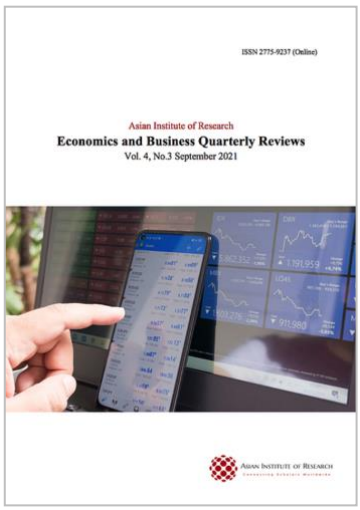

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The Combined Effects of Managerial and Operational Performance of Various Fundamental Components on Stock Selection

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Abstract
This study aims at quantifying fundamental components such as the country economy, stock market development, economic sectors, and company's performance computed by Data Envelopment Analysis (DEA) built-in MATLAB program and combined using a top-down approach. It was conducted in the East African region specifically Kenya, Tanzania, Uganda, and Rwanda from 2015 to 2018. A secondary data extracted from the listed company's websites, capital market authorities of each country, and World Bank. The study found that the combined performance of various components has a great impact on screening the stocks to be used for portfolio construction. It gives a signal to the authorities of capital markets, investors, policymakers, and other regulatory bodies to take immediate measures on designing policies and best practices. Further recommendation to the capital market authorities within the region is to ensure the growth of managerial and operational performance of stock exchanges. Also, regulatory bodies, policymakers, and higher-level administration of each country within the region to take responsibility to uplift the country's economy as well as economic sectors growth. The board of directors and management of listed companies should formulate strategies to improve both managerial and operational performance.

Keywords: Fundamental Components, Managerial Performance, Operational Performance, Stock Selection, Top-down Approach

I. Introduction

It is a conventional practice of the researchers to regress several factors and estimate the expected returns of shares. Guerard, Markowitz and Xu (2015) considered 10 factors while Loncarski and Skocir (2018) regressed 8 factors including 5 factors proposed by Farma and French (2014). They both agreed that the multifactor model increases the explanatory power of expected returns. Generally, the scholars look at the decomposition of systematic risk into several components depending on the number of factors included in the model and conclude which factor has

a higher influence on expected returns. This study looks at the root cause by evaluating the managerial and operational performance of Decision-Making Units (DMUs) where those factors incorporated in the models are extracted and measured by Data Envelopment Analysis (DEA). This led to an effective model with the higher predictive power of returns, its volatility, and sensitivity.

DEA is the well-known model used to measure efficiency and it has been applied in various studies that relate share selection and portfolio construction such as the study of Lim, Oh, and Zhu (2014) and Jothimani, Shankar and Yadav (2017) in different approaches. They are mostly used as an alternative measure of share and portfolio performance. This study used the DEA to measure the managerial and operational performance of various components and used as the base of share selection. Various studies have associate managerial and operational efficiency and effectiveness with technical efficiency of DMUs measured by various DEA models which are Constant Return to Scale (CRS) and Variable Return to Scale (VRS) model (Maria and Sunchez, 2007; Kumar and Gulati, 2008; Wong and Deng, 2016). The scholarly work of Banker, Charnes, and Cooper (1984) addressed that CRS model measures the Overall Technical Efficiency (OTE) and VRS model measures Pure Technical Efficiency (PTE) and the ratio of OTE and PTE measure the Scale Efficiency (SE). Kumar and Gulati (2008) further interpreted that the OTE helps to determine inefficiency due to the input/output configuration as well as the size of operations, PTE measures the management performance and SE measures the management ability to choose the optimum size of available resources. Maria and Sanchez (2007) reported that the PTE measures the management effectiveness. Contrary to the study of Wong and Deng (2016) who remain silent, they only mentioned that it to be the measure of efficiency. Somewhere across the lines, Wong and Deng compared PTE with effectiveness. The study of Yannick, Hongzhong, and Thierry (2016) clarified that OTE could be broken into two categories which are PTE and SE, while PTE measures management efficiency which means how well resources are managed and SE measure operational efficiency which means how well resources are utilized. It was stressed that the effectiveness requires goal achievement and efficiency requires minimization of resources used. It was further explained by Bartuseviciene and Sakalyte (2013) that the product of efficiency and effectiveness result in performance. Impliedly, Input Oriented (IO) DEA is more on efficiency, Output Oriented (OO) is more on effectiveness and product of IO and OO is the performance as illustrated in Figure 1. Therefore, mathematically management effectiveness can be defined as PTE computed using OO, management efficiency can be referred to as PTE computed using IO and management performance is the product of PTE-OO and PTE-IO. Likewise, operational effectiveness corresponds to SE computed using OO, operational efficiency is the SE computed using IO and operational performance is the product of SE-OO and SE-IO.

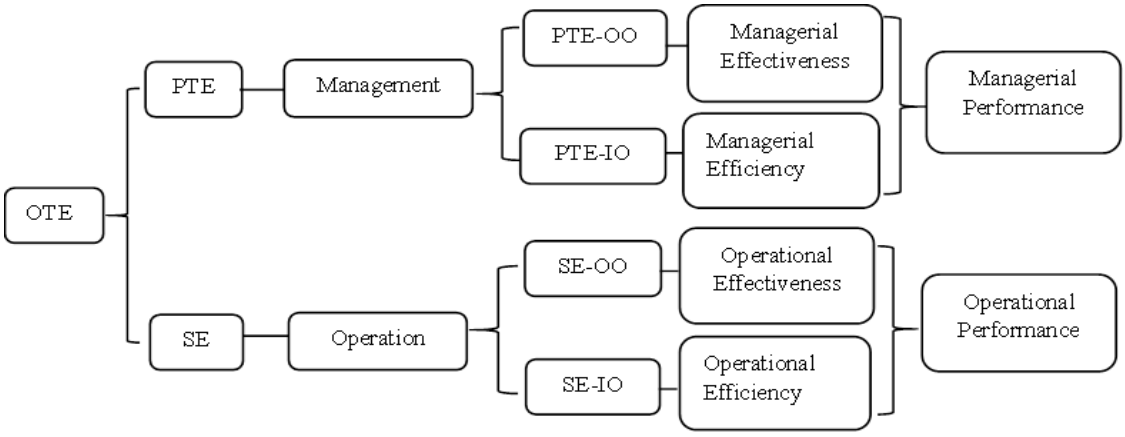

Figure 1: The Flow of Technical Efficiency

The methodology of determining the managerial and operational performance, and the limited previous studies incorporating components like stock market development, economic sector growth and country economy with the company's fundamentals remain the reasons of conducting of this study. Broadly, this study is plagued with conceptual and methodological issues that have precluded by other researchers from concluding the combined influence of managerial and operational performance on share selection.

