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Productivity Convergence of Microfinance Institutions in Latin America and the Caribbean: The Role of Financial Performance and Inclusion

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Productivity Convergence of Microfinance Institutions in Latin America and the Caribbean: The Role of Financial Performance and Inclusion

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Abstract

This study examines the performance and productivity convergence of profit-oriented microfinance institutions in Latin America and the Caribbean from 2007 to 2018. Importantly, the study assesses two aspects of performance: financial performance and financial inclusion through lending to microenterprises. During the period studied, the productivity change in both aspects declined. Furthermore, productivity convergence reveals that the productivity change of the previously lagging institutions increases faster than previously leading institutions in both aspects (catching up). Nevertheless, in terms of financial performance, dispersion in productivity change is growing. In conclusion, the study confirms that microfinance institutions with an emphasis on profit must operate at an optimal scale to achieve progress in productivity changes in terms of financial inclusion. Moreover, to achieve progress in productivity change and productivity convergence in the financial performance aspect, profit-oriented microfinance institutions have to focus on technological improvement and innovations, getting the maximum output by utilizing the inputs by using efficient managerial practices, and operating on an optimal scale.

Keywords: Financial Performance, Financial Inclusion, Productivity Convergence

1. Introduction

It is becoming increasingly apparent that microfinance programs play a vital part in fostering a thriving and inclusive financial sector in developing economies. A recent trend in the microfinance sector has resulted in lucrative investment opportunities for profit-seeking companies, a process referred to as the commercialization of microfinance (Olivares-Polanco 2005). Microfinance has gained momentum as a result of limited access to affordable financial services in most developing countries. It is imperative to study the performance of these institutions and to promote their effective functioning, as a strong financial sector is necessary for economic growth and financial inclusion.

The growing competition and tightening regulations forced microfinance institutions (MFIs) to become financially viable to survive. In fact, heavy reliance on government subsidies may undermine MFIs' ability to deal with adverse shocks in the future. An institutional perspective strives to foster

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efficient operational activity as it maximizes resources and achieves maximum earnings for the organization with the most cost-effective delivery methods and innovations. A further consideration in using efficiency as a performance metric is that the level of risk experienced by the institution's clients is closely correlated with its portfolio risk.

Microfinance is also integrated with financial inclusion. Basically, financial inclusion involves providing individuals and businesses with useful and affordable financial products and services. As a stepping stone to financial inclusion, microfinance addresses the necessities of both unbanked individuals and businesses. This study aims to determine the impact of microfinance on financial inclusion through microenterprises and the financial sustainability of MFIs. MFIs have been the subject of many studies analyzing their financial efficiency and social mission (Olivares-Polanco 2005; Awaworyi & Marr 2014; Amin et al. 2018; Churchill 2020). There are; however, a few studies assessing the impact of microfinance on financial inclusion (Adeola & Evans 2017; Mia et al. 2019). An important aspect is financial inclusion via lending to microenterprises. A significant difference exists in using lending to microenterprises as the main determinant of financial inclusion. It is primarily for the purpose of investment of the enterprise and not for the purposes of consumption. Providing financial support to microenterprises may contribute to a long-term process of inclusion because the loan is invested in income-generating activities, and the business requires continuous financial support as it expands.

In spite of the fact that microfinance is practiced in a number of developing regions, this study focuses exclusively on Latin America and the Caribbean (LAC). The main reason is that there are distinct differences between LAC and Asia or Africa in that MFIs in those regions tend to specialize in the poorer, whereas MFIs in LAC also support microenterprises (Berger 2006). A thorough examination of the features of the microfinance industry in LAC reveals that MFIs place a greater emphasis on microenterprises. For instance, statistics show that loans to microenterprises accounted for 42.3% of the total gross loan portfolio and 72.4% of the total loan outstanding in the 2017–2018 period in LAC (Khamar 2019). Moreover, the study focuses solely on LAC since maintaining a homogeneous sample is simple and allows for precise results to be drawn.

There are a number of different entities that practice microfinance. Most notably, profit-oriented and non-profit-oriented MFIs. This study focuses exclusively on profit-oriented MFIs as non-bank financial institutions (NBFIs), commercial banks, and credit unions for two key reasons. First, in this study, financial inclusion is measured through loans to microenterprises. Its objective differs from that of non-government organizations (NGOs), which focus primarily on vulnerable populations like the poor or women. Second, MFIs in LAC use a higher proportion of commercial funds and have assets than MFIs in other regions (Servin et al. 2012) and the majority of MFIs in the region are under pressure to become regulated companies (Mersland & Strøm 2009). Furthermore, the microfinance sector in LAC has become controversial due to the commercialization of MFIs. The significant factors

in the commercialization process are upgrading and downscaling. NGO MFIs are being upgraded to become formal financial institutions, whereas banks are downscaling into the microfinance sector. BancoSol is one of the most popular institutions. It is Bolivia's first microfinance bank, which was founded in 1992 by the NGO Prodem. Therefore, it is important to measure the performance of profit-oriented MFIs in the region in light of changes such as changes in legal status, competition, and regulations.

