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Measuring the Efficiency of the Microfinance Institutions - An MPI Index Approach

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ABSTRACT

The aim of this study is to look at how Total Factor Productivity (TFP) has undergone a change in the Ethiopian microfinance institutions (MFIs), as well as the change in TFP's components, namely efficiency change and technical change. In addition to this, the study investigates the differences in levels of productivity that can be seen across the various organizational ownership forms and size categories of MFIs. In addition, a comparison of the results prior to and during covid 19.

The researcher gathered data from the secondary sources to undertake the study for 25 microfinance institutions as DMU for the fiscal years 2017–2021. Regarding this, four inputs and three output variables were used to analyze the effectiveness of the institutions. Such include: Branch locations, employee wages, operational expenses, total assets, revenue from interest and fees, total loan portfolio, and debtors. The researchers have followed the data by using DEAP software to evaluate the quantitative aspects.

The results reveal that according to the Malmquist index average, Somali, Nisir, Adeday, and SFPI microfinance institutions experienced the greatest improvement in productivity. Positive shift in productivity from an ownership structure point of view, three MFIs, viz., Somali, Dire, and Harar, were government-affiliated and seven were private MFIs. During study period, five MFIs in the large size category (Dire, SFPI, Wasassa, Somali, Adeday), three MFIs (Harar, Nisir, and Kendil) were the medium size category, and two MFIs (Digaf and Lefeyeda were from the small size category) experienced positive TFP growth, which was largely attributable to efficiency change. Twelve of twenty-five MFIs saw a decline in technical efficiency. To sum up, the majority of private MFIs have positive Total Factor Productivity and are in the category of large-scale MFIs. In contrast, small-scale private and large-scale government MFIs decreased overall productivity change as a result of technical efficiency. Therefore, Ethiopian Microfinance Institutions experienced negative TFP growth on average due to the lowering of the frontier, this decline in TFP growth is primarily attributable to negative technical efficiency change.

The research's practical implications is that the Ethiopian MFIs have to make the delivery of the financial system more efficient and dynamic, MFIs must adopt new technologies such as internet banking, mobile banking, ATMs, online payment systems, online loan application and collection systems, digital finance services, agent banking service (Hello cash), and other technological advancements.

To compare national productivity, we propose that this pattern of variable inputs and outputs be applied to the institutions examined in this study. In any case, this methodology is quite valuable as a quantitative and reliable method for measuring productivity and its analysis, and its implementation would produce positive results.

Keywords: Total Factor Productivity, DEAP, efficiency change, technical change, MFI, Ethiopia, productivity, Malmquist Productivity Index

INTRODUCTION

Microfinance has its origins in the nineteenth-century cooperative movement, the rural finance experience following World War II, and the micro enterprise development sector beginning in the 1970s. These

various beginnings are linked by at least five similar goals: micro enterprise development, encouragement of innovation/investment, consumption smoothing, women's empowerment, and financial system development. All five are critical short-term steps toward the international aim of poverty reduction. One of the amazing aspects about microfinance is that it may achieve all of these goals (Stanley J. et. al, 2009).

Muhammad Yunus established the first microfinance institution in Bangladesh in 1983. With the intention of eradicating poverty worldwide, he established a Grameen bank in Bangladesh to provide small loans to the poor. With only $27 from his own pocket, he extended his first loans to 42 local women(Yunus, 1997). In the 1990s, there was a focus on developing microfinance as an industry. Commercial microfinance is undergoing an exponential expansion at the turn of the millennium as a result of the spread of information about the size of the information revolution has enabled microfinance marketplaces and microfinance institution profitability. (Hanso, 2016).

Subsequently, the formal microfinance institution began with a small number of poor women and a small amount of money and has now benefited millions of poor people, with the service spreading throughout our world over the last thirty to forty years. Globally, both developed and developing countries have used MFIs as a tool for poverty alleviation programs as well as for commercial gain in order to ensure institutional sustainability. According to Severino (2019) the figure mentioned in the Microfinance Barometer, there are approximately 10,000 Microfinance institutions in over 140 countries service over 140 million debtors and have a total loan book of $124 billion. Microfinance lending portfolios have increased by at least 8% for a period of three years prior to COVID-19. South Asia continues to dominate worldwide microfinance, with the most lenders (85.6 million in 2018) and a higher rate of growth than other areas. It also has the top three debtor markets in India, Bangladesh, and Vietnam, and the remaining balance amount of African MFIs has grown by 56%, while the number of borrowers has grown by 46%, reaching 6.3 million in 2018.Therefore, Microfinance performance is essential to ensuring that the underprivileged receive ongoing financial and social help. Despite the social objectives that MFIs strive for, achieving self-sufficiency is essential to leaving the group of people who need permanent subsidies. This goal can be attained by solid performance practices, which are essential to maintaining the MFIs' service-providing activities without interruption.

Roy & Goswami (2013) proposed a fresh performance evaluation conceptual approach for MFIs, and it carried out by using longitudinal and geographically extensive study from 1995 to 2010.The more comprehensive view of MFI performance is said to consist of eight performance characteristics. Thus, efficiency, productivity, ecology, social, institutional qualities, outreach governance, and financial viability includes factors to consider (Kifle, 2021). Efficiency and productivity, two of the eight dimensions proposed by Roy & Goswami (2013) will be the focus of this study. By examining changes in technological efficiency and technical efficiency, productivity analysis will provide additional information about the sources of efficiency and productivity in addition to information about the use of resources and the scope of waste. Additionally, the outcomes of both analyses will support and add to the findings.

Efficiency has been defined by Kipesha (2013) as the better use of resources to maximize a firm's output of goods and services. It looks at how inputs like labor costs, capital expenditures, and equipment affect the output that is made using those inputs (Farrell, 1957). Efficiency measures how well businesses use their resources to produce goods and services, as well as how quickly they employ their input resources to create or deliver their outputs. The two most important elements are pure technical efficiency (PTE) and allocative efficiency. (Farrell, 1957), identified as constituting any firm's economic efficiency (AE). When a company is able and willing to produce as much output as its input utilization permits, they are said to have PTE. In other words, businesses won't waste the resources they use to create their products or services. As a result, organizations can attain productive efficiency when they efficiently use all of their resources to provide the best possible output. Economic efficiency is another name for productive efficiency. Allocation efficiency is the selection of an input mix that allots elements to their maximum value.It is a model for calculating the value or utility of a suggested or real resource allocation choice.

MFI efficiency therefore refers to how successfully MFIs use input resources such as assets, subsidies, and employees to create output, as measured by the borrowings and poverty volunteer activities (Bassem, 2008). In other words, MFI efficiency relates to how well these organizations utilize their inputs to get the greatest potential outputs. Efficiency measurement is especially critical in MFIs since it offers information on the firm's performance, notably in terms of resource use and waste minimization. It facilitates in the measuring, monitoring, and improvement of results, resulting in enhanced firm performance and profitability. It also supports companies in defining objectives for monitoring operations through improved management of bottlenecks and performance impediments.

Efficiency is a crucial feature in every organization, especially MFIs, as per Reynolds et al. (2002), Angelidis (2003) and Kipesha (2013). First, funders are reluctant to support MFIs to the requisite capacity to service all impoverished clients, therefore input resources used by MFIs are constrained, The second factor is the development community's identification of MFIs as an innovative and promising tool for reducing poverty, which has increased the need for their effectiveness in allocating public resources. Finally, greater competition

among MFIs has led to lower interest rates and more effective operations. Last but not least, the profitability potential of the microfinance sector has drawn commercial banks and other private investors to start microfinance businesses with effective operations, greater resource usage, and decreased waste.

According to Asmare and Begashaw (2018), efficiency study metrics are classified into two types: parametric and non-parametric. According to bank efficiency studies, common non-parametric techniques include Free Disposal Hull Analysis (FDH) and Envelopment Analysis (DEA), whilst also prevalent estimated parameters have included the Stochastic Frontier Approach (SFA), the Thick Frontier Approach (TFA), and the Distribution Free Approach (DFA) (Mokhtar et al., 2006).

Studies on the effectiveness of MFIs are extremely few, particularly in emerging and underdeveloped countries like Ethiopia, Uganda, Kenya, and other sub-Sahara African countries. As far as we are aware, limited research has been done to compare the MFI effectiveness of among Ethiopian microfinance institutions using Data Envelopment Analysis. Consequently, the research on efficiency in this area is important and will help.

The findings of this study could empirically serve as a springboard for additional MFIS efficiency comparison studies in Ethiopian MFIs. The outcomes will then serve as a standard for MFIs nationwide as they work to raise their level of efficiency. The industry will profit by concentrating on the variables that have been identified as having low efficiency; therefore, this study also has practical value. Additionally, it will help decision-makers spot and lessen wasteful or excessive input utilization. As a result, the sustainability of MFIs in the Ethiopia will improve.