The proposed model was tested in East African Capital Market (EACMs) which comprise Nairobi Securities Exchanges (NSE), Dar es salaam Stock Exchanges (DSE), Uganda Securities Exchanges (USE) and Rwanda Stock Exchanges (RSE). The selection of the region were influenced by its growth compare to another region in the continent (ADB, 2019), equity is the best stock to trade in the region, although brokers are not competitive, local investors within the national stock markets are less confident on trading equity stock rather they invest on government bonds (Kimani, Aduda and Mwangi, 2017) also, there is an ongoing project sponsored by World Bank to integrate EACMs in one trading platform (Biau, 2018), most important this study is unique on its kind to be conducted in the region.

The integrated model is useful to practitioners and policymakers on understanding the efficiency of various listed companies concerning the country's economy, economic sectors, and stock market development. The following sections of this study will be organized follow; Section 2 will review the related literature. Section 3 will explain the data and techniques used. Section 4 will present and discuss the results. Section 5 will conclude and propose a future study to be conducted.

II. Literature Review

Investors or fund managers commonly use fundamental or technical analysis to select shares to be included in different portfolios. Though both analyses have common objectives of maximizing the accuracy of predicting the future price movement and profit of shares, this approach is different. The fundamental analyst examines the proxies of the country's economy, its stock market, economic sectors and company listed. While technical analysts are emphasized on examining the behavior, trend, intensity, and quality of the past price of shares (Petrusheva and Jordanoski, 2016). Studies conducted in different stock markets to compare fundamental and technical analysis found that fundamental outperform technical models (Jakpar, Tinggi and Tak, 2018; Beyaz, Tekiner, Zeng, and Kean, 2018; Kulkarni and Kulkarni, 2013). Although various scholars suggested using a hybrid model that combines both fundamental and technical analysis for best results (Souza, Ramos, Pena, Sobreiro and Kimura, 2018; Bonga, 2015; Drakopoulou, 2015; Waworuntu and Suryanto, 2010; Markwat, Dijk, Swinkels, and Zwart, 2008), few of them show the clear methodology of merging these two models. Several studies were confined to the standard fundamental analysis framework by looking at screening criteria extracted from audited financial statements. Shen and Tzheng (2015); Jothimani, Shankar, Yadav (2017) considered profitability, growth, liquidity, solvency, valuation, and operational efficiency ratios as screening criteria of fundamental analysis. Likewise, Wong and Deng (2016) used absolute value including assets, loans, deposits, investments, total cost, and interest on deposits.

A recent study of Tarczynski and Tarczynska-Luniewska (2018) reconsidered the Graham and Dodd framework by including other components like macroeconomic, sectoral analysis, and company financial conditions to account companies' fundamental strength that can lead to long term sustainability. However, they overlooked the identification of the proxies used for economic, market, and sectoral analysis. Precisely, company liquidity, profitability, indebtedness, and management efficiency are the only criteria they used. An empirical study of Baresa, Bogdan, and Ivanovic (2013) addressed the importance of incorporating macroeconomic and sectoral analysis during the share selection process. They considered GDP, unemployment rate, interest rate, budget deficit, and inflation as key macroeconomic proxies that affect share returns. Similarly, different sectors within the market have a different level of risk, therefore diversification across different sectors will minimize risk and maximize the portfolio returns. Sukcharoensin and Sukcharoensin (2013) analyzed stock market development in ASEAN-5 Equity Markets by looking into the size, accessibility, efficiency, and stability of the stock market and able to classify the market development which is very useful information to investors who are interested to cross border share trading. Therefore, the broad scope of fundamental analysis includes the components such are country economy development, economic sectors, stock market, and listed company.

Country's Economy

The relationship between the country's economy and stock selection is associated with the study of Rose (1976) when introduced to APT. The country's economy proxies including interest rate spread, inflation rate, and

industrial production growth rate were used to explain the different levels of risks that can influence stock returns. Studies conducted to measure the sensitivity of macroeconomic variables on expected returns show contradicting results. Amtiran, Indiastuti, and Masyata (2017) confirmed that macroeconomic variables have a strong influence on stock returns. French (2017) reported that industrial production growth shows significant contribution and other variables are poorly explained the expected returns. Gabriel, Semion, and Akpoede (2016) and Elhusseiny, Michieka, and Bae (2019) both concluded that all macroeconomic variables have a very low contribution to stock returns. Recent scholars, therefore, opt to regress more variables such as a change in export, gross domestic product, unemployment rate, domestic credit, exchange rate, and observe the effect on expected returns (Oyetayo and Adeyeye, 2017; Elshqirat, 2019). All those variables are commonly used to explain the country's economic position.

Most of the cross-countries studies conducted were more interested in understanding collectively the efficiency of the country economy. They classified macroeconomic variables into two main categories which are input factors and output factors and evaluated using the performance evaluation method commonly DEA. Skare and Rabar (2016) emphasized that the DEA is the best measure of country economic efficiency, it provides valuable insights in cross country comparisons and has been widely used in OECD countries and somehow in developing and developed nations. It was stressed that different studies used different macroeconomic indicators to evaluate country economic efficiency ranging from the gross domestic product (GDP), inflation, and unemployment, as the primary variables, to a series of less used variables such as consumer price index, access to credit, business cycles. Tasnim and Afzal (2018) argued the benefits of the global entrepreneurship system on the country's economic efficiency over macroeconomic factors which are commonly used in other studies. Using data extracted from 59 countries and DEA, the results revealed the influence of the global entrepreneurship system as among the factors that can be used to evaluate the country's economic efficiency. It was insisted that the DEA was able to segregate the countries based on efficiency. Ozkan and Ayan (2017) used DEA to evaluate the efficiency of OECD countries on utilizing national income for social development. Deliktas and Gulan (2016) conducted a comparative study between low income, upper-middle, and high-income countries on efficient use of labour, capital, and energy on economic growth using DEA. Overall, the studies witnessed the power of DEA on identifying an efficient country and they recommended using the technique to evaluate the individual or cross-country efficiency (Skare and Rabar, 2016).

However, other scholars are more focused on comparing the countries with a wide gap of financial resources (Ozkan and Ayan, 2017; Deliktas and Gulan, 2016) which end-up to fail to draw a general conclusion. Still, there is a gap in a body of literature of cross-country efficiency comparison which has a comparable level of the economy. Although labour force and capital are observed to be common inputs used while GDP is dominated as output factor. Some studies conducted include more inputs or outputs variables that fit with the study objective. Ozkan and Ayan (2017) included socio-economic development indicators as output variables since the study aims to determine the effectiveness of the countries on socio-economic development provision. Tasnim and Afzal (2018) involved the global entrepreneurship index as among the inpuvariablesble to observe its influence on the overall economy of the country however, the results were inconsistent compare to common input/output factors used.

