be done in an intermediate approach to assessing the MFI's efficiency. Furthermore, only a non-parametrical DEA approach is adopted by the method of this study. This study may therefore expand research for the assessment of financial efficiency through parametric approaches or by typical financial ratios such as Stochastic Frontier Analysis. The Generalized Method of Moments (GMM) estimation method of panel regression analysis can be used to further strengthen the current study to develop the intended connections in future research. The GMM approach to persistence and endogenous issues provides clear assessments of different structural and economic conditions.

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