The goal of this study is to employ a Quasi Data Envelopment Analysis to assess the effectiveness of MFIs in Ethiopian MFIs by analyzing the change in total productivity levels (TFP) and its elements, namely efficiency change and technological breakthroughs, in Ethiopian MFIs operating between 2017 and 2021. In addition, the study investigates differences in MFI productivity levels across ownership structures and size categories.

Section 1 shares a glimpse about the MFIs in Ethiopia, the literature on efficiency studies has been reviewed in Section 2, data and methodology serves as main topics of Section 3 and findings and discussion has been included in Section 4 with the final section concluding in Section 5.

1. Microfinance Institutions in Ethiopia

It is widely acknowledged that a robust and inclusive financial system is required to ensure faster economic growth with equity, because the presence of a developed financial intermediary system not only ensures mobilization of resources from the entire society, but also provides access to financial resources to all sections of society. This suggests that the financial sector has a significant impact in a country's economic performance. In this regard, the key financial institutions in Ethiopia include banks, insurance firms, and microfinance organizations.

Ethiopia has one of the world's fastest-growing economies, and achieving inclusive growth remains one of the country's top priorities. Access to financial services is critical to ensuring inclusive growth. A sizable number of Ethiopians are still financially excluded. Hayder & Michael (2002), stated that the formal banking system does not reach the urban poor, and even less so the rural poor. Credit and savings cooperatives are primarily active in urban areas and serve only employees. Moreover, Ethiopia has a strong informal financial system culture. The majority of the informal credits are provided by friends and relatives. Many people belong to informal savings and credit organizations such as iqqub (a type of Rotating Credit and Savings Association), iddir, and mehaber. Some MFIs attempt to incorporate these organizations into their own services.

Since 1996 Ethiopian government declared a regulatory framework proclamation No. 40/1996 to license and supervises the microfinance institutions under the supervision of the country's central bank. Afterwards, the National Bank of Ethiopia has been working to create an enabling environment for existing and newly established microfinance institutions through providing various directives and proclamations for instances; Microfinance Business Directives No. MFI/23/2013, Requirements for Licensing and Renewal mobile and agent banking service directive no. FIS/01/2012, interest rates applicable to microfinance institutions directive no. MFI/29/2017, and others rules and regulations in placed (Yohannes, n.d.).

Ethiopian MFIs have grown significantly in the last sixteen years, from 2005 to 2021. Thus; microfinance institutions registered with the National Bank of Ethiopia twenty six to thirty nine, the number of active borrowers 1.21 million to 4.67 million, loan portfolio volume 1.5 billion to 69.3 billion, and savings deposited birr 501 million to birr 52.4 billion increased (AEMFI, 2021; Amha, 2007).

Furthermore, by the end of 2020/21, the Ethiopian microfinance sector's total capital and total assets will have increased by 43.4 % and 13.8 %, respectively, and for Birr 27.9 billion and 105 billion. Furthermore, the deposit mobilization and credit of MFIs increased considerably. The 5 biggest MFIs, namely Amhara, Dedebit, Oromia, Omo, and Addis Credit and Savings Institutions, account for 84.8% of total capital, 88.8 % of the total deposit, 82.7 % of total credit, and 84.3% of total assets of MFIs (Report of The National Bank of Ethiopia Fourth Quarter 2021).

2. LITERATURE REVIEW

The microfinance efficiency study still had considerable holes that needed to be filled. Numerous studies have effectively assessed the efficacy of MFIs by concentrating on different areas, settings, sample periods, and methodology. Previous research has made use of ratio analysis, parametric approaches, and non-parametric methodologies, parametric Stochastic Frontier Analysi s(Nourani, 2021;Kablan, 2014), in addition to that the most recent and bulk of those studies were conducted in ASEAN and other regions, EU, UAE and west Africa (Goswami & Gulati, 2022; Bansal et al., 2022; Chowdhury et al., 2022; Gurjar et al., 2021; Wahyudi et al., 2021).

The reasons for emphasizing on MFIs Productivity measurement is the significance of social goals in serving poor clients over the role of profit-making for institutions and investors. The number of studies conducted on the productivity of microfinance institutions during COVID was insignificant, and the operational time covered as of the end of 2018 (Khan & Gulati, 2022; Efendi & Hadziahmetovi, 2019; Ambarkhane et al., 2019; Fall et al., 2019).

The majority of researches compared the productivity of international and domestic banks and MFIs, as well as Islamic and conventional banks. According to Kamarudin et al. (2017), both local and foreign Islamic banks saw a shift in total factor productivity as a result of an increase in efficiency change (EFFCH), which was predominantly managerial in nature and not scale-related. According to Haider et al. (2019), foreign-owned banks are slightly more productive than domestic banks because to greater EFFCH. Increased efficiency explains why Islamic banks outperform conventional banks in terms of productivity. However, there is no statistically significant difference in the production of different types of banks. (Jubilee et al., 2020).

Regarding DEA, there are a number of excellent DEA studies in microfinance and banks from around the world that have provided sound suggestions based on empirical DEA findings. For instance, Khan & Gulati (2022) found that the study conducted in India MFIs were in terms of size categories, small MFIs exhibit the largest TFP growth, followed by large MFIs and medium MFIs. In addition to this overall the TFP change increases by 6.70% due to Efficiency (4.80%) and technical efficiency by 2.3%. In similar way, Gebremichael and Rani (2012) analyzed the productivity change for the Ethiopian MFI industry and discovered that total factor productivity increased by an average of 3.80 percent over the course of the study period.

However, Efendi & Hadziahmetovi (2019) found that TFP declines by 2.5 due to technology declines 1.7%, and technical efficiency declines 0.8% in Bosnia and Herzegovina countries MFIs. Technological inefficiencies cause negative total factor productivity change. To meet their strategic goals in BiH MFIs, policymakers must boost technological progress. Similarly, Fall et al. (2019) found that the lowest productivity rises to date, at 1.5%. This productivity rise is mostly owing to technological advancements, with technical efficiency generally declining post-reform. Decomposing technical efficiency demonstrates that scale inefficiency is the main cause of decline.

According to Sufian and Kamarudin (2017) the Malaysian banking sector showed increases total factor productivity during the post-merger period due to technological improvement. On the contrary the UAE banking sector's total productivity fell After the 2008 financial crisis (Jreisat et al., 2017).

Hassan (2020) studied that North American and Latin American bank have greater capital requirements than European, African, and Asian banks. Except in Europe and Central Asia, supervisory agencies promote the rise of bank productivity. The volatility of the market and the Z-score promote the progress of technology and the expansion of scale efficiency, but at the loss of pure technical efficiency.

As a summary of previous studies, evaluate the productivity of banks and MFIs using the DEA Malmquist productivity index summary. It depends on changes in efficiency and technology for the total factor productivity changes. The differences explained by country, by type of bank, and by time period, which includes the financial crises years 2008-2009. In addition, Gebremichael et al. (2012) used two inputs and three outputs in their study; the inputs were the number of employees and operational expenses, while the outputs were interest and fee income, gross loan portfolio, and the number of outstanding loans (number), and the time frame was 2004-2009. Moreover, the number of studies conducted during COVID on the productivity of microfinance institutions was insignificant, and the operational time covered as of the end of 2018 was minimal(Khan & Gulati, 2022; Efendi & Hadziahmetovi, 2019; Ambarkhane et al., 2019; Fall et al., 2019).

This study will look at how efficiency and technical change have affected total factor productivity (TFP) in Ethiopian microfinance organizations (MFIs). The study also looks at how production levels change amongst MFIs of different organizational ownership structures and sizes. Additionally, a comparison of the outcomes before and after COVID 19.

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3. APPLICATION OF DEA MODEL FOR KPI OF ETHIOPIAN MFIS

3.1 Method of Data Collection

This study largely depends on secondary data from books, journals, newspapers, magazines, MFI annual financial reports, and publications from various governments and nonprofit groups. The majority of the data utilized to generate the statistical data for this research came from databases maintained by the National Bank of Ethiopia's MFI supervision unit and the Association of Ethiopian Microfinance Institutions'. Both organizations give information on the financial and social performance of 39 formally registered MFIs. Additionally, it offers analytical tools to support the microfinance industry. Data based on country profiles may be available from the source. As mentioned, the database is used to gather various data for 25 microfinance institutions for the fiscal years 2017–2021. The aforementioned information is simply utilized in this paper to support and clarify the aforementioned model. In this instance, 25 microfinance institutions are referred to as DMUs. Figure 1 depicts the input and output data for the DMUs MFIs.

In the literature on financial institutions, Fisher index, Tornqvist index, and Malmquist index are the three alternative methods for measuring productivity changes (Tayles et al., 2007). In fact, the Malmquist TFP index is the most widely used indicator of productivity change and it has three significant advantages over the Fischer and Tornqvist indices. The first advantage of the Malmquist index is that its calculations require a small number of inputs and outputs without the need for extensive modification. Second, the evaluator is not required to attempt to maximize the outputs or minimize the inputs. In addition, inputs and outputs are not assigned fixed weights (Grifell-Tatje & Lovell, 1996).