Stock Market Development

The analysis of stock market development was firstly understood by Calderon-Rossell in 1991 who come-up with a partial development model of stock market growth (Yartey, 2008 and El-Wassal, 2013). The model explained that stock market development is the function of stock market liquidity and country economic growth. Some studies focused on evaluating the ability of the stock market on capital allocation, providing opportunities to investors to diversify the risk, and to trade economically (Sukcharoensin and Sukcharoensin, 2013). Further was elaborated that, the World bank introduced Financial Sector Development Indicators (FSDI) in 1996 which captures other dimensions of development such as access, stability, efficiency, and size. While stock market access can be assessed by number of listed companies and newly listed companies. Market stability can be determined using market fundamental information extracted from its financial statements. Stock market efficiency can be measured by observing the proportion of listed companies with autocorrelations and zero returns. Stock market

size are market capitalization, volume and value of share traded. Most of the studies conducted on examining the influence of market development are skewed on identifying the significant contribution of each indicator and overlooked to identify the overall strength of the market. Onoh, Ukeje, and Nkama (2017) found that trade volume has a negative significant contribution while market turnover has a positive significant contribution. Saeed and Hassan (2018) reported that Market depth liquidity measured by turnover rate and volume of share traded found to be positively correlated with stock returns. Kuvshinov and Zimmermann (2018) found that the stock market size and the market capitalization to GDP ratio is a reliable indicator for stock market growth and financial development which is also influenced stock returns. Eze (2019) found that market capitalization of Nigeria stock exchange had a positive and significant impact on stock returns.

Few of the studies focused on a general understanding of the stock market and draw a conclusion based on market access, stability, efficiency, and size. Yi, Chang, Xing, and Chen (2019) revealed that the fluctuation of relative valuation efficiency of the Hong Kong stock market is less than the mainland stock market, this signified the maturity and stability of the Hong Kong stock market. When the valuation level and valuation efficiency of the DEA and P/E ratio are compared, the P/E values are found to be overestimated while DEA is found to fit the real situation. Kuo, Lu, Dinh (2020) argued that the findings contradict previous studies explaining that fundamental information of listed companies is the proxies of evaluating stock market performance (Zhang, 2007; 2008). Sharma (2018) concluded that the managerial efficiency measured by PTE and operational efficiency measured by SE of Indian banks show different significance levels on stock market performance.

Generally, the studies conducted do not consider the variables which directly measure the stock market development as suggested by Calderon-Rossell or FSDI instead they used the inputs and outputs variables related to listed companies and draw a conclusion with the respect to the efficiency of the companies (Yi, Chang, Xing and Chen, 2019; Dong, et al., 2016 and Sharma; 2018). While the recommendations of Dong, et.al. (2016) lead to improve market stability and market access which are among the FSDI, yet the indicators were not included in the model. A recent study of Kuo, Lu, Dinh (2020) concluded that the companies fundamentals cannot explain the stock market performance, other factors like information asymmetry need to be considered to improve market efficiency. Although, Sharma (2018) reported that operational efficiency computed using fundamental information of listed banks significantly explained the stock market development.

Economic Sectors

Among the earliest study conducted on the analysis of economic sector growth are conducted by Lewis (1954); Kuznet (1966); Chenery (1975) and Kuznet (1979) who hypothesized as a structural change involved the reallocation of capital outflow, labor, tax revenue as well as the structural term of trade across economic sectors (Hussin and Ching, 2013 and Lankauskiene and Tvaronaviciene, 2013). Generally, the indicators which are commonly used to evaluate economic sectors are growth which measures the value added by individual sectors to the country economy, productivity which is the ratio of value-added to labour input, profitability measured by net profit margin or return on assets, International trade measured by Revealed Comparative Advantage (RCA) or export market share, Foreign Direct Investment (FDI) measured by the ratio of inward FDI to value-added or ratio of outward FDI to value-added (Tahamipour and Mahmoudi, 2018; Lankauskiene and Tvaronaviciene, 2013; Ahmad and Malik, 2009).

Studies conducted to observe the variability of stock returns across different economic sectors incincludenjaman and Aralas (2017) who found that the technology sector shows the highest returns while in the telecommunication sector showshows lowest returns although the difference was not significant. Tandon and Walia (2015) revealed that the pharmaceutical sector performs better than media, finance, and metal. The discussion note released recently by Norges Bank (2019) examined the importance of country and economic sectors in global equity returns found that mixed results over time. By applying Heston and Rouwenhorst (1994) methodology which decompose sectors and country effect into factor and regress with stock returns. It was concluded that in recent decades the sectors have a higher contribution to global equity returns. At least Norges Bank (2019) regret to regress sectoral factors and country factors due to the existence of perfect collinearity among regressors.

Other studies managed to identify some variables which can explain the sectoral effect and evaluated them using DEA. Yet the results contradict among scholars, the context of the study, type of model used, and orientation. Nazako and Chodakowska (2015) contended that DEA only explained managerial efficiency and excluded the impact of exogenous factors such as country economic condition. The Tobit regression results revealed that country GDP is the main contributor to the productivity of the industrial sector. Atici and Podinovski (2015) disclosed that different DEA models produced different results however, the conventional model which is VRS and CRS produce poor efficiency compare to the production trade-off DEA model. Yang, Shi, Qiao, and Wanga (2017) evident that there are different technical efficiencies of the selected steel industry in China in different provinces, areas, economic zone, and country development plans. Yannick, Hongzhong, and Thierry (2016) found Ivorian commercial banks are not operationally efficient. Also, the efficiency score was decreased when the VRS assumption was held.

The reported findings of the selected studies revealed that DEA ccouldevaluate the efficiencies of different economic sectors. The question of identifying input and output factors still raised concern among the scholars. Yannick,et al.. (2016) measured the efficiency of the banking sector found the exclusion of local and foreign ownership among the input/output parameter was not an appropriate decision. Likewise, Nazako and Chodakowska (2015) forgone GDP in the initial stage while measuring the efficiency of the industrial sector result to have a false conclusion. It worth noting that, the type of DEA model used results to have unexpected results. Atici and Podinovski (2015) stressed that both CRS and VRS produced poor efficiency when they used to measure the agricultural sector in a different region in Turkey. Although was justified that mainly caused by many input variables used.

Company's Fundamental

Analysis of company fundamentals on share selection was associated with the criteria suggested by Graham and Dodd (1934). The most common criteria used was Price to earnings (P/E) ratio, price to book value (P/BV) ratio, dividend yield, current ratio, positive earnings per share (EPS), debt to equity (D/E) and market capitalization (Kok, Ribando and Sloan, 2017; Kabrt, 2015; Otuteye and Siddiquee, 2015; Lee, 2014). Current studies which have tested the Graham and Dodd framework found that profitability and market-based ratios have strong predictive power on share returns (Mohammad and Ali, 2018; Ma, Ausloos, Schinckus, Chong, 2018).