Moreover, this research contributes to the existing literature on microfinance by incorporating productivity convergence. It is vital for MFIs to ensure efficiency and productivity in order to minimize costs, increase profitability (financial performance), and increase lending (in this case to micro-enterprises). The study is designed to assess the performance of microfinance as a whole from two perspectives, namely financial performance and financial inclusion through microenterprise lending. Nevertheless, it is imperative to understand the behavior and differences in efficiency and productivity changes among profit-oriented MFIs, despite the fact that they have distinct characteristics.

Although Li et al. (2019) apply the concept of productivity convergence, the current study focuses on financial inclusion through MFIs rather than the depth of outreach and the size of the loan. Hence, the research employs a variety of approaches to assess changes in productivity and convergence. Malmquist Productivity Index (MPI) is one of the methods widely used to measure productivity change (see, for example, Bassem 2014; Wijesiri & Meoli 2015; Mia & Soltane 2016). MPI offers the most significant benefit of decomposing the index into technological, technical, pure, and scale efficiency changes. Accordingly, this study employs output-oriented MPI. Moreover, the productivity convergence is measured by using conditional beta (β) convergence and sigma (σ) convergence proposed by Barro & Sala-i-Martin (1992) and Sala-i-Martin (1996).

Beta (β) and sigma (σ) convergence, however, highlight different aspects and are relevant in different ways for policymakers. σ-convergence indicates whether the differences (mainly using standard deviation or covariance) in productivity change between MFIs have decreased over time. Nevertheless, it does not indicate any underlying changes in productivity change in MFIs. In particular, it is not possible to determine whether MFIs that were behind are now catching up with those that were leading. In essence, β-convergence provides greater insight as it measures whether MFIs that experienced relatively low productivity changes in the past have shown more improvement since then as compared to MFIs whose productivity change is high. The fact remains, however, that β-convergence does not always lead to σ-convergence. Despite β-convergence being necessary but not sufficient for σ-convergence (Higgins et al. 2008). Similarly, if no σ-convergence is estimated, this does not necessarily imply that low-productivity MFIs are continuously disadvantaged. It is necessary to conduct β-convergence tests to determine whether lagging MFIs are catching up or whether leading MFIs are stagnating.

The study examines the financial performance and inclusion of profit-oriented MFIs in LAC from

2007 to 2018. The results reveal that there is a regress of the productivity change in both aspects, financial performance and financial inclusion, during the period of 2007–2018. The determinants of MPI explain that the main cause for the decline of the productivity change in financial performance as the regress in both technological efficiency change, technical efficiency change, and its determinants as scale and pure efficiency change during 2007–2018. On the other hand, the main determinant for the regress of the productivity change in the financial inclusion aspect is technical efficiency change and its determinants, scale, and pure efficiency change. Hence, better managerial practice and optimal scale should be the main focus to improve the productivity change in the financial inclusion aspect. Furthermore, the findings of the productivity convergence reveal there is convergence in the financial inclusion aspect (both conditional β-and σ-convergence), which indicates that the previously lagging MFIs are improving the productivity change faster than the previously leading MFIs (catching up) and the dispersion among the productivity change of MFIs is decreasing. There is, however, a conditional β-convergence and a σ-divergence among profit-oriented MFIs in the region with regards to financial performance. This implies that the previously lagging MFIs are moving towards the mean of the distribution (catching up with previously leading MFIs), however, previously leading MFIs are moving away from the mean of the distribution.

The remainder of the paper is organized as follows. Section 2 summarizes the literature on productivity and productivity convergence. The data and methodology are outlined in section 3, while the results are presented in section 4. Finally, the conclusion is presented in section 5.

2. Literature Review

The availability of studies related to efficiency and productivity in MFIs in LAC is relatively low. In many studies, LAC compares with other regions. Hassan and Sanchez (2009) research on microfinance in developing countries by comparing LAC, North Africa, Asia and, the Middle East from 2001 to 2005. The study applies MPI to analyze productivity in both intermediate and production approaches.[1] The study reveals that the main two determinants of defining the decline of the total factor productivity (TFP) are pure and technological change. Furthermore, Servin et al. (2012) examine the ownership type and its impact on technical efficiency in the region using 315 institutions from 2003 to 2009 and discovered that NBFIs and banks are progressing in technical efficiency than NGOs and cooperatives.

In recent studies, Kar & Rahman (2018) use Färe-Primont index[2] to measure efficiency level changes of MFIs. In accordance with the findings of LAC, the annual TFP change of MFIs in LAC from 2003 to 2013 is −2.355%. The main determinant of negative growth of TFP change is scale efficiency and residual scale efficiency change. Wijesiri et al. (2017) confirm that MFIs in LAC are performed better in financial efficiency yet better perform in outreach efficiency when the size and age of the MFIs are taken into account. Nourani et al. (2021) compares the performance of MFIs using

operational, social, and financial efficiency in different regions in the world from 2013 to 2019. The study uses both regulated and unregulated MFIs in LAC and finds that regulated MFIs in LAC achieve outstanding operational efficiency levels. It also finds that both regulated and unregulated MFIs in LAC have weak performance on financial sustainability and efficiency in social outreach.

