Malmquist Productivity Change of Mutual Funds in Tanzania

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Abstract
This study utilized Data Envelopment Analysis to assess the efficiency of six mutual funds in Tanzania spanning from 2018 to 2022. The analysis explores efficiency changes, technical advancements, scale efficiency, and total factor productivity. The results revealed significant trends of Mutual funds, on average, demonstrate a 3 percent increase in total factor productivity, signifying enhanced output relative to inputs attributed to improved management practices, technology integration, and operational enhancements. Conversely, technical efficiency change experiences by 2.7 percent decline, indicating that certain funds struggle to optimize inputs, potentially due to shifts in management strategies, resource allocation, or market variations. Further differentiation between large and small mutual funds reveals that larger entities exhibit more favorable productivity changes. This disparity is ascribed to economies of scale, improved investment prospects, and reduced transaction costs for larger funds. The study underscores substantial implications for mutual fund managers and the industry. Positive improvements in efficiency change, scale efficiency change, and total factor productivity indicated an overall positive trend in the mutual fund industry. Emphasizing economies of scale can enhance efficiency and overall outcomes, urging regulatory bodies to provide guidance on achieving economies of scale and fostering better practices. This research offers valuable insights into the mutual fund landscape, emphasizing the critical importance of adapting to evolving market dynamics and incorporating technology to maximize efficiency and success.

Keywords: *Tanzania, Mutual funds, Malmquist Productivity Change, Data Envelopment Analysis, Total factor productivity*

1.0 Introduction

Mutual funds are professionally managed collections of stocks, bonds and other securities. Money is pooled from many sources and invested by a fund manager. The fund manager trades the fund's underlying securities, realises capital gains or losses, and collects the dividend or interest income from the assets. The investment proceeds are then passed along to the individual investors. In exchange for managing and maintaining the mutual fund, the manager charges a fee deducted from the shareholders' earnings. Money is invested in a mutual fund by purchasing shares of the fund. Mutual fund shares are analogous to shares of stock, as the shareholders are considered to be owners of the fund. Shareholders have voting rights in proportion to their ownership of the fund (Investment Company Institute, 2020).

Collective investment schemes, or mutual funds (MFs), have become one of the most innovative and successful investment vehicles for pooling savings from small investors by professional managers today. Mutual funds (MFs) offer an avenue for investors who purchase ownership units in small amounts to reap the benefits of professionally managed funds pooled into a diversified portfolio of investments that minimise investors' risk while enhancing returns. At the end of 2019, the total amount of investments in MFs globally is at 54.9 trillion US dollars with the United States having the lion share of 25.7 trillion US dollars (Investment Company Institute, 2020).

The mutual fund industry is an essential part of the financial set up of every economy, be it emerging or developed. Given the role, it plays by providing cheaper alternative avenues of investment for those who do not possess the technical expertise to identify potentially viable or financially feasible investment opportunities, its impact on the growth and development of an economy cannot be overlooked. It serves as a financial intermediary since it helps transfer funds from surplus spending units to deficit spending units. The importance of the industry is manifest in the growth in number as well as the value of funds under management of such schemes in the world, especially in developed or advanced economies. In the US for example, there were over 8000 mutual funds with total assets of US$14.7 trillion in 2012, an increase of US$1.7 trillion over the 2011 figure (Investment Company Fact Book, 2013). Global mutual fund assets grew from US$46.2 billion in 1990 (Tkac, 2001) to US$ 26.8 trillion in 2012 (Investment Company Fact Book, 2013).

Managers of mutual funds are expected to make viable investment decisions about the funds entrusted to them. Investors in mutual funds expect to earn returns commensurate with the level of risk that their funds have been exposed to. Making good returns for mutual fund investors is the work of the mutual fund managers. Predicting movements in the market returns and making wise investment decisions is a core aspect of their job. Many investors could be interested in knowing how well they are doing. Also important is the ability of the manager to select good stocks. These two activities form the core of the investment management process. The primary aim behind mutual funds is to create a pool of money from individuals and organizations to invest in stocks, bonds and other assets in different industry sectors and regions of the world; the money collected from investors is invested by the fund manager in various types of securities depending upon the objective and need of the investor based on the preferred risk and return.

Malmquist total factor productivity change of the investment firm has been a current agenda that creates attention to most investors worldwide. The decision of investors to invest or not to invest does not come quickly; several scrutinisation procedures vary from investor to investor and from investment scheme to scheme(Hafasnuddin et al., 2022). One of the primary factors commonly observed before investing in a business company, such as banks or mutual funds,is the state of productivity (Neves et al., 2020). According to Neves et al. (2020), the pure performance of investment schemes is revealed in terms of total factor productivity change (TFP). The total factor productivity index measures change in inputs to change in output, also known as variable returns to scale. Total factor productivity change measures pure efficiency change resulting from technological and technical efficiency changes. It is from pure technical and technology change acquitted through optimised and upgraded training where employee are capacitated with managerial competence on the efficient use of assets of the firm (expenses) to effectively manage costs and risks and hence have business organisations achieve the best (Sharma et al., 2020).