Recent studies incorporated the Graham and Dodd criteria with various DEA models to strengthen the relationship between company fundamentals and future payoff. Some of them even combined the mean-variance (MV) framework and examine the deference. Lim, Oh and Zhu (2014) concluded that portfolio selection based on MV-DEA cross efficiency evaluation is more effective than pure DEA cross efficiency and benchmark market index. Although a hybrid model was found to be effective and recommended by scholars, it was criticized by Mashayekhi and Omrani (2016) complained that the methodology of merging MV with DEA cross efficiency was not conducted simultaneously. This means that all the constraints such as maximize portfolio returns, minimize weighted covariance of the returns, maximize portfolio efficiency, and minimize weighted covariance of the firm efficiencies need to be considered concurrently. It was explained that the stocks were selected based on DEA cross efficiency and portfolios were constructed using MV framework. Using the same criteria used by Lim, Oh, and Zhu (2014), the study further revealed that when the merging is conducted simultaneously the portfolio performance becomes lower although it shows good diversity of the Pareto solution. Other studies intensified on the enhancement of the DEA model and preliminary selection of shares before portfolio construction to maximize the portfolio returns. Jothimani, Shankar, and Yadav (2017) reported that the DEA-PCA model helps reduce curse dimensionality which is reported as a major drawback of standard DEA. A total of 115 firms were found efficient when the standard DEA model was while only 41 remained when DEA-PCA was used. Higher variability was merely caused by many inputs/outputs that directly increase the dimensionality of data which causes difficulty in solving an optimization problem using standard DEA. Edirisinghe and Zhang (2010) found that the correlation between company fundamentals with expected returns was maximized and portfolios developed were demonstrated to be superior when expert information (EI) is incorporated in DEA model. Conclusively, studies that evaluate the company fundamentals using DEA and examine their relationships with stock returns realized marginal improvement though differs from the model used. The question of efficiency of the company

fundamentals and their contribution of excess returns remains a hot discussion in the field especially in the methodology and identification of inputs and output factors.

Integration of Fundamental Components

There are two common approaches that investors can use to integrate the components which are considered during fundamental analysis. There are top-down and bottom-up. The top-down approach is the one where the analysts put more emphasis on analyzing the economy of the country followed by the stock market and industry, and less emphasis on company analysis. Under the bottom-up approach, more emphasis is on company analysis followed by industry and market with little importance on analysis of the economy of the country (Navas and Bentes, 2013; Baresa, Bogdan, and Ivanovic, 2013; Li and Sulivan, 2011). The study of Juozapaitis and Stasytyte (2015) added a mixed approach after top-down and bottom-up. The mixed approach is involving the implementation of both top-down for economic activities and bottom-up for the company's activities. This means that both macroeconomic variables and company fundamentals are broadly evaluated, while other components like the stock market and economic sectors received little attention. However, top-down approach is recommended when the investor aims to conduct geographical diversification. Where for that case, indeed must emphasize on evaluating the economic condition of the countries and compare before making an investment decision (Navas and Bentes, 2013). Correspondingly, this study involves four countries with different economic status in which the top-down approach fit the minimum requirements.

III. Methodology

Data and Data Source

The data used in this study are classified into four components and range from 2015 to 2018. There are country economies and economic sectors data that are extracted from the word bank database, stock market data are extracted from Capital Market Authority (CMA) of each country, and company data are extracted from the company's database. The defined inputs and outputs variables of each dimension are presented in Table 1.

Table 1: Summary of Data and Data Sources

Dimension	DMUs	Inputs	Outputs
Country Economy	Kenya, Tanzania, Uganda and Rwanda	Government spending % of GDP and Investments % of GDP.	Inflation rate and Public debt % of GDP
Stock Market	NSE, DSE, USE and RSE	Listed shares and Market Capitalization.	Turnover and All share index
Economic Sector	Agriculture, Industry and Service	Labour force % of total employment.	Value added % of GDP and Growth rate
Company Fundamentals	51 listed shares (36-NSE, 9-DSE, 4-USE and 2-RSE)	Equity, total Assets and Investing Cash flow.	Turnover, Net profit, Financing and Operating cash flow

Sampling Framework

All companies selected are domestic companies from each stock exchange. The cross-listed companies were excluded to avoid redundancy. Only companies that have published audited financial statements and all defined inputs and outputs constrained from 2015 to 2018 are considered.

Managerial and Operational Performance Evaluation

CCR and BCC models in both orientations as shown in Table 2 were incorporated in MATLAB.

Table 2: Models Used

Model 1: Input Oriented	Model 2: Output Oriented
$\min_{u,v} \theta - \varepsilon\left(\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right)$	$\max_{u,v} \vartheta_j + \varepsilon\left(\sum_{i=1}^{m} S_i^- + \sum_{r=1}^{s} S_r^+\right)$
Subject to.	Subject to;
$\sum_{j=1}^{n} x_{ij}\lambda_j + S_i^- = \theta x_{io} \quad or\ i = 1,2,\dots m$	$\sum_{j=1}^{n} x_{ij}\lambda_j + S_i^- = \vartheta x_{io} \quad or\ i = 1,2,\dots m$
$\sum_{j=1}^{n} y_{rj}\lambda_j - S_i^- = y_{io} \quad for\ r = 1,2,\dots s$	$\sum_{j=1}^{n} y_{rj}\lambda_j - S_i^- = y_{io} \quad for\ r = 1,2,\dots s$
$\lambda_j \geq 0 \quad for\ j = 1,2,\dots n$	$\lambda_j \geq 0 \quad for\ j = 1,2,\dots n$
$S_i^- \geq 0\ ;\quad S_r^+ \geq 0$	$S_i^- \geq 0\ ;\quad S_r^+ \geq 0$
For BCC, $\sum_{j=1}^{n} \lambda_j = 1 \quad for\ j = 1,2,\dots n$ is added	For BCC, $\sum_{j=1}^{n} \lambda_j = 1 \quad for\ j = 1,2,\dots n$ is added

The evaluation of managerial and operational performance of the country's economy, market, economic sectors and listed companies follow the following steps.

1. Identification of Inputs and outputs of all DMUs

— For input and output matrix, each raw represent one DMU and each column represent one constraint.

— The input of $j^{th}DMU$ is defined as $X = \{x_{1j},\ x_{2j} \dots, x_{ij}\}$, the output is defined as $Y = \{y_{1j},\ y_{2j} \dots, y_{rj}\}$ where $j \in \{1, n\}$.

— The proportional increase of outputs is (S_r^+) and proportional decrease of input is (S_i^-).

— The multiplier λ_j represent a combined inputs and output weights.

2. Computation of Overall Efficiency

— The overall efficiency is denoted by θ_j is evaluated using Mode 1

— The objective function defined as *f = [zeros (1, n) -epsilon*ones (1, s) -epsilon*ones (1, m) 1]*

— The equality constraints *Aeq* and *beq* which are left-hand matrix and right-hand vector, respectively. *Aeq = [Y', -eye(s,s), zeros(s,m+1); -X', zeros(m,s), -eye(m,m), X(j,:)']* and *beq = [Y (j, :)'; zeros (m,1)]*.

— To solve the optimization problem, the command *z = linprog (f, [],[],Aeq, beq, lb)* was used.

3. Computation of Overall Effectiveness

— The overall effectiveness is represented by ϑ_j is evaluated using Model 2

— The objective function defined as *f = - [zeros (1, n), epsilon*ones (1, s+m), 1]*

— The equality constraints Aeq and beq which are left-hand matrix and right-hand vector, respectively. The *Aeq = [-Y', eye(s,s), zeros(s,m), Y(j,:)'; X', zeros(m,s), eye(m,m), zeros(m,1)]* and *beq = [zeros(s,1); X(j, :)']*.