Nevertheless, productivity convergence is a relatively new method for microfinance literature. Many empirical studies apply productivity convergence in banking literature (Matthews & Zhang 2010; Chen et al. 2020); however, only Li et al. (2019) have applied productivity convergence in microfinance literature. Li et al. (2019) apply σ and β-convergence in their study to identify the performance of MFIs. The study employs the intertemporal Data Envelopment Analysis to analyze 171 MFIs from 2003 to 2012. The study finds an overall improvement in financial and social performance, but financial performance is remarkable. The study uses 5-year sub-periods and identifies that capital deepening has a significant impact and technological innovations in the later years. Furthermore, LAC and Eastern Europe and Central Asia show a higher level of the financial production frontier while the social productivity frontier hardly shifts upward. More importantly, the study identifies that lagging MFIs are converging.

This study's main contribution is the application of productivity convergence to profit-oriented MFIs in LAC. In addition, the convergence of each MPI element (technological, technical, pure, and scale efficiency change) makes it easier to comprehend the behavior of the MPI. The ability to obtain essential information regarding the movements (catching up and reducing the dispersion) of lagging and leading MFIs is aided by productivity convergence. The previous findings on the efficiency and productivity of MFIs in LAC are mixed. There is a lacuna for further discovery on the performance of MFIs, especially about the profit-oriented MFIs. More importantly, the number of studies on efficiency and productivity convergence is extremely limited in microfinance literature.

3. Data and Methodology

3.1. Data

Microfinance data extracts from the Microfinance Information Exchange (MIX Market database-(https://www.themix.org/) from 2007–2018. The sample consists of 149 profit-oriented MFIs in 18 countries[3] in LAC. However, only 118 profit-oriented MFIs were considered to calculate the financial inclusion due to a lack of consistent data. DEAP software applies to calculate MPI. Moreover, R 4.0.3 software is used to measure the convergence, and missing data are imputed using R's "missForest" package.

3.2. Variables

The study uses three inputs to calculate the MPI for both dimensions: the number of loan officers,

total assets, and cost per borrower. For the financial performance, four outputs are examined: operational self-sufficiency (OSS), return on equity (ROE), return on assets (ROA), and gross loan portfolio (GLP). Financial inclusion calculates by using three main variables: the number of loans to microenterprises, the gross loan portfolio of loans to microenterprises, and each MFI's active borrowers as a percentage of each country's population. Furthermore, to quantify conditional β-convergence, the study used several macro variables as conditional variables. Conditional variables are the financial development index, the annual growth of the gross domestic product, domestic credit to the private sector (as a% of gross domestic product), per capita gross domestic product, and real interest rate. The conditional variables are from the World Bank and the International Monetary Fund (IMF) databases.

3.3. A Malmquist Productivity Index (Output-Oriented)

This study adheres to the MPI proposed by Färe et al. (1994). As a result of this method, productivity change can be decomposed into two mutually exclusive but equally important components: technological change and technical efficiency change, which help to identify innovation and catch up over time (Färe et al. 1994).

MPI calculates productivity change along with time variations. In this methodology, productivity change calculates by using the geometric mean of two MPIs. There are two ways of calculating MPI as output-oriented and input-oriented. This study uses output-oriented MPI because the focus is on the output maximization of MFIs. Based on output-oriented MPI, efficiency is defined as the amount of output that the firm produces in comparison to the best-practice output level for any given amount of input.

To define the MPI, we assume that for each period $t=1, \cdots, T$, the production technology S^t model transformation of inputs $x^t \in \mathbb{R}_+^N$ into outputs, $y^t \in \mathbb{R}_+^M$,

$$S^t = \{(x^t, y^t): x^t \text{ can produce } y^t\} \tag{1}$$

Equation (1) defines the feasible input and output vectors. In evaluating production efficiencies, output efficiency is defined as the proportional change in output amounts observed for the unit when compared to the output quantities achieved with frontier technologies. Defining the output-oriented distance function at t (Shepherd 1970; Färe et al. 1994) as follows;

$$D^t(x^t, y^t) = min\ \theta\ \{\theta: (x^t, y^t/\theta) \in S^t\} \tag{2}$$

The radial distance is indicated by θ. If $(x^t, y^t) \in S^t$ then $D^t(x^t, y^t) \leq 1$, and $D^t(x^t, y^t) = 1$ if and only if (x^t, y^t) is on the boundary. We can interpret MPI using the distance function in t and $t+1$.

$$MPI^t = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)} \tag{3}$$

$$MPI^{t+1} = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)} \tag{4}$$

Equation 3 and 4 explain the geometric mean of adjacent periods as t and $t+1$. In equation 3, output-oriented distance function measures the geometric mean by referring to the technology in time t and equation 4 refers the technology in time $t+1$.