Numerous empirical studies regarding productivity extensively utilise the economic theory of production as their fundamental analytical framework. The production function articulates the relationship connecting variable inputs and a fixed input at the minimum threshold required to generate optimal Output. Ojo et al. (2013) characterises this relationship as a quantifiable representation highlighting the interconnectedness between inputs and outputs within the production process. The assessment of total factor productivity frequently engages either of two prominent methodological pathways: the parametric and non-parametric approaches. The parametric approach relies on econometric methodologies, encompassing techniques such as simple regression analysis (SRA) and stochastic frontier analysis (SFA) (De Guzmanet al., 2005). Juxtaposing alterations in technical efficiency with changes in overall efficiency can derive the combined gauge of total factor productivity.

The Malmquist Total Factor Productivity (TFP) Change Model, developed by Färe et al (1994) was adopted for this study. This Model's foundational premise revolves around identifying factors that elucidate investment firms' pure efficiency and productivity. Investment firms become enticing to shareholders when they manifest into favourable performance (Dickinson et al, 2023). This attractiveness is rooted in pure efficiency, specifically total factor productivity (TFP) alteration. This phenomenon beckons shareholders to invest in the transformation of TFP (Yang et al., 2019). The Model underscores changes in both technical and technological efficiencies, both of which serve as magnets for equity holders to engage in investment ventures. This propensity for investment augments the firm's ongoing operations, consequently contributing to the attainment of firm value (Adiputra & Hermawan, 2020). Without such mechanisms, the firm might merely be exhibiting growth or scale efficiency, which may not inherently translate into firm sustainability or the amelioration of firm value.

Despite the Malmquist TFP Model's constructive proposals, none has shown how pure technical efficiency and productivity change that may be achieved. Again, the Model has not said how adoption to the new technologies and pure technical efficiency lead to total factor productivity i.e., what are the inputs to be acted upon to reveal pure efficiency (variable returns to scale, VRS) and not only scale efficiency which details on constant returns to scale (CRS)(Obsa et al,2021). Malmquist TFP model is a pure efficiency measurement platform that is silent on the factors promoting the development of investment schemes such as; Banks, hospitals, schools, and mutual funds, (Kaur, & Aggarwal, 2017) The factors for the development of investment firms such as mutual funds include good public perception, free information flow and fair legislative framework, which are not the focus of this study and are thus to be taken as areas for further studies.

The volume of literature related to the world of investment funds has increased significantly in recent decades at an international level and, albeit with some delay, at a domestic level, driven by the strong growth of the collective investment sector. The first empirical works related to the funds' performance date from the sixties of the last century and centred, above all, on the equity fund segment of the United States market. (Peifer, 2011).These early works tried to ascertain whether the returns obtained by investment funds over some time were reasonable. The study on assessing the performance of mutual funds in Indonesia reported on average; the mutual funds experienced a decrease in total factor productivity (TFP) growth (Majid & Maulana, 2010). A decrease in total factor productivity was caused by a decline in both efficiency change and technical efficiencies, where the efficiency change was contributed mainly by the changes in pure efficiency rather than scale efficiency. The study suggested promoting its total factor productivity by constantly optimising and upgrading the education and training intended to improve managerial ability and speed up the adoption of new technologies.

The study by Bhatia et al (2016) on the efficiency analysis of select mutual funds in India found outthat most funds in all categories were inefficient. The most efficient category of funds was the hybrid fund category. However, substantial gains (greater than 10%) in funds' productivity in all categories of funds for the analysed period were observed. The results indicated improved managerial skills and better investment decisions as the underlying causes of improved productivity. The study by Bhatia et al (2016) purported to evaluate funds' scale efficiencies and to rank the sampled mutual funds as the basis of total productivity change using the DEA-based Malmquist index.

In China Sylviane et al (2011) reported on the performance of ESG funds in which, overall, ESG funds. The total factor productivity of ESG funds shows a decreasing trend during the study period. There are three paths to improve the performance of ESG funds. The 1st path is to maintain a low concentration of holdings and reduce the frequency of fund position adjustments based on increasing fund size. Sylviane (2011) study on how ESG funds can improve their performance involved 26 ESG funds and the DEA-Malmquist productivity index.