— The optimization problem was solved using command *z =linprog(f, [],[],Aeq,beq,lb).*

4. Computation of Managerial Efficiency

— The management efficiency is defined as φ_j is evaluated using model 1 with additional constraint $\sum_{j=1}^{n} \lambda_j = 1 \quad for\ j = 1,2,\dots n$

— The objective function is defined as *f = [zeros (1, n) -epsilon*ones (1, s+m) 1]*

— The equality constraints Aeq and beq which are left-hand matrix and right-hand vector, respectively. The *Aeq = [Y', -eye (s, s), zeros (s, m+1); -X', zeros(m,s), -eye(m,m) X(j,:)'; ones(1,n), zeros(1,s), zeros(1,m+1)]* and *beq = [Y (j, :)'; zeros (m,1);1]*.

— To solve optimization problem, the command *z = linprog(f, [],[],Aeq,beq,lb).*

5. Computation of Managerial Effectiveness

— The managerial effectiveness is denoted by $\emptyset_j$ is evaluated using Model 2 with additional constraint $\sum_{j=1}^{n} \lambda_j = 1 \quad for\ j = 1,2, \dots n$

— the objective function is defined as *f = -[zeros(1, n), epsilon*ones(1,s+m), 1]*

— The equality constraints, *Aeq* and *beq* which are left-hand matrix and right-hand vector, respectively. The *Aeq = [-Y', eye (s, s), zeros(s,m), Y(j,:)'; X', zeros(m,s), eye(m,m), zeros(m,1); ones(1,n), zeros(1,s+m+1)]* and beq = [zeros(s,1); X (j, :)';1].

— The optimum solution is obtained using the command *z = linprog(f, [],[],Aeq,beq,lb).*

6. Computation of Operational Efficiency, $\emptyset_j$

The operational efficiency which is represented by $\emptyset_j$ is formulated by dividing overall efficiency with management efficiency which are θ_j and φ_j respectively, as shown in the equation 3.

$$\emptyset_j = \frac{\theta_j}{\varphi_j} \tag{3}$$

7. Computation of Operational Effectiveness, ϱ_j

The operational effectiveness which is denoted by ϱ_j can be computed by dividing overall effectiveness with management effectiveness which are ϑ_j and ϕ_j respectively, as shown in the equation 4.

$$\varrho_j = \frac{\vartheta_j}{\phi_j} \tag{4}$$

8. Computation of Managerial Performance, ξ_j

The Managerial performance which is denoted by ξ_j is computed by multiplying management efficiency φ_j and management effectiveness ϕ_j as shown in the equation 5.

$$\xi_j = \varphi_j \times \phi_j \tag{5}$$

9. Computation of Operational Performance, ς_j

The Operational performance which is denoted by ς_j is computed by multiplying operational efficiency $\emptyset_j$ and operational effectiveness ϱ_j as shown in the equation 6.

$$\xi_j = \emptyset_j \times \varrho_j \tag{6}$$

10. Combined Evaluation

The performance score of each component (economy, market, sector and companies) were combined. Four steps were involved during the combination process top-down approach.

— The DMUs of the company analysis which are the listed companies were considered as the reference.

— The scores of each component were assigned in respect to listed company arranged column-wise.

— The component's matrix was developed with column of listed companies and rows of component's scores.

— The combined score of each DMUs is computed by summing up the scores of each component weighted by top-down ($w_e > w_m > w_s > w_c$). The basic assumptions of weight generation, $\sum_i w_i = 1$ and $w_i \geq 0$, where $i = 1,2 \dots n$ were held. Therefore, the formulation of the combined score can be presented using the equation 7

$$S_T = w_e S_e + w_m S_m + w_s S_s + w_c S_c \tag{7}$$

Whereas S_T is the combined score or total score, S_e is the economy score, S_m is the market score, S_s is the sector score and S_c is the company score.

11. Selecting Companies

The short-listed companies are those which are performed equally or above minimum average out of all four years in all three measures which are overall, managerial and operational.

IV. Results

Country Economy

Table 4.1 presents the managerial, operational, and overall performance of the four countries under EAC from 2015 to 2018. The degree of the economy among EAC members is inconsistent throughout. Kenya and Tanzania are fully performed in all three measures with a score of 1. That signified their capability of managing and identifying ideal expenditures and investments to maintain the required rate of inflation and balance of the public debt. This builds confidence to existing and prospective investors both within and outside these countries while making an investment decision. The full performance of Kenya was associated with a huge investment of China-Kenya's Nairobi-Mombasa railway, which was completed since 2016, although the consequence was expected on public debt and in Tanzania was associated with strengthening domestic resource mobilization via enhancing tax administration and collection (United Nations Economic Commission for Africa, 2018). The performances of Uganda and Rwanda fluctuated throughout 2015-2018. Comparatively, Uganda records higher managerial and operational performance in the entire time. However, both were suffered from recognizing the optimal level of government expenditure and investment to minimize inflation and public debt. Various tax reforms including enhancing tax collection, avoid tax evasion, and increase the efficiency of public spending are among the reasons associated with such performance. ADB (2018) addressed that 65 percent of Rwanda's 2016 budget was funded by the domestic tax, non-tax revenue, and domestic financing. Correspondingly, government expenditure reported hitting 12.9 percent which is the second after Tanzania which records 15.8 percent.

Table 1: Development Degree of EAC States

	Country	Performance		
		Overall	Managerial	Operational
2015	Kenya	1.00	1.00	1.00
	Tanzania	1.00	1.00	1.00
	Uganda	0.98	1.00	0.98
	Rwanda	0.32	0.54	0.60
2016	Kenya	1.00	1.00	1.00
	Tanzania	1.00	1.00	1.00
	Uganda	1.00	1.00	1.00
	Rwanda	1.00	1.00	1.00
2017	Kenya	1.00	1.00	1.00
	Tanzania	1.00	1.00	1.00
	Uganda	0.92	1.00	0.92
	Rwanda	1.00	1.00	1.00
2018	Kenya	1.00	1.00	1.00
	Tanzania	1.00	1.00	1.00
	Uganda	0.85	0.90	0.95
	Rwanda	0.46	0.64	0.72

EACMs Performance Trends

Four EACMs were evaluated from 2015 to 2018 and the performance score were summarised in the Table 4.2. The DSE record full performance in all measures throughout and NSE record full performance for the last three year from 2016 to 2018. USE performance of all measures was bumpy throughout. While in RSE's account full managerial performance from 2015 to 2018 and other measures were varied from time to time.