After measuring the geometric means of two time periods, the MPI can be expressed as follows;

$$MPI = Technical\ efficiency\ change \times Technological\ change$$

$$MPI = EFFCH \times TECHCH$$

$$MPI\,(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t\,(x^t, y^t)} \times \left[\frac{D^t\,(x^t, y^t)}{D^{t+1}\,(x^t, y^t)} \times \frac{D^t\,(x^{t+1}, y^{t+1})}{D^{t+1}\,(x^{t+1}, y^{t+1})} \right]^{1/2} \tag{5}$$

EFFCH shows the location of the institution against the efficiency frontier, and TECHCH measures whether the frontier shifts over time due to technological changes and innovations. Furthermore, we can decompose the EFFCH into two parts as scale efficiency (SECH) and pure efficiency change (PECH) by using CRS (constant returns to scale) and VRS (variable returns to scale) DEA frontiers.

$$\text{PECH} = \frac{D^{t+1}_{VRS}\,(x^{t+1}, y^{t+1})}{D^t_{VRS}\,(x^t, y^t)} \tag{6}$$

$$\text{SECH} = \left[\frac{D^{t+1}_{VRS}\,(x^{t+1}, y^{t+1}) / D^{t+1}_{CRS}\,(x^{t+1}, y^{t+1})}{D^{t+1}_{VRS}\,(x^t, y^t) / D^{t+1}_{CRS}\,(x^t, y^t)} \times \frac{D^t_{VRS}\,(x^{t+1}, y^{t+1}) / D^t_{CRS}\,(x^{t+1}, y^{t+1})}{D^t_{VRS}\,(x^t, y^t) / D^t_{CRS}\,(x^t, y^t)} \right]^{1/2} \tag{7}$$

PECH is calculated by estimating the efficient frontier (technical efficiency) under VRS and by accounting for deviations from the frontier due to managerial inefficiencies. Accordingly, SECH is determined by the ratio between overall technical efficiency (using CRS) and PECH, which indicates the institution's capacity to select the optimal scale at which to operate.

Assuming a regress of the productivity change exists, the relative position of any financial institution over time will be determined by two factors: its position with respect to the production frontier as well as its location with respect to that frontier.

3.4. Conditional β-Convergence

This study uses the conditional β-convergence approach proposed by Barro & Sala-i-Martin (1992) and Sala-i-Martin (1996). MFIs with relatively low productivity change will experience β-convergence when their productivity changes are more pronounced than the leading MFIs'. To assess convergence of productivity change between $t=0$ and $t=1$, we can examine whether there is a negative relationship between the level of productivity change at $t=0$ and the change in productivity change between 0 and 1.

This study selects conditional β-convergence over absolute convergence by considering that the

productivity levels of MFIs may differ on many other variables relevant to each country (macro-economic variables).

The following equation describes how to derive conditional β-convergence as:

$$\Delta \ln (y_{i,t}) = \alpha + \beta \ln (y_{i,t-1}) + \gamma z_{i,t} + u_{i,t} \tag{8}$$

In equation 8, $y_{i,t}$ indicates the productivity change and $\Delta y_{i,t}$ is the growth rate of productivity change in MFI i, at time t. Moreover, $z_{i,t}$ indicates conditional variables, $u_{i,t}$ is the standard error term, and α, β, γ are the parameters to be calculated. β-convergence can be identified if the rate of change of productivity negatively correlates with the initial productivity level.

Apart from the β-convergence, "half-life" is an informative parameter that measures the time that a representative MFI would halve the gap between the initial efficiency level and its final convergence equilibrium.

$$\text{Half-life} = \frac{log\ 2}{\beta} \tag{9}$$

A half-life usually measures the number of years. This parameter is essential to make policy-related decisions. In this study, the half-life calculates for all the components of MPI, which assists in understanding which component should be highly focused on to speed the convergence of productivity among MFIs.

3.5. σ-Convergence

σ-convergence explains the dispersion of the cross-sectional variation of productivity change over time.

$$\sigma_{t+T} < \sigma_T \tag{10}$$

In this study, the standard deviation (SD) used to measure the σ-convergence. Although the two concepts are different, they are related, and β-convergence is essential but it is not the only reason for σ-convergence (Sala-i-Martin 1996). There can be a situation when initially lagging MFIs grow much more extensively than initially leading MFIs. Hence, the dispersion between two institutions has not fallen, so there is no σ-convergence.