In the study conducted in Philippine by De Guzman (2005), employing the DEA-Based Malmquist productivity index, it was discerned that bonds and stocks exhibited the highest growth in Total Factor Productivity (TFP). This growth was predominantly attributed to advancements in Technology. These findings aligned with the study by Sylviane et al (2011) in China, which indicated that the augmentation in Total Factor Productivity primarily stemmed from technological progress as opposed to improvements in efficiency.

Majid & Maulana (2010) empirically investigated the relative efficiency of mutual funds in Indonesia. The outcomes unveiled a decline in the Total Factor Productivity of mutual funds. Both changes in efficiency and technological advancements predominantly drove this decline.Conversely, Babalos et al (2012) scrutinized the relative efficiency of Greek equity funds by utilising a DEA-based Malmquist index. The results demonstrated noteworthy declines in the productivity of the funds, predominantly attributed to technological changes rather than changes in technical efficiency. This contrasts with the findings of Nazet al (2019) who by employing DEA-Based Malmquist index in Pakistan, identified that TFP growth was primarily engendered by alterations in pure technical efficiency rather than changes in scale efficiency.

Unlike previous research efforts that mainly evaluated performance in mutual funds, banks, and hospitals, the current study investigated total factor productivity, specifically in mutual funds in Tanzania. Notably, the current state of knowledge lacks comprehensive insights into the dynamics of productivity changes within mutual funds operating within the Tanzanian context. Therefore, the principal objective of this study was to examine productivity change of mutual funds in Tanzania

The subsequent sections of this paper are thoughtfully organised as follows: The introductory section encompasses an exploration of the significance attributed to mutual funds and an overview of past research endeavours concerning productivity changes on a global scale. Additionally, the introductory portion encapsulates a theoretical analysis that lays the groundwork for the subsequent discussions. Following this, the methodology section delves into crucial aspects such as the nature of the employed data and the analytical Model adopted for the study. Lastly, the paper concludes with a meticulous analysis of the results obtained and a comprehensive delineation of the implications derived from the findings.

2.0 Methodology

2.1 Data Sample and Variables

The data for this study were taken from the Fund's financial reports for 2018-2022. The financial statements are available from the database of the Capital Market and Securities Authority(CMSA) in Dar es Salaam, Tanzania. Other data were taken from the mutual funds 'individual prospectus. The data were gathered from all six mutual funds, including Umoja Fund (Umoja Unit Trust Scheme); Wekeza Maisha (Invest Life Fund); Watoto Fund (Children Career Plan Unit Trust Scheme); Jikimu Fund (Regular Income Unit Trust Scheme); Ukwasi Fund (Liquid Fund); and Hatifungani Unit Trust Scheme (Bond Fund).

The study used three inputs and one output. The Dar es salaam-Tanzania mutual funds inputs are (i) net asset value, (ii) expenses, and (iii) risks. The Output is the funds' returns to scale. The input-output variables are taken to measure the fund's efficiency and productivity for the test period of 2012 to 2022.

Table 1: Variables Definition and Measurement Procedures

Variable(s)	Definition	Measurement
NAV	NAV is the total value of a mutual fund's assets minus the total value of its liabilities. It represents the per-share market value of all the securities held by the fund.	NAV is calculated by dividing the total value of the fund's assets minus liabilities by the number of outstanding shares. Mathematically, NAV = (Total Asset Value - Total Liability) / Number of Outstanding Shares.
Expenses	Expenses in mutual funds refer to the costs associated with managing and operating the fund. These can include management fees, administrative expenses, distribution fees (loads), and other operational costs.	The expense ratio is calculated by dividing the total expenses of the fund by its average net assets. Mathematically, Expense Ratio = (Total Expenses / Average Net Assets).
Risks	Risks in mutual funds encompass various factors that may affect the performance and value of the fund.	Risk is often assessed using statistical measures such as standard deviation, beta, and alpha. Standard deviation measures the volatility of returns, beta measures the fund's
Fund's return	Total returns represent the overall change in the value of a mutual fund's investment portfolio over a specific period. It includes both capital appreciation (or depreciation) and any income generated from the fund's investments, such as dividends or interest.	Common measures of risk-adjusted returns include the Sharpe ratio, Treynor ratio, and Jensen's alpha. T

2.2 The Research Model

The study employed Data Envelopment Analysis (DEA)-Malmquist Productivity Index. DEA is the non-parametric mathematical programming approach to frontier estimation (Coelli, 1996). The DEA technique defines an efficiency measure of a fund by its position relative to the frontier of the best fund performance established mathematically by a weighted sum of outputs to a weighted sum of inputs (Galagedera& Silvapulle, 2003). DEA involve using linear programming methods to construct a non-parametric piecewise surface (or frontier) over the data to calculate efficiencies relative to this surface.