Table 2: EACMs Development

Year	Country	Performance		
		Overall	Managerial	Operational
2015	NSE	0.51	1.00	0.51
	DSE	1.00	1.00	1.00
	USE	0.52	0.79	0.65
	RSE	0.33	1.00	0.33
2016	NSE	1.00	1.00	1.00
	DSE	1.00	1.00	1.00
	USE	0.55	0.97	0.56
	RSE	0.29	1.00	0.29
2017	NSE	1.00	1.00	1.00
	DSE	1.00	1.00	1.00
	USE	0.59	0.84	0.71
	RSE	0.24	1.00	0.24
2018	NSE	1.00	1.00	1.00
	DSE	1.00	1.00	1.00
	USE	0.79	1.00	0.79
	RSE	0.28	1.00	0.28

An interesting observation was found in 2018 where all four stock exchanges record 100 percent on managerial performance. DSE and NSE both were able to detect the optimal number of listed companies and market capitalization required to meet the required level stock turnover and market returns. Contrary to USE and RSE where both management and operation were unable to achieve and spot the ideal volume of listed companies and a market capitalization that can generate the required market turnover and returns. Except for DSE, the overall performance of EACMs was not impressive, operationally are not convincing investors to make an immediate decision, although the management of individual stock exchanges shows exemplary performance. The findings supported by Biau (2018) who reported that the individual markets are very small with few numbers of listed shares, they are illiquid with small market capitalization. It was further suggested to speed-up the EACMs integration process solve the existing problem. Likewise, Bright Africa (2018) insisted that asset allocation within the region is dominated by fixed income allocations mostly local bonds, alternative investment opportunities are still very limited. Similarly, the performance of EACMs is also associated with high requirements and cost associated with new entrants, lack of investors' confidence and risk appetite, weak local currencies, policies are changed drastically (Raubenheimer, 2018).

Economic Sectors Growth

Overall, managerial and operational performances of various economic sectors in each country from 2015 to 2018 are summarised in Table 3. The results indicated that only the industry sector in Tanzania records 100 percent performance on overall, managerial, and operational throughout from 2015 to 2018. Uganda and Rwanda both records 100 percent on managerial performance in the service sector for the last three years from 2016 to 2018. None of the sector in Kenya, which is fully performed in any measure, at least the agricultural sector performance reaches 3 percent which is higher than rest of the countries.

Table 4.3: Economic Sectors Performance from 2015 to 2018 for EAC member states

Date	Country	Economic Sector	Overall	Managerial	Operational
2015	Kenya	Agriculture	0.02	0.11	0.17
		Industry	0.43	0.66	0.66
		Service	0.13	0.59	0.22
	Tanzania	Agriculture	0.01	0.07	0.17
		Industry	1.00	1.00	1.00

		Service	0.17	0.55	0.32
	Uganda	Agriculture	0.01	0.04	0.18
		Industry	0.55	0.59	0.93
		Service	0.35	0.59	0.59
	Rwanda	Agriculture	0.01	0.08	0.16
		Industry	0.51	0.64	0.79
		Service	0.28	0.53	0.53
	Kenya	Agriculture	0.02	0.13	0.16
		Industry	0.40	0.60	0.67
		Service	0.12	0.56	0.22
	Tanzania	Agriculture	0.01	0.08	0.15
		Industry	1.00	1.00	1.00
		Service	0.16	0.56	0.29
2016	Uganda	Agriculture	0.01	0.05	0.17
		Industry	0.58	0.73	0.79
		Service	0.34	1.00	0.34
	Rwanda	Agriculture	0.01	0.09	0.15
		Industry	0.27	0.48	0.58
		Service	0.27	1.00	0.27
	Kenya	Agriculture	0.03	0.17	0.16
		Industry	0.37	0.59	0.64
		Service	0.11	0.47	0.23
	Tanzania	Agriculture	0.01	0.10	0.14
		Industry	1.00	1.00	1.00
		Service	0.16	0.48	0.33
2017	Uganda	Agriculture	0.01	0.05	0.18
		Industry	0.58	0.75	0.78
		Service	0.35	1.00	0.35
	Rwanda	Agriculture	0.02	0.13	0.13
		Industry	0.25	0.46	0.55
		Service	0.27	1.00	0.27
	Kenya	Agriculture	0.03	0.21	0.15
		Industry	0.33	0.56	0.59
		Service	0.11	0.47	0.22
	Tanzania	Agriculture	0.01	0.09	0.16
		Industry	1.00	1.00	1.00
		Service	0.16	0.51	0.31
2018	Uganda	Agriculture	0.01	0.05	0.16
		Industry	0.51	0.70	0.73
		Service	0.34	1.00	0.34
	Rwanda	Agriculture	0.01	0.08	0.16
		Industry	0.44	0.66	0.66
		Service	0.27	1.00	0.27

Weak infrastructure, such as transportation networks, access to energy, irrigation system, and stock holding facilities are main setbacks that slowdown agricultural sector performance (OECD/FAO, 2016; African capacity-building foundation, 2017, ADB, 2019). Apart from structural change which made most of the skilled labour forces shift from the agricultural sector to industry and service sectors, most of the country within the region fail to reach an optimal level, especially in the industrial sector. The exemplary performance of the industry sector in Tanzania was associated with new government policies which are among them is to make Tanzania an industrialized country. Page (2016) reported that the rising star of Tanzania on economic growth not reflected on industrial sectors of international benchmark. However, when African economies are considered as a benchmark, the industry sector in Tanzania is growing faster than the economy. It was insisted that Tanzania records the most

rapid growth in manufactured exports compare to other EAC's member states. The main reasons are the growth in formal manufacturing has been above the average rate of economic growth, although not as rapid as the services business. Also, many micro and small enterprises have entered manufacturing since 2005.

Listed Companies Performance

The results presented in Table 4.4 show the performance score of the listed companies in different measures from 2015 to 2018. Five companies which are BAT, FTGH, KQ, SCOM, and BOBU records 100 percent overall, managerial and operational performance in all four years. Only the MSC maintains full performance for three years continuously from 2015 to 2017 in all performance measures while TPCC maintains for two years which are 2017 and 2018. Astonishing capabilities of the listed companies within the region is to manage and optimize the shareholders' funds, company's assets, and investments to generate the required revenue, profits as well cash required for operation and financing activities are associated with a foreign professional which hold the highest management position in most of the listed companies. This was also observed by Jumanne (2018) when compared the performance between foreign and local owned companies and it was revealed that there is a significant difference in performance between these two categories. Although the listed companies are working hard to safeguards shareholders' interest, other scholars pinpoint the challenges which are beyond to company's management. Ndiritu and Mugivane (2015) addressed various factors that lead to the poor performance of the listing companies in the region including institutional factors, environmental factors, regulatory factors, historical factors, and information factors. It was stressed that there is a lack of well-trained professionals in the market and the interest rate yield is always high and unstable in all countries within the region. It is worth noted that all the countries within the region share a common problem for years. Since the study of Onyuma, Mugo, and Karuiya (2012) addressed that cross-listing within EACMs was not helpful to boost listed companies' performance. Low improvements in firm performance in term of liquidity and profitability have been observed which were also not significant.