Where the component inside the brackets is the geometric mean of the two productivity indices and the ratio outside the brackets equals the change in technical efficiency between time t and time t+1, representing the change in the distance between the observed production and the maximum potential production. Efficiency change combined with technological progress produces productivity change (total factor productivity change). Scale efficiency change and pure technical efficiency change are other categories under which technical efficiency change may be categorized.

Fare et al. (1994) followed that inputs and outputs from one period will be combined with the technology of another. Regarding this paper adopts the output-oriented Malmquist productivity change index, which places an emphasis on the proportional increase of outputs for a given level of inputs. The output-focused Malmquist productivity change index is calculated as follows:

$$M_O\left(X^{t+1}, y^{t+1}, X^t, Y^t\right) = \frac{D_r^{t+1}\left(X^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \left[\frac{D_o^{t+-}\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+-}\left(x^{t+1}, y^{t+1}\right)} \frac{D_o^t\left(x^t, y^t\right)}{D_o^{t+1}\left(x^t, y^t\right)} \right]^{1/2} \quad (1)$$

Where the component outside the brackets represents the change in efficiency scores between time t and time t+1, going to represent the change in the relative distance of identified production from maximum potential production; and the element inside the brackets represents the arithmetic mean of the two productivity indices, going to represent the shift in production technologies (technical change) between time t and time t+1. Productivity change is the result of two factors: efficiency change and technological development (total factor productivity change). Furthermore, technical efficiency change may be classified as either pure technical efficiency change or scale efficiency change.

And therefore, there are two terms in equation (1):

Efficiency change

$$= \frac{D_o^{t+1}\left(x^{t+1}, y^{t+1}\right)}{D_o^t\left(x^t, y^t\right)} \quad (2)$$

Technical change

$$= \left[\frac{D_o^{t+-}\left(x^{t+1}, y^{t+1}\right)}{D_o^{t+-}\left(x^{t+1}, y^{t+1}\right)} \frac{D_o^t\left(x^t, y^t\right)}{D_o^{t+1}\left(x^t, y^t\right)} \right]^{1/2} \quad (3)$$

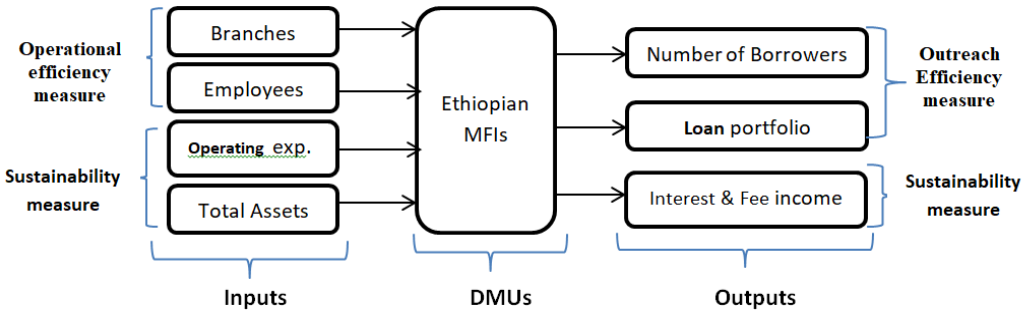
Total factor productivity (TFP) growth can be measured by the Malmquist productivity index. Values greater than one indicate an increase in productivity, as well as in efficiency and technology, whereas values less than one indicate a decline.

3.2 Selection of input and output variables for DEA model

When it comes to assessing the technical productivity and efficiency of financial institutions, the most major problem, and one that is still debated in the literature, is characterizing such institutions' outputs and inputs (Berger and Humphrey, 1997). The three most frequent methods to this problem are the production approach, the intermediation technique, and the asset strategy (Berger and Humphrey, 1997). Financial institutions are considered as institutions that shift resources from savers to investors under the intermediation principle. In this method, the amount of loans, deposits, and money borrowed from the financial markets serve as the inputs, while loans and investments serve as the outputs. Financial institutions produce loans and deposits under the production approach. According to this method, the best way to assess output is the number of accounts opened or transactions processed, but the number of personnel, physical capital, and other operating costs required to carry out those activities are considered inputs. Last but not least, the assets approach makes the assumption that any financial institution's primary role is to create credit (loan). Thus, in this technique, the output is the value of financial institutions' assets. Microfinance institutions are financial institutions as well, but they operate differently and have different goals. They frequently do not demand collateral and target mostly the poor, and their goal is not just to make as much money as possible(Serrano el al. 2005; Chauhan, 2021).

The dual aims of microfinance institutions outreach and sustainability framework has guided the selection of inputs and outputs for this study. In order to avoid model saturation issues, a basic rule for selecting an adequate sample size in DEA is that it must be at least three times greater than the sum of the inputs and outputs (Charnes et al., 1978; Banker et al., 1984). The sample size for DMUs should be at least twice the total of the input and output numbers, according to a number of studies. Based on seven indicators, the effectiveness of 25 microfinance institutions is assessed in this study. Such include: Branch locations, employee wages, operational expenses, total assets, interest and fee income, gross loan portfolio, and borrowers.

Figure 1: Simplified DEA model for performance measurement of MFIs



Source: Author's own, 2022

Input variables

1. **Branches:** A total number of offices or a physical location including the head office of a microfinance Institution.
2. **Employees:** Total number of employees working in a microfinance institution (including all branches).
3. **Operating Expenses:** Expenses involved for discharging the service
4. **Total Assets:** the total value of MFI's assets and the account that represents them on the balance sheet.

Output variables

1. **Interest and Fee Income -** Interest collected on customer loans, plus any additional fees.
2. **Gross Loan Portfolio -** Total loan proceeds paid out to clients.
3. **Borrower-** individuals or group who obtain a loan from an MFI with the understanding that they will repay it in the future, generally with interest.

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4. Analysis and discussions

4.1 Microfinance Institutions spatial distribution and their branches

There are 39 licensed MFIs who are working in the country in different regions, and their services are delivered through 2096 branches. Table 1 reveals the distribution summary of microfinance institutions in the country and its branches.

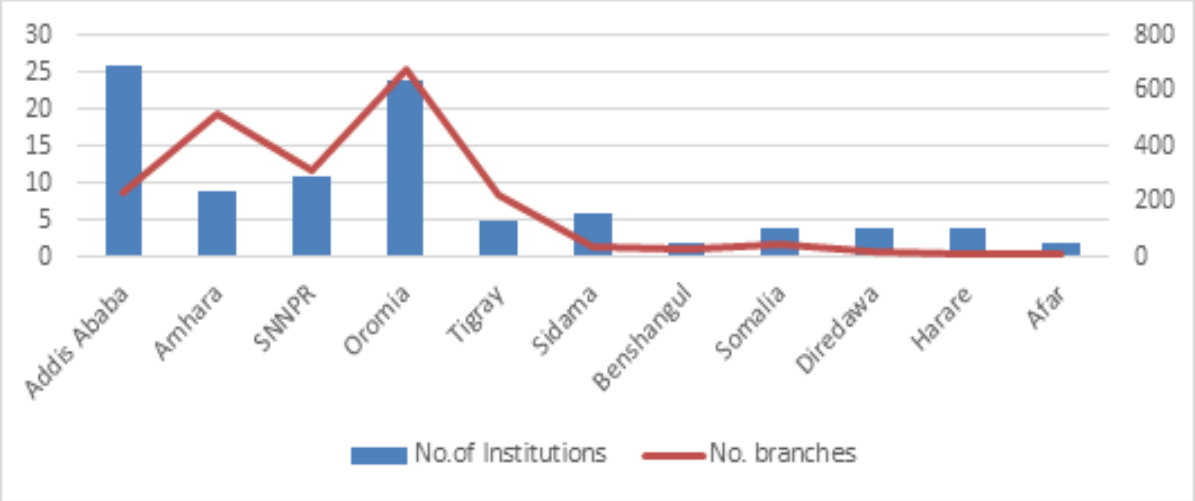
Table 1: MFIs by regions and number of branches

Sl.no.	MFIs operational Regions	MFIs		Branches	
		Number of Institutions	%	No. of branches	%
1	Addis Ababa	26	67%	228	11%
2	Amhara	9	23%	521	25%
3	SNNPR	11	28%	308	15%
4	Oromia	24	62%	673	32%
5	Tigray	5	13%	225	11%
6	Sidama	6	15%	36	2%
7	Benshangul	2	5%	25	1%
8	Somalia	4	10%	47	2%
9	Diredawa	4	10%	14	1%
10	Harare	4	10%	6	0%
11	Afar	2	5%	13	1%
		39 MFI		2096	

Source: Author's own compilation through field survey, 2022

The majority of MFIs are located in Ethiopia's capital, Addis Ababa with 26 MFIs, and the Oromia region with 24 MFIs (67% and 62%, respectively). And the remaining MFIs; SNNPR, Amhara, Sidama, and Tigray (28%, 23%, 15%, and 13%, respectively). The institutions' service coverage from point of branches to what extent did it reach the target community? In terms of the number of branches, Oromia, Amhara, SNNPR, Tigray, and Addis Ababa have taken the lion's share of branch distribution in the country. In the five regions mentioned, government-owned MFIs have a large number of branches.