The DEA-Malmquist method is applied to calculate the indices of total factor productivity (TFP) and technological and technical efficiency changes. Fare et al. (1994) reported that the productivity change index is given as:

$$M_0(X,^t y^t, x^{t+1}, y^{t+1}) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)} \times \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)} \right) \right]^{\frac{1}{2}} \ldots\ldots.(1)$$

Where Mo= Malmquist productivity index

D_0= Distance function

x^t = Input from the current period Technology

x^{t+1} = Input I n the next period technology

y^t = Output from the current period Technology

y^{t+1} = Output in the next period Technology

The ratio outside the blackest measures the change in relative efficiency between years' t and t+1. The x and y represent inputs and outputs, respectively. The geometric mean of the two ratios inside the blackest capture the shift in the Technology between the two periods evaluated at x^t and x^{t+1}, that is:

$$\text{Efficiency change} = \frac{D_0^{t+1}(x^{t+1} y^{t+1})}{D_0^t(x^t, y^t)} \quad \text{and} \qquad (2)$$

$$\text{Technical change} = \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^{t+1})} \right) \left(\frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)} \right) \right]^{\frac{1}{2}} \quad (3)$$

All indices are relative to the previous year. Therefore, the estimated result begins with year 2. If x^t x^{t+1} and y^t = y^{t+1} (i.e., there has been no change in Input and Output between the periods, the productivity index signals no change: M_0 =1. In this case, the component measuring efficiency and technical change are reciprocals, but not necessarily equal to 1 (Fare et l.,1994). The Data Envelopment Analysis criteria are as follows: if any of the Malmquist indices is below 1, this implies that there is a decline in performance of the firm. If any of the Malmquist indices is above 1, this indicates that there is an increase in performance of the firm. Moreover, if any of the Malmquist indices is equal to 1, this means that there is no change in the firm's performance.

The DEA-Malmquist has five indices, to measure the following: i) Technical efficiency change (relative to a constant return to scale, CRS technology), ii) technological change, iii) pure technical efficiency change (relative to a variable return to scale, VRS technology), iv) Scale efficiency change, v) Total factor productivity (TFP) change.

In practical applications, the distance measures that appear in (1) above are calculated for each operator in each pair of adjacent time periods using mathematical programming technique. We assume that k=1,…K firms that produce m=1,…M outputs $y_{k,m}^{t}$ using n=1,…N inputs $x_{k,n}^{t}$ at each time period t=1,…,T. Under DEA, the reference technology with constant returns to scale(CRS) at each time period t from data can be defined as

$$G^{t} = \left[(x^{t}, y^{t}) : y_{m}^{t} \leq \sum_{k=1}^{k} z_{k}^{t} y_{k,m}^{t} \right] m = 1,\ldots,M,$$

$$\sum_{k=1}^{k} z_{k}^{t} x_{k,n}^{t} \leq x_{n}^{t} \; n = 1,\ldots,N, z_{k}^{t} \geq 0 \; K = 1,\ldots,K, \; (4)$$

Where z_{k}^{t} refer to the weight on each specific cross sectional observation, following Afrit(1972),the assumption of constant return to scale may be relaxed to allow variable returns to scales by adding the following restrictions

$$\sum_{k=1}^{k} z_{k}^{t} = 1 (VRS) \quad (5)$$

Following the Fare et al (1994), this study an enhanced decomposition of the Malmquist index by decomposing the efficiency change component calculated relative to the constants returns to scale technology into pure efficient component (Calculated relative to the constant return to VRS technology) and scale efficiency component (Calculated relative to the VRS technology) and the scale efficiency change component which captures changes in deviation between VRS and CRS technology. The sub set of pure efficiency change measures the relative ability of operators to convert inputs into outputs while scale efficiency measures to what extent the operators can take advantage of returns to scale by altering its size towards the optimal scale.

To construct the Malmquist productivity index of firm k between t and t+1, the following four distance functions are calculated using DEA approach: $D_{0}^{T}(X^{t}, y^{t}), D_{0}^{t+1}(x^{t}, y^{t}), D_{0}^{t}(x^{t+1}, y^{t+1}), D_{0}^{t+1}(x^{t+1}, y^{t+1})$. These distance functions are reciprocals of the Output Farrell' (1957) measure technical efficiency. The non-parametric programing models used to calculate the Output based Farell(1957) measure technical efficiency for each firm $K^{`} = 1,...K,$ is expressed as

$\left[D_0^1(X_k^t, y_k^t\right]^{-1} = \max\ \lambda^{k'}$ subject to (6)

$$\lambda^{k'} y_{k,m}^t \leq \sum_{k=1}^{K} z_k^t y_{k,m}^t \quad m = 1,...,M$$

$$\sum_{K=1}^{K} Z_k^t x_{k,n}^t \quad n = 1,...,N \quad (7)$$

$$\sum_{k=1}^{K} Z_k^k = 1 (VRS)\ Z_k^t \geq 0\ K=1,...K.$$

The computation of $D_0^{t+1}(X^{t+1}, y^{t+1})$ is similar to (7), where t+1 is substituted for t