4. Results

Table 1 summarizes the descriptive statistics for the input and output variables of the MPI. In the period of 2007–2018, input variables (the number of loan officers, assets, and cost per borrower) have increased. It is noteworthy that the increase in the cost of borrowing per borrower has been identified

Table 1 Descriptive Statistics of the Variables

Variable \ Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Input variables												
Loan officers	201	206	216	245	284	303	338	347	393	429	407	417
Assets (million, $)	85	96	121	152	180	219	238	241	247	275	305	328
Cost per borrower ($)	221	246	256	287	308	323	351	371	379	362	372	382
Output variables-Financial Dimension												
ROA (%)	0.03	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
ROE (%)	0.14	0.12	0.04	0.08	0.10	0.07	0.08	0.07	0.08	0.07	0.08	0.08
OSS (%)	1.19	1.16	1.11	1.19	1.15	1.13	1.14	1.13	1.14	1.13	1.13	1.13
GLP (million, $)	70.1	77.9	96.6	117	143	174	187	193	197	217	240	252
Output variables-Financial Inclusion Dimension												
Active borrowers/Population	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.005	0.005
Loan outstanding (microenterprises)	43600	46283	51953	63915	75527	80875	85554	87991	96086	98419	95986	95918
GLP (million, $)(microenterprises)	46.2	48	59	81	97	105	98	102	104	114	127	135

Notes: The descriptive statistics derive from using the data of profit-oriented MFIs in the sample. The input variables and output variables of financial performance are calculated using 149 profit-oriented MFIs, and 118 profit-oriented MFIs are used to calculate the variables of the financial inclusion aspect. ROA-Return on Assets, ROE-Return on Equity, OSS-Operational Self-Sufficiency (financial revenue as a percentage of total expenses), GLP-Gross Loan Portfolio. The definitions and the calculations of the variables are in the appendix section.

Source: Author's calculations by using the MIX market database (https://www.themix.org/)

as an important factor in the region. The cost per borrower has increased by 72% between 2007 and 2018. Cost per borrower calculates by operating expenses[4] over the number of active borrowers in each year. A calculation based on the sample data indicates that operating expenses and the number of active borrowers have both increased over the years. Nevertheless, the operating expenses (nominal) have increased more than the number of active borrowers.

MFIs' performance has been influenced by the impact of the global financial crisis. This is an indisputable fact when analyzing their performance. As a consequence of the economic crisis, the microfinance industry has faced many challenges. These challenges include limited access to capital due to the cost of funds, an increase in the number of nonperforming loans, and a reduction of remittance payments from expatriate workers (Campion et al. 2010). Nevertheless, financial inclusion indicators show an upward trend over the past few years. Increasing the number of active borrowers (active borrowers as a proportion of the population of each country) has led to a significant increase in the outstanding loan amount and the portfolio of loans for microenterprises.

4.1. Financial Performance Dimension

4.1.1. Results of MPI-Financial Performance Dimension

The Malmquist Productivity Index (MPI) breakdown reveals changes in technological (TECHCH), technical (EFFCH), pure (PECH), and scale efficiency (SECH). Table 2 illustrates the average annual productivity change in financial performance for the period 2007–2018.

According to Table 2, there is a regress of average annual productivity change by 3.1% (TFPCH, 0.969). Similar to Hassan and Sanchez (2009), Wijesiri et al. (2017), Kar & Rahman (2018), and Nourani et al. (2021) study confirm a regress in the productivity change in financial performance. Furthermore, it is important to note that none of these studies exclusively examine profit-oriented MFIs in the region. The MPI components indicate that both main components, TECHCH and EFFCH, show a regress in the efficiency change of 2.3% (0.977) and 0.8% (0.992). Furthermore, the decomposition of EFFCH reveals that there is also an annual average regress of its components, PECH and SECH, as 0.4% (0.996) and 0.5% (0.995), respectively.

Using data from 2001 to 2005, Hassan and Sanchez (2009) determined that PECH and TECHCH are the main predictors of the decline in TFP. The significant fact is that a regress of TECHCH implies a downward shift of the production frontier from the period of 2007 to 2018 in the region. The downward shift of the frontier illustrates a deteriorate performance of the leading MFIs in the region due to the fact that the production frontier is constructed by the best-performing institutions.

Moreover, looking into the further decomposition EFFCH, both components (PECH and SECH) illustrate a regress over the 12 years. The decline of PECH and SECH implies poor managerial practice, and the institutions fail to perform on an optimal scale. Therefore, the results of MPI confirm that the profit-oriented MFIs in LAC lack in their performance in financial performance over the period 2007–2018, and both technological and technical efficiency have to be improved.

Table 2 Results of MPI (2007–2018)-Financial Performance

<table>
<tr><td colspan="3">TFPCH 0.969</td></tr>
<tr><td rowspan="2">TECHCH
0.977</td><td colspan="2">EFFCH 0.992</td></tr>
<tr><td>PECH 0.996</td><td>SECH 0.995</td></tr>
</table>

Notes: The output-oriented MPI is calculated from 2007 to 2018. The above table only indicates the average annual productivity and efficiency change of MPI components. The table creates according to the hierarchy of the composition of MPI components. Among the components, TFPCH indicates the MPI index. The acronyms of the table stand for TFPCH-Total factor productivity change, TECHCH-technological change, EFFCH-technical efficiency change, PECH-pure efficiency change, SECH-scale efficiency change

Source: Author's calculations by using the MIX market database (https://www.themix.org/)

4.1.2. Results of Conditional β-and σ-Convergence-Financial Performance

The values of the MPI index for 12 years (2007–2018) use to calculate conditional β and σ convergence. The results of the MPI for financial performance indicate an overall regress in TFP, and the main determinant is TECHCH.