Table 4: Performance of various listed companies from 2015 to 2018

	2018			2017			2016			2015		
Shares	Overall	Mg	Op	Overall	Mg	Op	Overall	Mg	Op	Overall	Mg	Op
BAMB	0.53	0.58	0.91	0.66	0.71	0.92	0.75	0.87	0.86	0.79	0.86	0.92
BAT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
BERG	0.99	1.00	0.99	0.82	0.85	0.97	0.89	1.00	0.89	1.00	1.00	1.00
BOC	0.78	1.00	0.78	0.31	0.48	0.64	0.31	0.46	0.68	0.33	0.42	0.79
BRIT	0.50	0.55	0.92	0.57	0.58	0.97	0.57	0.61	0.93	0.56	0.57	0.97
CFC	0.97	1.00	0.97	0.47	0.56	0.83	0.66	0.76	0.86	1.00	1.00	1.00
CIC	0.66	0.69	0.96	0.57	0.59	0.97	0.60	0.66	0.91	0.59	0.60	0.99
COOP	0.78	0.84	0.93	0.48	0.65	0.75	0.63	0.76	0.82	0.71	0.78	0.91
DTK	0.90	1.00	0.90	0.43	0.57	0.76	0.63	0.71	0.88	0.82	1.00	0.82
FTGH	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HFCK	1.00	1.00	1.00	0.52	0.56	0.93	0.62	0.64	0.97	0.75	0.77	0.98
I&M	0.55	0.87	0.63	0.53	0.61	0.88	0.58	0.68	0.86	1.00	1.00	1.00
JUB	0.34	0.37	0.91	0.54	0.57	0.94	0.54	0.63	0.86	0.55	0.59	0.92
KCB	0.57	1.00	0.57	0.42	0.64	0.66	0.64	0.86	0.75	0.62	0.80	0.77
KNRE	0.89	0.97	0.92	0.50	0.53	0.95	0.56	0.58	0.95	0.55	0.59	0.94
KUKZ	0.45	0.51	0.89	0.45	0.60	0.74	0.46	0.56	0.82	0.52	0.57	0.92
NIC	0.59	0.62	0.96	0.45	0.57	0.79	0.60	0.72	0.83	0.81	0.82	0.99
NMG	0.90	0.94	0.96	0.50	0.58	0.87	0.77	0.78	0.99	0.83	0.84	0.99
SCAN	0.70	0.72	0.97	0.75	0.78	0.96	0.78	0.89	0.87	0.53	0.69	0.78
SGL	0.62	0.67	0.92	0.69	0.70	0.98	0.72	0.74	0.97	0.71	0.75	0.94
TCL	0.55	0.61	0.89	0.54	0.56	0.96	0.58	0.66	0.88	0.88	0.89	0.98
TOTL	1.00	1.00	1.00	0.88	1.00	0.88	0.89	1.00	0.89	1.00	1.00	1.00
TPSE	0.42	0.45	0.93	0.45	0.53	0.85	0.46	0.52	0.88	0.38	0.42	0.90

EQTY	0.74	0.81	0.92	0.79	1.01	0.78	0.92	1.00	0.92	1.00	1.00	1.00
KEGN	0.96	1.00	0.96	0.45	0.54	0.83	0.63	0.72	0.87	0.91	1.00	0.91
KPLC	1.00	1.00	1.00	0.67	0.77	0.88	0.70	1.00	0.70	0.92	1.00	0.92
MSC	0.80	0.82	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PORT	1.00	1.00	1.00	0.45	0.50	0.89	0.71	0.73	0.97	1.00	1.00	1.00
UNGA	1.00	1.00	1.00	0.85	0.87	0.98	0.79	0.88	0.91	1.00	1.00	1.00
EABL	0.93	0.96	0.97	0.97	1.01	0.96	1.00	1.00	1.00	1.00	1.00	1.00
KAPC	0.64	0.75	0.85	0.40	0.52	0.78	0.44	0.56	0.79	0.30	0.35	0.85
KQ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SCOM	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SASN	0.40	0.48	0.84	0.22	0.32	0.67	0.28	0.33	0.82	0.31	0.34	0.91
C&G	0.83	0.84	0.99	1.00	1.00	1.00	0.74	0.84	0.89	0.86	0.87	0.98
CARB	0.29	0.62	0.47	0.23	0.41	0.55	0.60	1.00	0.60	0.44	0.57	0.77
CRDB	0.55	0.77	0.71	0.56	0.70	0.80	0.57	0.65	0.89	0.61	0.69	0.87
DCB	1.00	1.00	1.00	0.45	0.55	0.82	0.74	1.00	0.74	0.43	0.60	0.71
NMB	0.64	0.66	0.96	0.70	0.85	0.83	0.56	0.59	0.95	0.73	0.74	0.98
SWIS	0.72	1.00	0.72	0.68	0.78	0.87	0.92	1.00	0.92	1.00	1.00	1.00
TBL	0.84	0.85	0.99	0.79	0.80	0.99	0.94	1.00	0.94	0.92	0.92	1.00
TCC	0.87	0.87	1.00	0.82	0.84	0.97	0.86	0.88	0.98	1.00	1.00	1.00
TCCL	0.67	0.72	0.94	0.48	0.50	0.97	0.42	0.47	0.90	1.00	1.00	1.00
TOL	0.47	1.00	0.47	0.25	0.39	0.64	0.41	0.58	0.71	0.65	1.00	0.65
TPCC	1.00	1.00	1.00	1.00	1.00	1.00	0.79	0.82	0.96	0.83	0.83	0.99
BOBU	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
DFCU	0.93	1.00	0.93	0.74	0.86	0.86	0.67	0.72	0.93	0.60	0.66	0.90
UMME	0.77	0.79	0.97	1.00	1.00	1.00	0.96	0.98	0.98	0.74	0.75	0.99
NVL	0.80	1.00	0.80	0.60	0.83	0.72	1.03	1.03	1.00	0.80	1.00	0.80
BOK	0.37	0.44	0.84	0.41	0.42	0.97	0.44	0.46	0.97	1.00	1.00	1.00
BRL	0.70	0.77	0.91	0.73	0.75	0.98	0.80	0.81	0.99	0.82	0.83	0.99

Note: Mg stands for Managerial and Op stands for Operational

Combined Performance Evaluation

Table 4.5 shows the company's combined score for overall, managerial, and operational performance from 2015 to 2018.

Table 5: Combined Performance Score of Listed Companies

	2018			2017			2016			2015		
share	Overall	Mg	Op	Overall	Mg	Op	Overall	Mg	Op	Overall	Mg	Op
BAMB	0.82	0.87	0.94	0.84	0.89	0.94	0.85	0.91	0.94	0.72	0.92	0.78
BAT	0.87	0.91	0.95	0.87	0.92	0.95	0.88	0.92	0.96	0.74	0.93	0.79
BERG	0.87	0.91	0.95	0.86	0.90	0.95	0.87	0.92	0.94	0.74	0.93	0.79
BOC	0.84	0.91	0.93	0.80	0.87	0.93	0.81	0.87	0.94	0.67	0.87	0.77
BRIT	0.77	0.85	0.91	0.78	0.85	0.91	0.78	0.87	0.89	0.63	0.88	0.73
CFC	0.82	0.89	0.92	0.77	0.85	0.90	0.79	0.89	0.89	0.68	0.92	0.74
CIC	0.79	0.86	0.91	0.78	0.85	0.91	0.78	0.88	0.89	0.64	0.88	0.73
COOP	0.80	0.88	0.91	0.77	0.86	0.90	0.79	0.89	0.89	0.65	0.90	0.73
DTK	0.81	0.89	0.91	0.77	0.85	0.90	0.79	0.88	0.89	0.66	0.92	0.72
FTGH	0.87	0.91	0.95	0.87	0.92	0.95	0.82	0.92	0.90	0.74	0.93	0.79
HFCK	0.82	0.89	0.92	0.77	0.85	0.91	0.79	0.88	0.90	0.65	0.90	0.73
I&M	0.78	0.88	0.88	0.78	0.85	0.91	0.78	0.88	0.89	0.68	0.92	0.74
JUB	0.76	0.83	0.91	0.78	0.85	0.91	0.78	0.87	0.89	0.63	0.88	0.72
KCB	0.78	0.89	0.87	0.76	0.86	0.89	0.79	0.90	0.88	0.64	0.90	0.71