Figure 2. Ethiopian MFIs distribution by regions and its branches



4.2 MFIs peer group classification based on operation scale

Table 2 presents the performance of microfinance institutions in order to facilitate comparisons with institutions in comparable circumstances. In addition to this classification by peer group, MFIs are able to comprehend the relative trends and drivers of their own performance (profitability, productivity, efficiency, productivity, scale, and outreach). Regarding this, the scale of MFIs is divided into three categories; small, medium, and large(Teshome, 2020).

Table 2: Classification of MFIs by scale: large, medium, small scale

Category	Definitions	MFIs under this category
Small (C)	MFIs with gross loan portfolio of less than 50 million	Digaf, Lefeyada
Medium(B)	MFIs with gross loan portfolio between 50 million & 200 million	Kendil. Eshet, Dynamic, Meklit, Haribu, Nisir, & Harar
Large(A)	MFIs with gross loan portfolio between 200 million	ACSI, ADCSI, Agar, Benshangul, Bussa, Metemamen, OCSCO, OMO, PEACE, SFPI, Wasassa, Vision fund, Dire, Somali, Sidama, and Adeday

Source: AEMFI Report,2020

The ownership of microfinance institutions is divided into two categories in Table 3 viz. government and private MFIs. Regional governments have contributed 70 percent or more of the capital to state MFIs. The remaining amount or percentage consists of government-affiliated organizations. This case is accounted for in this paper as a government-owned financial institution. In Somalia's MFI ownership structure, however, half of the shares are held by private and government entities. Other MFIs began as NGOs and cooperatives before becoming private over time. This is essential for demonstrating the productivity index based on the ownership structure. It will help in the revision of policies and procedures by decision-makers.

Table 3: Ownership structure of MFIs

Ownership type	MFIs
Government	ACSI, ADCSI, OCSCO. OMO, Dire, Harar, Somali(mixed)
Individuals (Private)	Agar, Bussa, Metemamen, PEACE, SFPI, Wasassa, Vision fund, Sidama, Adeday, Kendil. Eshet, Dynamic, Meklit, Nisir, AVFS, Digaf, Lefeyada,

Source: Authors compilation through survey, 2022

4.3 Productivity Change: Results from Malmquist Productivity Index

Table 3 shows that overall years and institutions performance in malqust index summary. For the year 2017-2018, the average total factor productivty change is13.2%(1.132-1=0.132*100=13.2%). The most productivity growth belongs to Somali microfinance which was 4.068. which was higher when compared to other MFIs. This due an incease of efficeincy change to the extent of 3.480 and pure efficiency change to the extent of 3.474. Adeaday MFI was at second place with TFP 2.267. this due an increase of technical efficeincy 2.267. but the scale efficeincy and efficiency changes were stagnat. Next, SFPI microfiance the total productivity change was 75.3%(1.753-1=0.753*100=75.3%) which was higher when compared to other MFIs. This is due to an increase in the eefficiency change to the extent of 33.2%, scale efficency changes are 0.1% and pure efficiency was 46.8%. the other 4 MFIs who have above the average 13.2% are: Dire, Harar, Omo. AVFS with total productivity change, 53.2%, 31.5%, 23.1%, and 18.5% respectively.

For the year 2018-2019, the average total factor productivty change is 0.7%(1.007-1=0.007*100=0.7%) which was less when compared to the year 2017-2018(13.2%). In the case of Harar microfiance the total productivity change was 31.9%(1.319-1=0.319*100=31.9%) which was higher when compared to other MFIs. This is due to an increase in the technical eefficiency change to the extent of 31.9%, scale efficency changes and pure efficiency were stagnant. the other 10 MFIs who have above the average 0.7% were: Lefayeda,SFPI, Wasassa. ACSI, PEACE, Dynamic, Nisir, OCSCO, AVFS, Mekilit with total productivity change, 22.7%, 20.7%, 20.5%, and 11%, 9.9%, 7%, 6.6%, 4.5%, 3.2%, and 2.9% respectively. This is due to an increase in the eficiency change the MFIs were; Lefayeda, SFPI, wasassa, Dynamic, Meklit to the extent of 29.5%, 10.6%, 20%, 6%, 2.4% and the total productivity change due to case of technical change the MFIs were ACSI, PEACE, Nisir, OCSCO, AVFS, to the extent of 5%, 0.3%, 50.8%, 4.2%, 3.2% repectively. In the contrary, 13 MFIs were declined with total productivity change. The reason for declining was due to efficiency change 6 out of 13 MFIs (Agar, Dire, Haribu, Kendell, Vision fund, and Somali), and the remaining 7 MFIs (ADCSI, Busa Gonofa, Digaf, Eshet, Metemamen, OMO, Sidama, and Adeday) were due to technical efficiency changes.

For the year 2019-2020, the average total factor productivty change was declined 5%(1-0.950=0.007*100=0.7%) due to decreased in technical change to the extent of 93.2%. whci was less when compared prevous years 2017-2018 and 2018-2019). In the case of OCSCO microfiance the total productivity change was 69.9%(1.699-1=0.699*100=69.9%) which was higher when compared to other MFIs. This is due to an increase in the technical eefficiency change to the extent of 40.4%, scale efficency changes 21% and pure

efficiency was stagnant. the other 10 MFIs who have Positive total factor productivty changes due to technical and efficiency changes. Thus; Somali(14.4%), Nisir(14.3%), Digaf(9.3%), Adeday(7.5%), Kendil(6.4%), Vision fund(6.4%), Lefayeda(5.1%), Wasassa(3%), Harar(2.7%), ADCSI(2.5%). The MFIs due to technical effiency change ADCSI, Harar, and Adeday and the other 7 MFIs were due to efficeiency change.

For the year 2020-2021, the average total factor productivty change was declined 9.8%(1-0.902=0.098*100=%) due to decreased in technical change to the extent of 93.5%. which was less when compared prevous year(2019-2020). In the case of Nisir microfiance the total productivity change was 23.9% (1.239-1=0.239*100=23.9%) which was higher when compared to other MFIs. This is due to an increase in the technical eeficiency change to the extent of 26.5%, and pure efficiency was 10.5%.. the other 5 MFIs who have Positive total factor productivty changes due to technical and efficiency changes. Thus; Dynamic microfiance increased by TFP 4.4% due to technical efficeny change, Adeday increased in total factor productivity by 4.1% due to technical efficiency chage,, Wasassa increased TFP change by 3.8% dute to efficiency change The MFIs due to technical effiency change Digaf(3.5%), and AVFS with TFP changes in 1.1% due to efficiency change. However, 19 MFIs decliend in total factor productivity changes due to teechnical and efficiency changes.

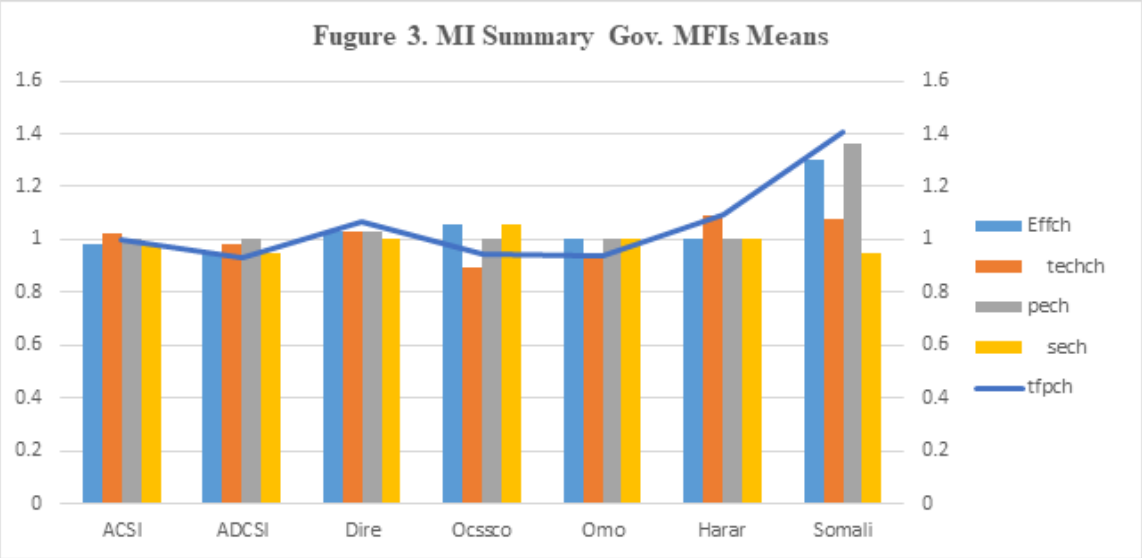
4.4 Malmquist Index Summary of Firm Means

Table 4 shows that ten out of twenty-five microfinance institutions experienced positive TFP growth over the study period. Thus; Dire, Digaf, SFPI, Wasasa, Harar, Lefayeda, Somali, Nisir, Kendil, and Adeday MFIs'. In contrast, the TFP growth of fifteen MFIs decreased due to changes in efficiency. This includes ADCSI, Agar, and Meklit, as well as Peace, Bussa gonofa, Eshet, Harebu, Metemamen, OCSCO, OMO, Sidama, Vision Fund, and Dynamics. In addition, ACSI total factor productivity declined due to both technical and efficiency changes. 5 MFIs in the large scale category, 3 MFIs in the medium scale category, and 2 MFIs over the five-year research period, MFIs in the small size group showed positive TFP growth, which was mostly due to efficiency improvements. Twelve of the twenty-five MFIs saw a decrease in technical efficiency. Due to the downward movement of the boundary, Ethiopian Microfinance Institutions witnessed negative TFP growth on average.