Construction pf Malmquist index also requires calculation of two mixed distance functions, which is computed by comparing observations in one-time period of the mixed distance function for observation k can be obtained from

$\left[D_0^t(x_{k'}^{t+1}, y_{k'}^{t+1})^{-1}\right] =$ max $\lambda^{'k'}$ subject to (8)

$$\lambda^{k'} y_{k,m}^t \leq \sum_{k=1}^{K} Z_k^t y_{k,m}^t\ m=1...M$$

$$\sum_{k=`}^{K} Z_k^t x_{k,n}^t \leq x_{k^{'},n}^t\ n=1...,\ N \qquad \sum_{k=1}^{K} Z_k^t = 1 \qquad (VRS)$$

$$z_k^t \geq 0\ K=1...,\ K \qquad (9)$$

To measure changes in scale efficiency, the inverse output distance functions under VRS technology are also calculated by adding (5) into constraints in (7) and (9). Technical efficiency change is calculated relative to CRS. Scale efficiency change in each time period is constructed as the ratio of inverse distance function satisfying CRS to the distance function under VRS, while pure efficiency change is defined as the ratio of the own-period change distance function in each period under VRS. With these two distance function with respect to VRS technology, the decomposition of (1) becomes.

$$M_0(x^t, y^t, y^{t+1}) = \left(\frac{D_0^{t+1}(x^t, y^t}{D_0^t(x^t, y^t}\right)\left(\frac{D_0(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t}\right)^{\frac{1}{2}} \times \left(\frac{D_0^T(x^t, y^t}{D_0^{t+1}(x^{t+1}, y^{t+1})}\right) \times$$

$$\left(\frac{D_{oc}^{t+1}(x^t,y^t)D_0^{t+1}(x^{t+1},y^{t+1})D_{oc}^{t}(x^t,y^t)D_0^{t}(x^{t+1},y^{t+1})}{D_0^{t+1}(x^t,y^t)D_{OC}^{t+1}(x^{t+1},y^{t+1})D_0^{T}(x^t,y^t)D_{oc}^{t}(x^{t+1},y^{t+1}}\right)^{\frac{1}{2}} \quad (10)$$

Where

$$\left(\frac{D_0^{t+1}(x^t,y^t}{D_0^{t}(x^t,y^t}\right)\left(\frac{D_0(x^{t+1},y^{t+1})}{D_0^{t}(x^t,y^t}\right)^{\frac{1}{2}}$$ = Technical efficiency change(techch)

$$\left(\frac{D_0^{t}(x^t,y^t}{D_0^{t+1}(x^{t+1},y^{t+1})}\right)$$ =Pure Efficiency change(pech)

$$\left(\frac{D_{oc}^{t+1}(x^t,y^t)D_0^{t+1}(x^{t+1},y^{t+1})D_{oc}^{t}(x^t,y^t)D_0^{t}(x^{t+1},y^{t+1})}{D_0^{t+1}(x^t,y^t)D_{OC}^{t+1}(x^{t+1},y^{t+1})D_0^{T}(x^t,y^t)D_{oc}^{t}(x^{t+1},y^{t+1}}\right)^{\frac{1}{2}}$$ = Scale Efficiency Change(sech)

Note that when the Technology in fact exhibit CRS, the scale change factor equals to 1 and it is the same decomposition as (1)

Note:
techch=Technical efficiency change
pech= Pure efficiency change
sech =Scale efficiency change

3.0 Empirical Results

3.1 Descriptive Statistics

Table 2 shows the descriptive statistics of inputs and outputs of 6 mutual funds across categories in Tanzanian mutual fund's industry during the study period. With reference to expense ratio the results suggest that the expense ratios of the mutual funds in the study period vary. The mean and median values are relatively close, indicating a relatively balanced distribution of expense ratios. The small standard deviation implies that most expense ratios were clustered around the mean, with relatively few outliers. The range between the minimum and maximum expense ratios (1.411% to 4.546%) was not extremely wide, but it indicated some variability in the cost of managing these funds. Investors often consider expense ratios when evaluating mutual funds because lower expense ratios could contribute to higher overall returns for investors. Funds with lower expenses have less of their returns eaten up by costs. On the other hand, higher expense ratios might be justified if a fund consistently delivers superior returns.