Contrary to the conditional β-convergence, there is σ-divergence for all the components in MPI. The existence of σ-divergence indicates that the dispersion (standard deviation) among MFIs increases. The EFFCH and its variables, SECH and PECH, indicate the highest dispersion in σ-convergence analysis. Nevertheless, β-convergence alone is not sufficient for σ-convergence (Higgins et al. 2008). Mainly, we can identify two reasons for the absence of either σ or β-convergence. There is a possibility that random fluctuations in $t=1$ may be relatively large, compared to the change that can be contributed to the convergence process. It is also possible that random fluctuations in the $t=0$ could be responsible for the observed-convergence. Second, some differences in σ and β-convergence can be attributed to systematic differences. The β-coefficient is more strongly affected by changes in the productivity change of MFIs that differ from the mean in $t=1$ in contrast to MFIs that are close to the average. The MFIs at the tail of the distribution converge towards the average, while those MFIs at the center of the distribution diverge from the mean may result in significant β-convergence and σ-divergence. Thus, the σ-divergence does not imply the absence of converging MFIs, while, on the other hand, significant β-convergence does not necessarily imply the convergence of all or most MFIs.

In the case of conditional β-convergence for financial performance, the findings are different from those obtained by Li et al. (2019). The study confirms β-convergence for LAC (all types of MFI sampled). It is crucial to note that this study used the intertemporal DEA method and decomposed the efficiency into three dimensions: learning, capital intensity and innovation. Based on the study, the main factor of convergence in productivity in financial performance in LAC is capital deepening, followed by learning and innovation.

Table 3 Results of Conditional β and σ-Convergence-Financial Performance

Component	β	T value	Speed of convergence[5]	Half-life	R^2	σ-convergence		△ SD/2008
						2008	2018	
TFPCH	−0.14	−7.64***	1.5%	45	0.438	0.081	0.165	1.03
TECHCH	−0.11	−9.68***	1.2%	57	0.497	0.060	0.072	0.2
EFFCH	−0.09	−4.06***	0.9%	76	0.270	0.055	0.126	1.3
PECH	−0.09	−5.54***	0.9%	75	0.357	0.039	0.065	0.7
SECH	−0.12	−4.45***	1.2%	57	0.270	0.027	0.081	2

Notes: $p<0.01^{***}$, $p<0.05^{**}$, $p<0.1^{*}$. The figure shows the σ-convergence of 2008 and 2018 for each component of MPI. TFPCH-Total factor productivity change, TECHCH-technological change, EFFCH-technical efficiency change, PECH-pure efficiency change, SECH-scale efficiency change

Source: Author's calculations by using the MIX market database (https://www.themix.org/)

4.2. Financial Inclusion Dimension

4.2.1. Results of MPI-Financial Inclusion

The performance of MFIs in the financial inclusion dimension is measured using 118 MFIs in the region. The Malmquist Productivity Index (MPI) breakdown reveals changes in technological (TECHCH), technical (EFFCH), pure (PECH), and scale efficiency (SECH).

The findings of the output-oriented MPI (Table 4) reveal a 0.7% (0.993) regress of the annual productivity change during 2007–2018. Despite this, TECHCH reveals an annual average increase of 0.6% (1.006). It is evident that though TECHCH increased, the decline in productivity change (TFPCH) explains the greater impact of the decrease in EFFCH. Moreover, the decomposition of EFFCH into PECH and SECH indicates a regression in the efficiency change of 0.6% (0.994) and 0.7% (0.993), respectively.

It is apparent that MFIs in the region fail to use inputs to obtain outputs to the extent desired (number of loans to microenterprises, gross loan portfolio of loans to microenterprises, and number of active borrowers as the percentage of population), in other words, technical inefficiency. The split of the technical inefficiency explains that the MFIs do not operate in their optimal scale (scale inefficiency) and poor managerial practice (pure technical inefficiency). In light of the decline in EFFCH, there is greater heterogeneity in productivity change among MFIs; this means that the average MFI is further away from the production frontier. Both components of EFFCH contribute to this effect almost equally.

The results of MPI of inclusion aspect has a comparatively higher TFP value (0.993) than financial performance aspect (0.969) and an upward shift of the production frontiers from 2007–2018. On the contrary, financial inclusion aspect has a lower efficiency change (a regress) value for EFFCH (0.987). Therefore, we can identify that profit-oriented MFIs in LAC are lacking in performance in both financial performance and inclusion aspects which is similar to the findings of Nourani et al. (2021).