Table 4. Malmquist Index Summary of Firm Means

MFIs	Efficiency change	Technical efficiency change	Pure efficiency change	Scale efficiency change	Total productivity change
ACSI	0.980	1.020	1.000	0.980	1.000
ADCSI	0.951	0.982	1.000	0.951	0.934
Aggar	0.845	1.020	0.830	1.018	0.862
AVFS	0.999	0.953	1.000	0.999	0.952
Bussa Gonofa	1.000	0.898	1.000	1.000	0.898
Dire	1.032	1.032	1.032	1.000	1.065
Digaf	1.208	0.836	1.000	1.208	1.010
Eshet	1.002	0.932	1.002	1.000	0.934
Harbu	0.950	0.948	0.951	0.999	0.901
Meklit	0.981	0.993	0.982	0.999	0.974
Metemamen	0.987	0.933	1.000	0.987	0.922
Ocssco	1.057	0.895	1.000	1.057	0.945
Omo	1.000	0.938	1.000	1.000	0.938
PEACE	0.991	0.986	0.991	0.999	0.976
SFPI	1.089	1.049	1.101	0.989	1.142
Kendil	1.045	0.995	1.026	1.019	1.040
Sidama	0.943	0.915	0.944	1.000	0.863
Wasasa	1.029	0.993	1.023	1.006	1.022
Vision Fund	1.000	0.987	1.000	1.000	0.987
Harar	1.000	1.092	1.000	1.000	1.092
Lefayeda	1.141	0.901	1.000	1.141	1.028
Dynamic	0.929	0.866	0.980	0.948	0.804
Somali	1.300	1.080	1.365	0.952	1.404
Nisir	0.951	1.256	1.000	0.951	1.194
Adeday	1.000	1.143	1.000	1.000	1.143
mean	1.013	0.982	1.006	1.007	0.994

Source: Author's Calculation Using DEAP Software


Fugure 3. MI Summary Gov. MFIs Means
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
ACSI
ADCSI
Dire
Ocssco
Omo
Harar
Somali
Effch
techch
pech
sech
tfpch

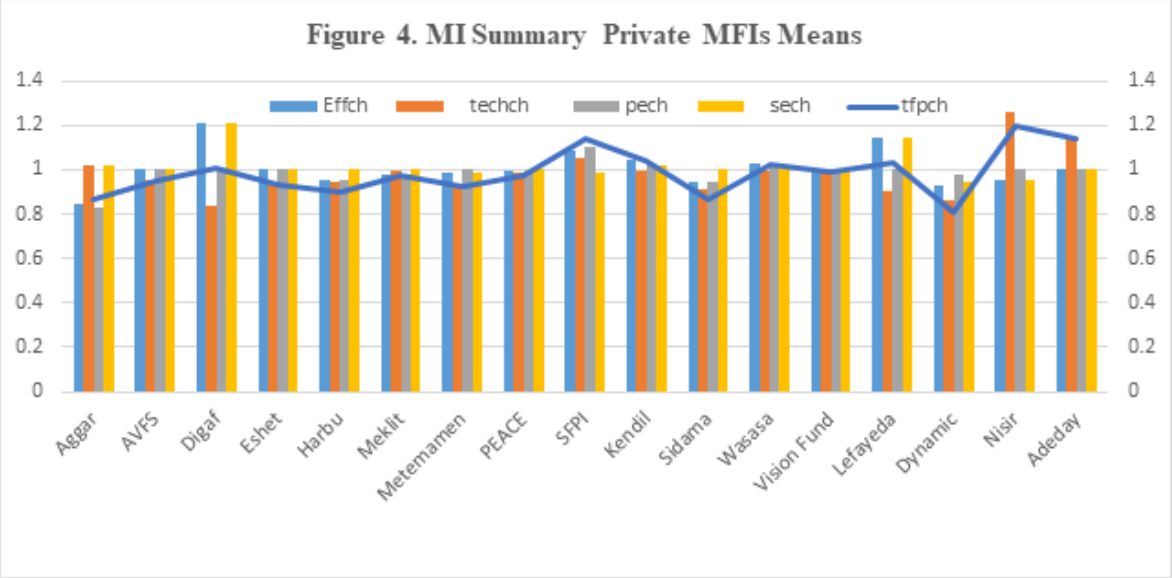


Figure 4. MI Summary Private MFIs Means
Effch
techch
pech
sech
tfpch
Aggar
AVFS
Digaf
Eshet
Harbu
Meklit
Metemamen
PEACE
SFPI
Kendil
Sidama
Wasasa
Vision Fund
Lefayeda
Dynamic
Nisir
Adeday

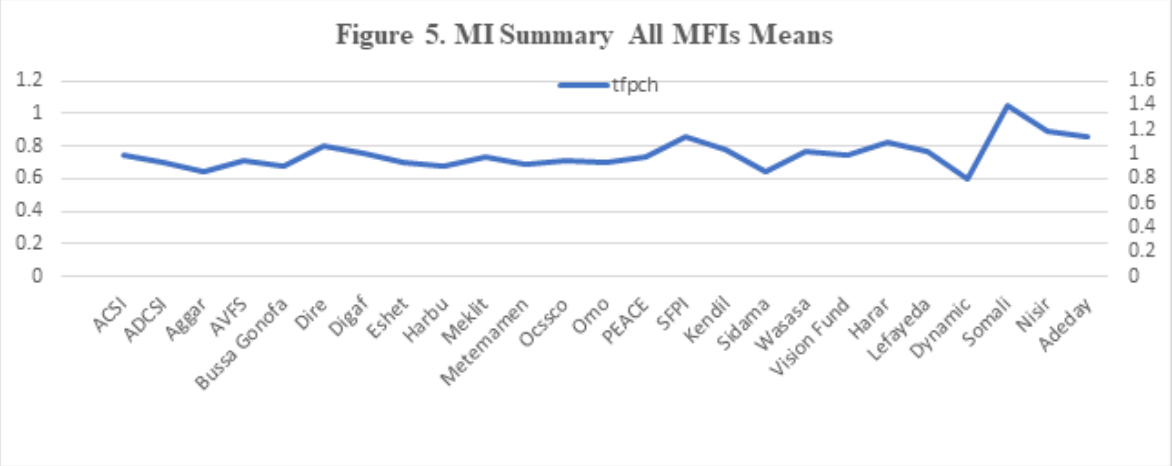


Figure 5. MI Summary All MFIs Means
tfpch
ACSI
ADCSI
Aggar
AVFS
Bussa Gonofa
Dire
Digaf
Eshet
Harbu
Meklit
Metemamen
Ocssco
Omo
PEACE
SFPI
Kendil
Sidama
Wasasa
Vision Fund
Harar
Lefayeda
Dynamic
Somali
Nisir
Adeday

4.5 Malmquist Index Summary of Annual Means

Table 5 contains a summary of the annual means derived from the Malmquist productivity index. In 2018, an increase in productivity of 13.2 percent (1.132 - 100) was seen on average across all industries. This fall in total factor productivity is simply the result of an upward shift in the frontier and an accompanying decrease in efficiency. This movement in the frontier was caused by an increase in total factor productivity. The table shows that there was an increase in TFP that was positive in 2018 and 2019, but a negative TFP change in 2020 and 2021.