The descriptive statistics also revealed relatively high mean and median risk values, suggesting that, on average, mutual funds carry a moderate level of risk. However, the broad standard deviation underscores the heterogeneity of risk levels among the funds, with some funds exhibiting substantially higher or lower risk than the mean. The slight standard deviation and the fact that the minimum and maximum values are the same (6.726) suggest that the NAVs of the funds remained relatively stable and did not vary much during the given period. The mean and median values of fund returns are close, indicating a relatively symmetric distribution of returns. The standard deviation suggests moderate variability in returns, with the minimum and maximum values indicating the range of returns achieved by different funds.

Table 2: Descriptive Statistics on Mutual Funds Input and Outputs From 2018-2022

Inputs	Mean	Median	S.D	Maximum	Minimum
RISK	30.132	15.808	32.164	77.531	0.900
Expense ratio	2.438	2.386	0.132	4.546	1.411
Net Asset value	5.635	5.791	0.126	6.726	6.726
Net Asset Attribution	17.022	17.125	0.344	19.894	13.979
Out put					
Fund Return	14.367	14.103	0.353	17.850	10.457

3.2 Malmquist Productivity Index(MPI) Results

In this section we intend to measure the total factor productivity and its corresponding changes in its component between 2018 and 2022. Balanced panel data was used in analysis with about 30 observations from six (6) available mutual funds in Tanzania. The Malmquist productivity index has components which are used in performance measurement; these are changes in technical efficiency, change in technological change, change in pure technical efficiency, and change in scale efficiency as well as change in Total factor productivity. Therefore, the Malmquist productivity indexes provide us with the opportunity to compare the productivity change within the mutual fund industry and the productivity change within groups, hence give the opportunity of poor performers to catch up. Total factor productivity as the word implies refer to all factors pertaining to the production of commercial banks, more specifically the change in total factor productivity entails the changes in efficiency and changes in technology. When interpreting the Malmquist total factor productivity, we consider all of its components greater than one that indicates improvement or progression. On the other hand, the values less than one refers to the deterioration of regression, whereas the values equal to one refers to as no improvement has been observed. We used DEAP 2.1 program developed by Coelli (1996b) to measure the productivity indexes.

T 3 presents the Malmquist index summary of annual means during the study period. Most mutual funds have shown greater performance in efficiency change improvement scoring 67percent, technical change 50 percent, pure technical efficiency change 50 percent, scale efficiency change improvement and 75 percent. In 2019/2020, there was a substantial increase in efficiency and significant improvements in technical efficiency, pure technical efficiency, and total factor productivity ,the results in efficiency change and technological change resulted in improvement of mutual fund performance, similar findings has been reported by Shabri et al (2010) who found that, in Indonesian mutual funds; the mutual fund productivity improvement was the function of both efficiency change and technological change and through these changes mutual funds can reach high performance level and achieve competitive ability. The mean results indicated technical efficiency change deteriorate by 2.7 percent while there was no improvement in pure technical efficiency change. The rest of the components recorded an improvement as follows efficiency change 5.8 percent, Scale efficiency change (an improvement to catch up) 5.8 percent similar to efficiency change and total factor productivity shown an improvement of 3 percent. The observed 2.7 percent deterioration in technical efficiency change suggested that the mutual funds' ability to utilise their inputs optimally and efficiently in producing outputs has decreased. Such a decline may be attributed to a variety of factors, including changes in management practices, resource allocation, or market conditions. The lack of improvement in pure technical efficiency change suggests that changes in scale have likely contributed to any observed efficiency changes. Pure technical efficiency change focuses on the technological aspect of efficiency, excluding scale effects. The absence of improvement in this aspect could indicate that technological advancements or operational practices have not been effectively utilised to enhance fund performance. The 5.8 percent improvement in efficiency and scale efficiency change is a positive sign. This implies that, on average, mutual funds have enhanced their overall efficiency by using inputs more effectively and optimising their scale of operations. It's important to delve deeper into the specific strategies or practices that have contributed to this improvement, as they could serve as valuable insights for other funds aiming to enhance their performance. The 3 percent improvement in total factor productivity is a notable result. Total factor productivity captures changes in the overall productivity that are not solely attributed to changes in efficiency. This suggested that mutual funds have achieved higher output levels relative to their combined inputs, indicating improvements in managerial practices, technology adoption, or operational processes. Generally, the results indicate a complex interplay between different components of efficiency and productivity. While technical efficiency has deteriorated and pure technical efficiency has remained stagnant, the gains in efficiency change, scale of efficiency change, and total factor productivity point to areas where mutual funds have managed to make positive strides, the findings are in line with (De Guzman et al., 2005; Babalos et al., 2012).