Table 4 Results of MPI-Financial Inclusion

<table>
<tr><td colspan="3">TFPCH 0.993</td></tr>
<tr><td rowspan="2">TECHCH
1.006</td><td colspan="2">EFFCH 0.987</td></tr>
<tr><td>PECH 0.994</td><td>SECH 0.993</td></tr>
</table>

Notes: The output-oriented MPI is calculated from 2007 to 2018. The above table only indicates the average annual productivity and efficiency change of MPI components. The table creates according to the hierarchy of the composition of MPI components. Among the components, TFPCH indicates the MPI index. The acronyms of the table stand for, TFPCH-Total factor productivity change, TECHCH-technological change, EFFCH-technical efficiency change, PECH-pure efficiency change, SECH-scale efficiency change

Source: Author's calculations by using the MIX market database (https://www.themix.org/)

4.2.2. Results of Conditional β-convergence and σ-Convergence-Financial Inclusion Dimension

The results of conditional β-convergence and σ-convergence (Table 5) for the financial inclusion reveal evidence for conditional β-convergence for all the components of MPI (negative and significant β coefficient). Moreover, the results of σ-convergence indicate a decrease in standard deviation (−0.38) of the productivity change (TFPCH), suggesting that there is an overall σ-convergence of the productivity change for the financial inclusion.

Following the findings of the convergence analysis for financial inclusion, we can identify that previously lagging MFIs are growing faster relative to previously leading MFIs. The difference between lagging and leading MFIs can be halved in 59 years. However, EFFCH and its components (PECH and SECH) have a low speed of convergence (1%) compared to other components of MPI. Furthermore, the dispersion in the distribution is falling in the examined period, and TECHCH and SECH report an increment of the dispersion of the distribution (σ-divergence) in financial inclusion.

The conditional β and σ-convergence results for the financial performance and inclusion dimensions provide useful information regarding the current state and future viability of profit-oriented MFIs in LAC. The financial inclusion aspect of profit-oriented MFIs provides favorable conditions as both β and σ-convergence. Despite a regress in both aspects, profit-oriented MFIs perform better in the financial inclusion aspect with progress in technological change over the 12 years. Moreover, the findings from the conditional β and σ-convergence for both dimensions reveal that lagging MFIs are catching up with leading MFIs. Despite this, in financial performance, the heterogeneity of the productivity change among the MFIs improves as there is σ-divergence. The fact that convergence exists in terms of financial inclusion in Latin America, however, it takes more years to halve the gap between lagging and leading MFIs, compared to their financial performance.

Table 5 Results of Conditional β and σ Convergence-Financial Inclusion

Components	β	T value	Speed of convergence	Half-life	R^2	σ-convergence		△ SD/2008
						2008	2018	
TFPCH	−0.110	−17.39***	1.1%	59	0.791	0.288	0.180	−0.38
TECHCH	−0.118	−8.41***	1.2%	55	0.580	0.066	0.072	0.09
EFFCH	−0.104	−21.41***	1.0%	63	0.856	0.286	0.141	−0.51
PECH	−0.103	−17.27***	1.0%	63	0.800	0.218	0.133	−0.39
SECH	−0.009	−6.73***	1.0%	68	0.483	0.043	0.058	0.86

Notes: $p<0.01^{***}$, $p<0.05^{**}$, $p<0.1^{*}$. The figure shows the σ-convergence of 2008 and 2018 for each component of MPI. TFPCH-Total factor productivity change, TECHCH-technological change, EFFCH-technical efficiency change, PECH-pure efficiency change, SECH-scale efficiency change

Source: Author's calculations by using the MIX market database (https://www.themix.org/)

5. Conclusion

An efficient and productive financial institution is beneficial for both the institution's sustainability and its customers, especially for microfinance institutions that tend to provide small loans with a high degree of risk. The objective of this study was to examine the productivity change and convergence of profit-oriented microfinance institutions in LAC during the period 2007–2018. In order to determine productivity change, the Malmquist Productivity Index (MPI) was used in conjunction with its four determinants technological (TECHCH), technical (EFFCH), pure (PECH), and scale efficiency (SECH). Furthermore, conditional β-convergence and σ-convergence were applied to find the productivity convergence. The study focused on measuring financial performance and financial inclusion through lending to microenterprises as the two performance dimensions.

The findings of the MPI revealed that there was a regress of the productivity change in both aspects, financial performance and financial inclusion during the period of 2007–2018. The determinants of MPI explain that the main reason for the regress of the productivity change in financial performance as the regress in both technological efficiency change and technical efficiency change and its determinants as scale and pure efficiency change during 2007–2018. Therefore, to increase the productivity change in the financial performance of the profit-oriented MFIs in LAC, it is necessary to improve the technology and innovations as well as better managerial practices and conduct activities on an optimal scale. On the other hand, the main determinant for the regress of the productivity change in the financial inclusion aspect is technical efficiency change and its determinants, scale, and pure efficiency change. Hence, better managerial practice and optimal scale should be the main focus in improving the productivity change in the financial inclusion aspect. In addition, the total factor productivity change revealed that productivity change of financial inclusion (0.993) was higher than financial performance (0.969) in profit-oriented MFIs in LAC.