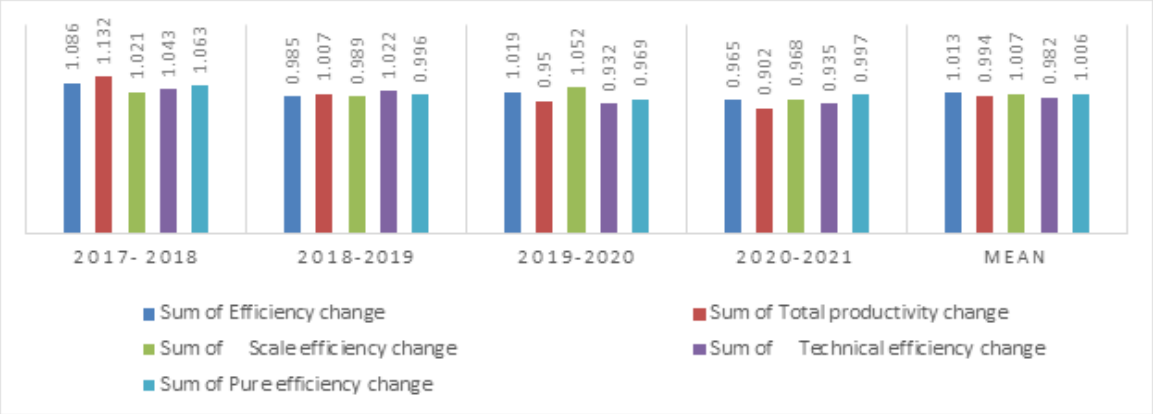
Positive TFP changes in 2019 are solely the result of an upward shift in the frontier caused by technical progress, whereas positive TFP changes in 2018 are the result of an efficiency change. Except for 2020 and 2021, the technical efficiency declines. The average productivity change during the five-year study period was negative 0.6 percent, with a corresponding 1.8 percent decline in the frontier. During the sample period, the technological efficiency change (due to CRS and VRS) has not altered.

Table 5: Malmquist Index Summary of Annual Means

Year	Efficiency change	Technical efficiency change	Pure efficiency change	Scale efficiency change	Total productivity change
2017- 2018	1.086	1.043	1.063	1.021	1.132
2018-2019	0.985	1.022	0.996	0.989	1.007
2019-2020	1.019	0.932	0.969	1.052	0.950
2020-2021	0.965	0.935	0.997	0.968	0.902
mean	1.013	0.982	1.006	1.007	0.994

Source: Author's Calculation Using DEAP Software

Figure 6. MI Summary of Annual Means Graph



5. CONCLUSION AND POLICY IMPLICATIONS

Malmquist productivity index measurement based on DEA is an essential technique with numerous applications. This index's capacity to be subdivided into its constituent aspects, namely management efficiency, efficiency scale, and technical developments, enables us to gain a wealth of useful information, allowing us to formulate and implement appropriate policies and procedures. This index was developed to analyze and evaluate the performance of licensed microfinance institutions in Ethiopia by the National Bank of Ethiopia. Regarding the findings and analyses, each MFI can assess whether or not it had an increase in productivity throughout the relevant time period. By possessing this knowledge and dissecting productivity into its constituent parts, the fundamental causes of productivity growth or decline will be identified, and management decisions and actions will be formulated based on this conclusion.

According to the Malmquist index average, Somali, Nisir, Adeday, and SFPI microfinance institutions experienced the greatest improvement in productivity between 2017 and 2021. Positive shift in productivity from an ownership structure point of view, three MFIs, viz., Somali, Dire, and Harar, were government-affiliated and seven were private MFIs. During the five-year study period, five MFIs in the large size category (Dire, SFPI, Wasassa, Somali, Adeday), three MFIs (Harar, Nisir, and Kendil) in the medium size category, and two MFIs (Digaf and Lefeyeda in the small size category) experienced positive TFP growth, which was largely attributable to efficiency change. Twelve of twenty-five MFIs saw a decline in technical efficiency. To sum up, the majority of private MFIs have positive total factor productivity and are in the category of large-scale MFIs.

Small-scale private and large-scale government MFIs, on the other hand, had a decrease in overall productivity change owing to technological efficiency. Therefore, Ethiopian Microfinance Institutions experienced negative TFP growth on average due to the lowering of the frontier, this decline in TFP growth is primarily attributable to negative technical efficiency change.

In order to make the delivery of the financial system more efficient and dynamic, MFIs must adopt new technologies such as internet banking, mobile banking, ATMs, online payment systems, online loan application and collection systems, Digital finance services, Agent banking service (Hello cash), and other technological advancements. To obtain a more accurate and complete picture of the productivity trend of the companies of interest, it is preferable to consider multiple time periods. The results presented in this research are based on the inputs and outputs considered in the design of this paper; consequently, it is feasible to achieve the same or different outcomes by modifying the inputs. We recommend applying this pattern of variable inputs and outputs to the institutions covered in this paper so that the results may be compared. In any case, this approach is highly beneficial as a quantitative and trustworthy tool for monitoring and analyzing production, and its use would give excellent results.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest between authors or any other organisation.

CONTRIBUTION

The concept and design of paper was done by Demissie Admasu, the analysis was performed by Dr. Sasmita Samanta and the final manuscript was prepared by Dr. Shikta Singh.

CONSENT FOR PUBLICATION

All the authors have been communicated regarding the publication of this paper in the journal Revista de Gestão Social e Ambiental to which consent was obtained from them.

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Annexures

Table 1. Literature Review summary (period 2017-2022)

Authors & Year	country	period	Financial Ins.	Ownership & scale	Methodology	Findings
Goswami A., & Gulati R. (2022)	India	1999 -2017	Bank	Public	(SMLPI) approach	TFP change -1% due to efficiency loss
Khan A., & Gulati R. (2022)	India	2005 -2018	MFI	Private & SML	DEA	TFP change 6.70% Efficiency (4.80%) technical (2.3%.), In terms of size categories, small MFIs

						exhibit the largest TFP growth, followed by large MFIs and medium MFIs.
Bansal P.& Kumar S. (2022)	India	2010 -2017	Bank		MLPI)	TFP positive change, due to technical change
Kamarudin F. et al. (2022)	Malaysia	2006–2016	Bank	Islamic vs Conventional	DEA-based MLPI	TFP Positive development in Islamic. Productivity of Islamic banks is merely influenced by bank size, credit risk, market dominance, managerial efficiency, and inflation
Chowdhury M.A.M., et al. (2022)	Indonesia	2013–2018	Bank	Public vs private	DEA-based MPI	Positive TFP, all commercial banks must improve their management practises, whereas Islamic banks are technically more efficient overall.
Gurjar H., et al. (2021)	India	2008–2017	Bank	Overall banks	DEA-based MPI	Positive TFP. These banks became inefficient as a result of the elimination of non-balance-sheet items. Most of the increase in productivity was due to technological advancements.
Zhu N., et al. (2021)	Pakistan	2006–2017	Bank	Private, public, foreign	DEA MPI Kruskal–Wallis test	1.9% reduction in commercial bank total factor productivity. Foreign banks' mean technical and pure technical efficiency scores are higher than local banks' mean scale efficiency score. Public sector banks outperformed private banks.
Kumar V.P.& Kar S. (2021)	India	2013 – 2018	Bank	Private & public	DEA-based MPI	Private banks are more productive than public ones. RBL had the highest MPI scores for technological change and total factor productivity change, while SBI and PNB had the lowest.
Nartey S.B.et al.(2020)	Africa	2007 - 2012	Bank	public,private, foreign	DEA biennial MPI &various regression model	A widespread deterioration in the productivity of African banks, primarily attributable to poor technological development. It has been discovered that state banks are more productive than international and private banks.
Ferreira C.(2020)	EU	2011- 2017	Bank	NA	DEA-based MPI	Existence of bank inefficiency, primarily due to ineffective managerial performance and poor input/output combinations. During this time period, the existence of bank inefficiency is especially

						pertinent, as European Union countries faced both financial and public budget imbalances.
Hassan M.(2020)	Global	1999-2017	Bank	Regional	DEA-based MPI	North and Latin American banks have higher capital requirements than European, African, and Asian banks. Except in Europe and Central Asia, supervisory authorities support bank productivity growth. Market volatility and Z-score stimulate technology evolution and scale efficiency growth, but hurt pure technical efficiency.
Jubilee R.V.W. et al. (2020)	Asia	2008 - 2017	Bank	Islamic vs Convensional	DEA-based MPI	The improvement in efficiency changes explains why Islamic banks are more productive than traditional banks. However, there is no statistically significant difference between the types of banks in terms of their productivity.
Efendia V. & Hadžiahmetovi N.(2019)	Bosnia and Herzegovin a	2008 -2015	MFI	NA	DEA-based MPI	TFP declines 2.5%, technology declines 1.7%, and technical efficiency declines 0.8%. Technological inefficiencies cause negative total factor productivity change. To meet their strategic goals in BiH MFIs, policymakers must boost technological progress.
Ambarkhane D., et al.(2019)	India	2014 - 2016	MFI	Small, Medium & Large	DEA-based MPI	Large MFIs can catch up by upgrading their systems and processes, but they must enhance scale efficiency. The Reserve Bank of India recently started giving banking licenses to large, financially stable institutions. It's used to shortlist MFIs before providing bank licenses. The method can also measure productivity.
Fall F.S., et al.(2019)	Senegal	2009 - 2013	MFI	NA	DEA-based MPI	The lowest productivity rises to date, at 1.5%. This productivity rise is mostly owing to technological advancements, with technical efficiency generally declining post-reform. Decomposing technical efficiency

						demonstrates that scale inefficiency is the main cause of decline.
Haider M.A., et al. (2019)	Pakistan and Malaysia	1980s	Bank	Islamic	DEA-based MPI	Compared to Islamic banks in Malaysia, the level of productivity of Pakistan's Islamic banking system has increased.
Sufian F. & Kamarudin F.(2017)	Malaysia	0	Bank	NA	semi-parametric MPI	During the post-merger period, the Malaysian banking sector has exhibited greater total factor productivity due to technological advancement
Jreisat A. et al.(2017)	UAE	2006-2010,	Bank	NA	Input-oriented MPI	After the 2008 financial crisis, the UAE banking sector's overall productivity decreased.
Kamarudin F. et al.(2017)	Southeast Asian	2006-2014	Bank	Islamic Domestic & foreign	DEA-based MPI	Domestic and overseas Islamic banks have shown total factor productivity change due to an increase in efficiency change (EFFCH), which was mostly managerial rather than scale-related. Foreign-owned banks are somewhat more productive than domestic banks due to a higher EFFCH.