Table3: Malmquist Index Summary of Annual Means

Year	effch	Techch	pech	sech	tfpch
2018/2019	1.090	0.227	0.892	1.222	0.248
2019/2020	1.484	2.402	1.121	1.324	3.566
2020/2021	0.689	2.290	1.000	0.689	1.577
2021/2022	1.125	0.718	1.000	1.125	0.807
Mean	**1.058**	**0.973**	**1.000**	**1.058**	**1.030**
	effch<1=1	techch<1=2	pech<1=1	pech<1=1	tfpch<1=2
	effch>1=3	techch>1=2	pech>1=1	pech>1=3	tfpch>1=2
	effch=1=0	techch=1=0	pech=1=2	pech=1=0	tfpch=1=0

Note: Technical efficiency change(techch), Efficiency change(effch), Pure Technical efficiency change(pech), Total factor productivity(tfpch)

Table 4 indicates most mutual funds that recorded an improvement in both categories with exception to technical efficiency change where the score recorded the deterioration in productivity change of about 2.7 percent. The annual mean productivity change in other categories wasas follows, efficiency change recorded a progression of 5.8 percent, pure efficiency change recorded no improvement, scale efficiency change recorded an improvement of 5.8 percent and total factor productivity change recorded an improvement of 3 percent.Total productivity improvement was mainly due to efficiency change and not technological improvement. While efficiency gains were indeed crucial for productivity enhancement, the lack of emphasis on technological advancement might have hindered the long-term competitiveness of mutual funds. A balanced approach combining efficiency and technological improvements could yield better results.

Looking into the number of efficiency and efficiency firms in each category, analysis revealed the following; with efficiency change 50 percent indicated an improvement in efficiency change, 33.3 percent recorded no improvement in efficiency change, and 17 percent recorded deterioration in efficiency change. Concerning technological change, most mutual funds during the study period recorded poor technological advancement with 67 percent deterioration while 33 percent recorded an advancement in technology use. The high percentage i.e.67 percent of mutual funds that experienced a deterioration in technological advancement is concerning. Technological innovation is often a key driver of success in today's rapidly evolving financial landscape. This deterioration could potentially indicate a lack of investment in technology or an inability to adapt to new technological trends or mutual funds has shifted their focus on managerial efficiency rather than acquiring new technologies, similar findings was recorded in Phillipine mutual funds (De Guzman et al., 2005). With respect to pure efficiency change most mutual funds recorded no improvement on this aspect, while in scale efficiency change most mutual fund recorded an improvement of about 67 percent. The fact that most mutual fund recorded deterioration on technological progress similarly most mutual funds recorded deterioration on total factor productivity by 67%. This could be a red flag for the overall health and effectiveness of these funds.

Table 4: Malmquist Index Summary of Firm Means

Firm	**effch**	**Techch**	**pech**	**sech**	**tfpch**
Umoja Fund	1.000	0.902	1.000	1.000	0.902
Wekeza Maisha	1.076	0.920	1.000	1.076	0.990
Watoto Fund	1.084	0.908	1.000	1.084	0.984
Jikimu Fund	0.893	0.845	1.000	0.893	0.755
Liquid Fund	1.000	1.148	1.000	1.000	1.148
Bond Fund	1.347	1.160	1.000	1.347	1.563
Mean	**1.058**	**0.973**	**1.000**	**1.058**	**1.030**
	effch<1=1	techch<1=4	pech<1=0	pech<1=1	tfpch<1=4
	effch>1=3	techch>1=2	pech>1=0	pech>1=4	tfpch>1=2
	effch=1=2	techch=1=0	pech=1=5	pech=1=1	tfpch=1=0

Technical efficiency change(techch), Efficiency change(effch), Pure Technical efficiency change(pech), Total factor productivity(tfpch)

Productivity Change by Group Categories

Following Tuzcu& Ertugay (2020), further analysis was done by dividing mutual funds into two groups. The funds over the median size were considered large, and those below the median were considered small. The main objective was to compare the productivity change of mutual funds within their respective groups. This will provide a precise description as to what among the groups of mutual funds have shown superior productivity change with respect to the rest of the groups in the industry. Similarly what among the groups have shown deterioration in productivity change. Table 5 illuminates productivity change among mutual funds by peer groups.