Furthermore, the findings of the productivity convergence reveal that there is convergence in the financial inclusion aspect (both conditional β and σ-convergence), which indicates that the previously lagging MFIs are improving the productivity change faster than the previously leading MFIs (catching up) and the dispersion among the productivity change of MFIs is decreasing. The span of time it takes to halve the productivity gap (using the result of total factor productivity change) between lagging and leading MFIs in the region is 59 years in the financial inclusion aspect. It is important to note that, while total factor productivity change implies β-convergence, scale efficiency indicates σ-divergence in financial inclusion. Furthermore, the findings of scale efficiency in conditional β-convergence records the highest number of years (69 years) to halve the gap between leading and lagging MFIs. Thus, based on both the Malmquist productivity index and productivity convergence findings, it is obvious that profit-oriented MFIs should focus on maintaining their operations at an appropriate scale to attain higher efficiency change and productivity convergence.

There is, however, a conditional β-convergence and a σ-divergence among profit-oriented MFIs in the region with regards to financial performance. This implies that the previously lagging MFIs are moving towards the mean of the distribution (catching up with previously leading MFIs); however, previously leading MFIs are moving away from the mean of the distribution. The findings of conditional β-convergence reveal that it will take 45 years to halve the gap in lagging and leading MFIs in total factor productivity change. Conditional β-convergence reveals that EFFCH and PECH have the highest number of years to halve the gap between leading and lagging MFIs. Moreover, σ-convergence reveals that the highest gaps of the standard deviation records for technical efficiency and its components, scale, and pure efficiency change in the financial performance aspect. Therefore, the findings of both Malmquist productivity index and productivity change reveal that both technology and technical efficiency should be improved to achieve progress in productivity change and convergence.

This study suggests that it is very important to reconsider criticisms regarding the profit-oriented MFIs in LAC. Despite the fact that most of the profit-oriented MFIs are rapidly expanding and developing, the results of the research indicate that policy makers need to pay close attention to the financial sustainability of these institutions in the region. In light of the results of this study, profit-oriented MFIs perform better in achieving financial inclusion by lending to microenterprises. Consequently, improving the financial performance and sustainability of profit-oriented MFIs is crucial to expand the financial inclusion in the region.

There were a number of limitations of this study. In spite of the extensive focus on Latin America and the Caribbean, the effects of institutional characteristics and unobserved country characteristics may still affect the findings of the results. Furthermore, the MPI has one notable limitation; the estimator defines efficiency relative to the best practice observations in the sample, rather than the "true" frontier (Simar & Wilson 1998). As an extension, we can use bootstrapping procedure adapted to the Malmquist Productivity Index. This allows the estimation of the bias in the results.

Endnote

1 In banking literature, intermediate and production approach measure efficiency and productivity change. The intermediate approach considers financial institutions as converting financial resources to make a profit, while the production approach considers

2 There are six individual components of the Färe-Primont index as technical change, technical, residual scale, and residual mix the efficiency, scale, and mix scale efficiency changes.

3 The countries are Jamaica, Dominican Republic Brazil Panama, Paraguay, Chile, Costa Rica, Argentina, Haiti, El Salvador Guatemala, Bolivia, Colombia, Ecuador, Honduras, Mexico, Nicaragua and Peru

4 Operating expenses include personnel expenses, depreciation, amortization, and administrative expenses

5 The speed of convergence is calculated as, $-\ln(1+T\beta)/T$.

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Appendix

Table 6 Definitions of Input, Output and Conditional Variables

Variables	Definitions
Input variables	
Number of loan officers	The employees who engage in managing the GLP as the main task.
Assets	The value of all resources controlled by the MFI.
Cost per borrower	Operating expense/average number of active borrowers
Output variables	
ROA	(Net operating income-taxes)/average total assets
ROE	(Net operating income-taxes)/average total equity
Operational self-sufficiency (OSS)	Financial revenue/(Financial expense＋net impairment Loss＋Operating Expense)
Gross loan portfolio	This includes current, delinquent, and renegotiated loans, excluding written off.
Financial inclusion variables	
Number of active borrowers per population of the country	Number of active borrowers/populations of each country
Number of loans for microenterprises	The number of outstanding loans given to microenterprises.
Gross loan portfolio of loan to microenterprises	The values of loans (excluding written-off) given to microenterprises.
Conditional Variables	
Financial Development Index	This index considers the efficiency, depth and access of the financial institution of the country. This is a combination of the Financial Institutions Index and the Financial Markets Index.
Annual growth of the Gross Domestic Product	The annual percentage growth rate of GDP
The gross domestic income per capita	Gross domestic income/mid-year population
Domestic credit to the private sector (as a percentage of Gross domestic production)	Financial resources to the private sector, as loans, purchases of non-equity securities, trade credits, and other accounts receivables that establish a claim for repayment.
Real interest rate	Real interest rate＝nominal interest rate-inflation rate.

Note: Definitions of input and output variables are exactly as MIX market database

Source: MIX market database (https://www.themix.org/), World Bank Database (https://data.worldbank.org/), International Monetary Fund Database (https://www.imf.org/en/Data)