Table-2: Input and output data for using Analysis in DEAP software

Name	YEAR	Interest & fee income	No of Active Borrowers	Loans Outstanding	Total Asset	Operating expense	Branches	Employees
ACSI	2021	816807900	1245812	22921465250	39196703172	3155576700.00	472	12533
ADCSI	2021	127905600	122014	5139938000	7409013000	327186600.00	150	1088
Aggar	2021	3619700	11605	290788030	715391442	72431000.00	22	280
AVFS	2021	186121000	1341	9612017	14383968	6121800.00	10	46
Bussa Gonofa	2021	69675300	77834	707628128	887635761	155943000.00	37	690
Dire	2021	108400	8436	287748966	555169291	47165500.00	15	122
Digaf	2021	27154300	223	572599	1765814	1658600.00	2	10
Eshet	2021	85318200	11710	89073840	112592424	25553600.00	18	154
Harbu	2021	66441900	33599	316609888	509795726	57609200.00	34	242
Meklit	2021	107202800	9442	263624955	332401313	45154800.00	23	193
Metemamen	2021	2313436400	26801	528180903	687469378	68810800.00	23	204
Ocssco	2021	930743800	1023092	12838211219	15874753472	1752924800.00	396	5972
Omo	2021	94764200	1222186	6032708696	10679003913	848020400.00	250	6401
PEACE	2021	137776900	30449	325436524	432107281	85602000.00	30	333
SFPI	2021	29303300	28852	594308336	766456015	37011600.00	38	320
Kendil	2021	112002500	1335	95582675	124152301	17842300.00	5	61
Sidama	2021	169238300	24451	345431294	510283639	67741100.00	30	389

Wasasa	2021	776972100	48454	778513436	1002185332	140548500.00	73	554
Vision Fund	2021	8702300	230503	2930544715	3404611713	464277300.00	91	1206
Harar	2021	14219000	8347	346663415	410883726	9587000.00	3	37
Lefayeda	2021	33517500	2206	22409870	43009727	17617000.00	2	41
Dynamic	2021	228416400	1502	124049480	201028216	21219900.00	0	119
Somali	2021	153705500	40382	1820152235	2617416439	224136700.00	42	459
Nisir	2021	68374900	2338	542023974	881316687	105953700.00	6	104
Adeday	2021	4329872300	15868	107482247	186788894	51367000.00	15	100
ACSI	2020	591886000	1320522	23026148410	35937879353	3155576700.00	472	12616
ADCSI	2020	133627200	300317	4795462000	6388702000	292212400.00	144	1046
Aggar	2020	4472700	11439	283728253	642482487	75111100.00	20	281
AVFS	2020	172470500	1341	9612017	14383968	7693000.00	10	50
Bussa Gonofa	2020	56145700	88863	619424840	833068375	141986000.00	37	639
Dire	2020	204700	7805	263221826	508314623	40080800.00	21	121
Digaf	2020	22982500	223	572599	1765814	1775800.00	2	10
Eshet	2020	72484000	11141	67883197	86452263	22066700.00	18	152
Harbu	2020	50213600	32655	220144526	321092954	48635900.00	21	182
Meklit	2020	76144200	8775	223649883	280417109	33296800.00	19	176
Metemamen	2020	1987207900	22165	327153228	419891904	48920500.00	22	145
Ocssco	2020	906799300	1045033	12138032026	15343456867	1611967700.00	43	5933
Omo	2020	76879400	1276163	4115224123	5794756900	694600200.00	180	6441
PEACE	2020	109151400	29077	330491494	412143262	63470900.00	26	298
SFPI	2020	21850800	29449	441473017	549363957	24690600.00	37	319
Kendil	2020	70708700	1324	67120791	83951070	13360000.00	5	61
Sidama	2020	155862500	38441	298662937	391940693	52511700.00	30	372
Wasasa	2020	533397600	48616	654800784	871585036	143483100.00	67	560
Vision Fund	2020	5181400	223477	2335779900	2720074594	385533300.00	94	1036
Harar	2020	10229700	11708	200794018	275814129	5060600.00	1	41
Lefayeda	2020	25968400	350	1197684	3607161	5259800.00	1	7
Dynamic	2020	196845200	1362	74829697	122902775	17325000.00	19	123
Somali	2020	117151500	39172	1698222673	2143699063	181601400.00	34	400
Nisir	2020	68374900	2036	341911057	593410871	87117200.00	5	86
Adeday	2020	4031989400	15868	107482247	186788894	51367000.00	15	100
ACSI	2019	500214000	1371198	23758353777	32640571183	2788057800.00	472	12686
ADCSI	2019	115447800	274538	2947278000	5035047000	223766000.00	144	1026
Aggar	2019	6306500	11997	370414912	605410495	69299000.00	17	246
AVFS	2019	142911000	11262	17683516	25756769	5928100.00	10	46
Bussa Gonofa	2019	57371800	67787	161153151	190962805	108569000.00	29	400
Dire	2019	279500	10352	254577759	433824720	33192100.00	21	121
Digaf	2019	19683000	223	572599	1765814	1392700.00	2	10
Eshet	2019	61887900	15406	53534199	59802430	19582900.00	20	172
Harbu	2019	38257700	30802	152117208	206162193	35621800.00	20	168
Meklit	2019	109687400	8438	154640015	174803691	26019500.00	19	163
Metemamen	2019	1646033600	20473	153149980	184255438	44090700.00	22	145
Ocssco	2019	927308500	1024946	10175205264	14069809118	1028407400.00	387	5869

Omo	2019	64932200	1276163	4115224123	5794756900	610832700.00	180	6441
PEACE	2019	81773800	24522	235197507	266152307	49007000.00	26	285
SFPI	2019	17796900	32428	313647479	449335784	11916200.00	27	311
Kendil	2019	70108700	4049	45259606	60340802	10360300.00	5	59
Sidama	2019	109888600	60404	174325888	193542960	48505000.00	26	307
Wasasa	2019	410564600	57681	409046359	571858533	90001900.00	60	521
Vision Fund	2019	6074000	192388	1411370897	1800504329	283113100.00	75	961
Harar	2019	4416800	11231	193076178	221898186	6017700.00	1	41
Lefayeda	2019	22775100	350	1197684	3607161	4838200.00	1	7
Dynamic	2019	88068100	1324	71037414	84680983	11241500.00	14	76
Somali	2019	57196600	34431	1060696270	1556005854	81775900.00	29	340
Nisir	2019	41057100	720	49255211	121526952	32231000.00	2	19
Adeday	2019	2885031300	15868	107482247	186788894	32071700.00	15	100
ACSI	2018	997256500	1359699	17776984830	27039084158	1646389700.00	460	12661
ADCSI	2018	124788400	294106	2481786000	3365103000	253050800.00	144	1021
Aggar	2018	5291700	15163	310804883	410186712	76723200.00	13	193
AVFS	2018	113576600	11201	16861222	26360750	4584600.00	10	64
Bussa Gonofa	2018	47253600	67787	161153151	190962805	86321500.00	29	400
Dire	2018	376400	10234	254111058	410622228	29909900.00	21	121
Digaf	2018	21088800	223	572599	1765814	3569400.00	2	10
Eshet	2018	30219800	15406	53534199	59802430	17749700.00	20	172
Harbu	2018	57080000	30603	133252613	182753913	25135700.00	20	159
Meklit	2018	77894800	7134	98490653	112726295	23434600.00	19	155
Metemamen	2018	2876445100	20473	153149980	184255438	33291300.00	22	145
Ocssco	2018	729235600	993013	8363925894	12184985130	831575900.00	375	5543
Omo	2018	73916700	1276163	4115224123	5794756900	576700700.00	180	6441
PEACE	2018	64081900	21065	158896808	197408619	33054700.00	25	250
SFPI	2018	14581700	22956	254366820	344146426	12509800.00	24	299
Kendil	2018	58551400	4049	44644231	59813824	8181500.00	5	59
Sidama	2018	209926800	60404	174325888	193542960	36749100.00	26	307
Wasasa	2018	462817100	56984	307507784	519813573	79580100.00	60	527
Vision Fund	2018	7338700	169183	1109938374	1270298855	188117200.00	65	841
Harar	2018	4216500	9355	95398756	116844214	4086700.00	1	35
Lefayeda	2018	12350000	350	1197684	3607161	6467000.00	1	7
Dynamic	2018	139535500	1035	42067838	54313284	7160500.00	9	59
Somali	2018	31976300	31079	959622934	1174802570	93211300.00	29	312
Nisir	2018	10943800	720	49255211	121526952	27144600.00	2	19
Adeday	2018	2101391400	15868	107482247	186788894	8217500.00	15	100
ACSI	2017	828668400	1074341	10450901066	17077604751	1120226400.00	450	11817
ADCSI	2017	66528700	291681	2368018000	3216427000	245054300.00	144	1018
Aggar	2017	5430400	12591	219903838	294566851	29172700.00	10	142
AVFS	2017	84029000	11504	17992878	26665956	6955800.00	13	71
Bussa Gonofa	2017	30332200	67787	161153151	190962805	56652000.00	29	400
Dire	2017	174100	5240	39373183	82292829	20303300.00	12	84
Digaf	2017	21682900	223	572599	1765814	2385800.00	2	10