The results from Table 5 indicated large mutual fund(LMF) recorded progression in productivity change in all perspectives compared to small mutual funds; hence managed to push the frontier of the production possibility outwards with respect to other groups. The large mutual funds records 10.4 percent improvement in efficiency change,6.3 percent in technological change,10.4 percent in scale efficiency change and Total factor productivity change of 17.4 percent. The improvement in total factor productivity was mainly due to improvement in efficiency change and technological progress of the mutual funds within the group. Similarly large funds have benefit over small funds in term of economies of scale because large funds purchase balk of orders so they can pay fixed cost and have access to more resources. Moreover, managers of large funds will have better investment opportunities than managers of small funds and reduced brokerage commission with the amount of the transaction, and consistent with compensation concerns of fund managers (Malhotra et al., 2007; Margaritis et al., 2007). On the other hand, Small Mutual Funds(SMF) recorded deterioration on technological change and total factor productivity by 10 percent and 9.4 percent respectively. Total factor productivity reflects the efficiency with which inputs (Net asset Value, operating expenses labor, Technology, etc.) are transformed into outputs (returns for investors). The decline in total factor productivity implied that SMFs are becoming less efficient at generating returns relative to their resource inputs. This could result from a variety of factors, including suboptimal investment strategies, poor portfolio management, increased operating costs, or outdated business models similarly as pointed out by Bauer et al (2002); small funds experience higher transaction costs than larger funds because they cannot take advantage of certain economies of scale. Small funds may face significant higher costs in their start-up period. This was due not only to marketing costs but also the initial cash flows as it will place a greater load on the fund's transaction costs. According to Bauer et al (2002), one of the reasons for underperformance of younger funds is their exposure to higher market risk since they are invested in fewer stock. The rationale for classifying mutual funds into groups based on these results is rooted in the observed disparities in investment opportunities, costs, efficiency, and risk factors between large and small funds. This classification helps to better understand the dynamics and challenges faced by different categories of mutual funds in the investment landscape.

Table 5: Malmquist Index Summary of Mutual Funds by Groups

	Year	**effch**	**techch**	**pech**	**sech**	**tfpch**
	2018/2019	1.261	0.227	0.801	1.574	0.286
LMF	2019/2020	1.384	2.287	1.248	1.109	3.165
	2020/2021	0.696	2.716	1.000	0.696	1.891
	2021/2022	1.225	0.904	1.000	1.225	1.108
	mean	1.104	1.063	1.000	1.104	1.174
	Year	effch	techch	pech	sech	tfpch
	2018/2019	0.788	0.270	1.000	0.788	0.212
SMF	2019/2020	1.522	2.608	1.000	1.522	3.969
	2020/2021	1.000	1.296	1.000	1.000	1.296
	2021/2022	0.855	0.720	1.000	0.855	0.616
	mean	1.006	0.900	1.000	1.006	0.906

LMF=Large Mutual funds, SMF=Small Mutual fund, Technical efficiency change(techch), Efficiency change(effch), Pure Technical efficiency change(pech), Total factor productivity(tfpch)

4.0 4.0.Conclusion and Recommendations

The findings from the study provided valuable insights into the performance and productivity changes of mutual funds over the study period. The Malmquist index summary revealed that most mutual funds have demonstrated improvements in efficiency change, technical change, scale efficiency change, and total factor productivity. These improvements reflect a complex interplay between various components of efficiency and productivity. Notably, the positive improvements in efficiency change and scale efficiency change suggest that mutual funds have enhanced their overall efficiency and optimized their operations, leading to increased productivity. The 3 percent improvement in total factor productivity signified that mutual funds have achieved higher output levels relative to their inputs, indicating improvements in managerial practices, technology adoption, or operational processes.

However, the study also identified areas of concern. The observed deterioration in technical efficiency change by 2.7 percent implied that some mutual funds struggle to utilise their inputs optimally and efficiently. This decline could be attributed to management practices, resource allocation, or market conditions changes. Moreover, the lack of improvement in pure technical efficiency change indicated that technological advancements have not been effectively leveraged to enhance fund performance. The analysis further highlights the importance of a balanced approach between efficiency and technological improvements. While efficiency gains are crucial, the study suggested that a lack of emphasis on technological advancement could hinder long-term competitiveness, especially considering the rapidly evolving financial landscape.

Dividing mutual funds into large and small groups provides additional insights. Large mutual funds have demonstrated superior productivity changes compared to small mutual funds. Large funds' ability to improve technological, scale efficiency, and total factor productivity is attributed to economies of scale, better investment opportunities, and reduced transaction costs. In contrast, small mutual funds have faced challenges, particularly in technological change and total factor productivity. The decline in total factor productivity for small funds suggests inefficiencies in generating returns relative to resource inputs. This could be due to higher transaction costs, suboptimal investment strategies, or outdated business models.

In conclusion, the study has highlighted the need for mutual funds to balance efficiency and technological advancements to ensure sustained competitiveness. The positive strides in certain areas underscore the growth potential, while the areas of deterioration signal the need for targeted improvements. The findings provided valuable insights for mutual fund managers and the industry, emphasising the importance of adapting to changing market conditions and leveraging technology to enhance overall performance. Encouraging mutual funds to achieve economies of scale can improve efficiency and performance. Regulatory authorities could provide guidance and best practices for achieving economies of scale. Due the challenges small mutual funds face, regulatory authorities could provide targeted support to help them overcome barriers to technological adoption. This might include financial incentives, technology-sharing platforms, or collaborations with larger funds for knowledge transfer.

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