Eshet	2017	17610500	15406	53534199	59802430	17197000.00	20	172
Harbu	2017	50150600	28825	59305144	85893734	16612100.00	18	147
Meklit	2017	60523900	10552	74436061	82418430	22466100.00	17	144
Metemamen	2017	2085073200	17148	53351094	75036926	30388700.00	19	79
Ocssco	2017	525892100	775947	3759325500	6548517655	553315500.00	305	4547
Omo	2017	56167000	873623	4115224123	5794756900	402534900.00	180	6441
PEACE	2017	138364600	19389	107853397	128369561	22763200.00	24	216
SFPI	2017	8773400	39501	165347176	279223029	96551700.00	25	286
Kendil	2017	13219600	4293	23674210	35094386	5578700.00	5	46
Sidama	2017	193751600	60404	174325888	193542960	31351900.00	26	307
Wasasa	2017	318171000	67325	387042301	556215168	80700600.00	54	497
Vision Fund	2017	6715900	114903	599071950	673734379	121007000.00	52	579
Harar	2017	708700	8324	63510200	82671552	5421500.00	1	28
Lefayeda	2017	8759200	350	1197684	3607161	4466300.00	1	7
Dynamic	2017	54604500	152	951144	1058287	4885000.00	1	12
Somali	2017	11877400	7518	46978764	194788992	38527300.00	17	127
Nisir	2017	10942800	385	24633409	34719372	8674800.00	2	11
Adeday	2017	10943	15868	107482247	186788894	8217500.00	15	100

Source: DEAP Software Result

Table- 3 Depicting Summary of Malmquist Productivity Index

FIs	2017-2018					2018-2019					2019-2020					2020-2021				
	effch	techch	pech	sech	tfpch	effch	techch	pech	sech	tfpch	effch	techch	pech	sech	tfpch	effch	techch	pech	sech	tfpch
ACSI	0.990	1.126	1.000	0.990	1.114	1.050	1.057	1.000	1.050	1.110	0.970	0.907	1.000	0.970	0.880	0.916	1.002	1.000	0.916	0.918
ADCSI	1.000	1.017	1.000	1.000	1.017	0.988	0.979	1.000	0.988	0.967	1.012	1.013	1.000	1.012	1.025	0.819	0.922	1.000	0.819	0.755
Aggar	0.963	1.056	0.903	1.067	1.018	0.779	1.043	0.846	0.921	0.812	0.757	0.951	0.694	1.090	0.719	0.898	1.035	0.896	1.002	0.929
AVFS	1.000	1.185	1.000	1.000	1.185	1.000	1.032	1.000	1.000	1.032	0.976	0.679	1.000	0.976	0.663	1.019	0.992	1.000	1.019	1.011
Buss	1.000	0.972	1.000	1.000	0.972	1.000	0.983	1.000	1.000	0.983	0.907	0.759	0.908	1.000	0.688	1.102	0.897	1.102	1.000	0.989
Gonofa	1.407	1.089	1.406	1.001	1.532	0.891	1.065	0.974	0.915	0.949	0.970	0.911	0.891	1.089	0.884	0.932	1.072	0.928	1.004	0.999
Dire	1.788	0.541	1.000	1.788	0.968	0.980	0.970	1.000	0.980	0.950	1.145	0.954	1.000	1.145	1.093	1.060	0.977	1.000	1.060	1.035
Digaf	1.001	0.999	1.007	0.994	1.000	1.004	0.998	1.000	1.004	1.002	0.989	0.841	0.993	0.996	0.831	1.013	0.900	1.007	1.006	0.912
Eshet	0.898	0.981	0.909	0.988	0.881	0.949	1.029	0.966	0.982	0.976	1.012	0.909	1.000	1.012	0.919	0.947	0.882	0.933	1.014	0.835
Harbu	0.977	0.997	0.983	0.993	0.974	1.024	1.005	1.017	1.007	1.029	0.947	0.960	0.952	0.995	0.909	0.978	1.011	0.975	1.002	0.988
Meklit	1.000	0.890	1.000	1.000	0.890	1.000	0.886	1.000	1.000	0.886	1.000	0.933	1.000	1.000	0.933	0.950	1.033	1.000	0.950	0.981
Metemamen	1.041	1.045	1.000	1.041	1.089	1.004	1.042	1.000	1.004	1.045	1.210	1.404	1.000	1.210	1.699	0.985	0.419	1.000	0.985	0.413
Ocssco	1.000	1.231	1.000	1.000	1.231	1.000	0.973	1.000	1.000	0.973	1.000	0.941	1.000	1.000	0.941	1.000	0.686	1.000	1.000	0.686
Omo	0.972	0.992	0.974	0.999	0.965	1.096	1.003	1.101	0.995	1.099	0.944	0.962	0.939	1.005	0.908	0.958	0.986	0.960	0.998	0.944
PEACE	1.332	1.317	1.468	0.907	1.753	1.106	1.092	1.000	1.106	1.207	1.000	0.851	1.000	1.000	0.851	0.955	0.988	1.000	0.955	0.943
SFPI	1.131	1.011	1.073	1.054	1.143	0.991	1.006	0.979	1.012	0.997	1.108	0.960	1.099	1.008	1.064	0.961	1.004	0.959	1.002	0.965
Kendil	1.000	0.966	1.000	1.000	0.966	1.000	0.953	1.000	1.000	0.953	0.927	0.806	0.930	0.996	0.747	0.855	0.945	0.852	1.002	0.807
Sidama	0.829	1.021	0.816	1.016	0.846	1.200	1.005	1.302	0.921	1.205	1.091	0.945	0.998	1.094	1.031	1.033	1.004	1.033	1.000	1.038
Wasasa	1.000	1.014	1.000	1.000	1.014	0.905	1.014	1.000	0.905	0.917	1.105	0.963	1.000	1.105	1.064	1.000	0.957	1.000	1.000	0.957
Vision Fund	1.000	1.315	1.000	1.000	1.315	1.000	1.319	1.000	1.000	1.319	1.000	1.027	1.000	1.000	1.027	1.000	0.797	1.000	1.000	0.797
Harar	1.073	0.963	1.000	1.073	1.033	1.295	0.947	1.000	1.295	1.227	1.230	0.854	1.000	1.230	1.051	0.992	0.844	1.000	0.992	0.838
Lefayeda	0.901	0.565	0.935	0.964	0.509	1.060	1.010	1.029	1.030	1.070	0.772	0.952	0.773	0.998	0.735	1.010	1.034	1.239	0.815	1.044
Dynamic	3.480	1.169	3.474	1.002	4.068	0.783	1.199	1.000	0.783	0.938	1.277	0.896	1.000	1.277	1.144	0.819	1.085	1.000	0.819	0.889
Somali	0.869	1.233	1.000	0.869	1.071	0.707	1.508	0.774	0.914	1.066	1.357	1.058	1.169	1.160	1.435	0.980	1.265	1.105	0.887	1.239
Nisir	1.000	2.267	1.000	1.000	2.267	1.000	0.673	1.000	1.000	0.673	1.000	1.075	1.000	1.000	1.075	1.000	1.041	1.000	1.000	1.041
Adeday																				
mean	**1.086**	**1.043**	**1.063**	**1.021**	**1.132**	**0.985**	**1.022**	**0.996**	**0.989**	**1.007**	**1.019**	**0.932**	**0.969**	**1.052**	**0.950**	**0.965**	**0.935**	**0.997**	**0.968**	**0.902**

Source: DEAP Software Result