KNRE	0.81	0.89	0.91	0.77	0.85	0.91	0.78	0.87	0.90	0.63	0.88	0.72
KUKZ	0.75	0.79	0.95	0.75	0.79	0.95	0.75	0.78	0.96	0.61	0.78	0.78
NIC	0.78	0.86	0.91	0.77	0.85	0.90	0.78	0.88	0.89	0.66	0.90	0.73
NMG	0.81	0.89	0.91	0.77	0.85	0.91	0.80	0.89	0.90	0.66	0.90	0.73
SCAN	0.79	0.87	0.91	0.80	0.87	0.91	0.80	0.90	0.89	0.63	0.89	0.71
SGL	0.78	0.86	0.91	0.79	0.86	0.92	0.80	0.89	0.90	0.65	0.89	0.73
TCL	0.82	0.87	0.94	0.83	0.87	0.95	0.84	0.89	0.95	0.73	0.92	0.79
TOTL	0.87	0.91	0.95	0.86	0.92	0.94	0.87	0.92	0.94	0.74	0.93	0.79
TPSE	0.76	0.84	0.91	0.77	0.85	0.91	0.77	0.86	0.89	0.62	0.86	0.72
EQTY	0.80	0.88	0.91	0.80	0.90	0.89	0.82	0.91	0.90	0.68	0.92	0.74
KEGN	0.82	0.89	0.91	0.77	0.85	0.90	0.79	0.88	0.89	0.67	0.92	0.73
KPLC	0.82	0.89	0.92	0.79	0.87	0.91	0.79	0.91	0.87	0.67	0.92	0.73
MSC	0.79	0.82	0.95	0.81	0.83	0.97	0.80	0.83	0.97	0.66	0.82	0.80
PORT	0.87	0.91	0.95	0.82	0.87	0.94	0.85	0.89	0.95	0.74	0.93	0.79
UNGA	0.87	0.91	0.95	0.86	0.90	0.95	0.86	0.91	0.95	0.74	0.93	0.79
EABL	0.86	0.91	0.95	0.87	0.92	0.95	0.88	0.92	0.96	0.74	0.93	0.79
KAPC	0.77	0.82	0.94	0.75	0.79	0.95	0.75	0.78	0.96	0.59	0.76	0.78
KQ	0.82	0.89	0.92	0.82	0.89	0.92	0.82	0.91	0.90	0.68	0.92	0.74
SCOM	0.82	0.89	0.92	0.82	0.89	0.92	0.82	0.91	0.90	0.68	0.92	0.74
SASN	0.75	0.79	0.94	0.73	0.77	0.95	0.73	0.76	0.96	0.59	0.76	0.78
C&G	0.81	0.88	0.92	0.82	0.89	0.92	0.80	0.90	0.89	0.66	0.91	0.73
CARB	0.80	0.87	0.91	0.80	0.86	0.93	0.84	0.92	0.91	0.68	0.89	0.77
CRDB	0.79	0.88	0.90	0.79	0.87	0.91	0.79	0.88	0.90	0.79	0.88	0.90
DCB	0.83	0.90	0.92	0.78	0.85	0.91	0.81	0.91	0.88	0.78	0.87	0.89
NMB	0.80	0.87	0.92	0.80	0.88	0.91	0.79	0.87	0.90	0.81	0.88	0.91
SWIS	0.80	0.90	0.89	0.80	0.87	0.91	0.82	0.91	0.90	0.83	0.91	0.92
TBL	0.98	0.98	1.00	0.98	0.98	1.00	0.99	1.00	0.99	0.99	0.99	1.00
TCC	0.99	0.99	1.00	0.98	0.98	1.00	0.99	0.99	1.00	1.00	1.00	1.00
TCCL	0.97	0.97	1.00	0.95	0.95	1.00	0.94	0.95	1.00	1.00	1.00	1.00
TOL	0.95	1.00	0.95	0.92	0.94	0.99	0.94	0.96	0.98	0.97	1.00	0.97
TPCC	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	1.00	0.98	0.98	1.00
BOBU	0.75	0.96	0.78	0.72	0.95	0.75	0.73	0.99	0.74	0.72	0.86	0.84
DFCU	0.74	0.96	0.77	0.69	0.94	0.73	0.70	0.96	0.73	0.68	0.82	0.83
UMME	0.72	0.94	0.77	0.72	0.95	0.75	0.73	0.99	0.74	0.69	0.83	0.83
NVL	0.72	0.96	0.75	0.67	0.94	0.72	0.74	0.99	0.74	0.70	0.86	0.82
BOK	0.36	0.80	0.45	0.58	0.94	0.62	0.59	0.95	0.62	0.38	0.72	0.53
BRL	0.43	0.76	0.56	0.61	0.87	0.70	0.62	0.88	0.71	0.41	0.73	0.57

Note: Mg stands for Managerial and Op stands for Operational

When the performance of the country's economy, stock market, and economic sectors are combined, the score of the listed companies in various measures are changed. This signified that, although the financial statements portrayed that companies are well performed yet not guarantee investors to select the company as a prospective investment (Grimm, 2012). The decreasing performance of listed companies in EACMs among other factors is associated with the country's economic status and stock market development (Ndiritu and Mugivane, 2015).

Literally, giant companies within the region were most affected when economic, market and economic sector growth are incorporated in the model compared to companies with moderate performance. Companies such as BAT, FTGH, KQ, SCOM and BOBU records 100 percent overall, managerial and operational performance in all four years consecutively before combination, and all of them were underperformed after combination. MSC which records full performance for three years consecutively observed to decline after combination. Only, TPCC which was full performed in all measures for two years consecutively which is 2017 and 2018 before combination maintained the same after combination. Surprisingly, TOL which was among least performed shares with minimum overall performance score of 25 percent during 2017 move to the list of most performed shares.

The companies from Tanzania particularly from industry sector found to perform well. This may be associated to well perform economic condition, stock market and industry sector. The results are in line with study of Page (2016) that Tanzania is among the leading stars of 'African growth miracle' also, the growth of industry sector is faster than economy. Page (2016) was further instated that the manufacturing industry in Tanzania show rapid growth compare to neighbouring countries which in turn influence the firm performance.

Comparison of Company's Performance before and after combination

Figure 2, 3 and 4 illustrates variability of performances of 51 companies listed in EACMs before and after combination with other components which country economic performance, market listed and economic sector for 2015, 2016, 2017 and 2018 in overall, managerial and operational performance, respectively.

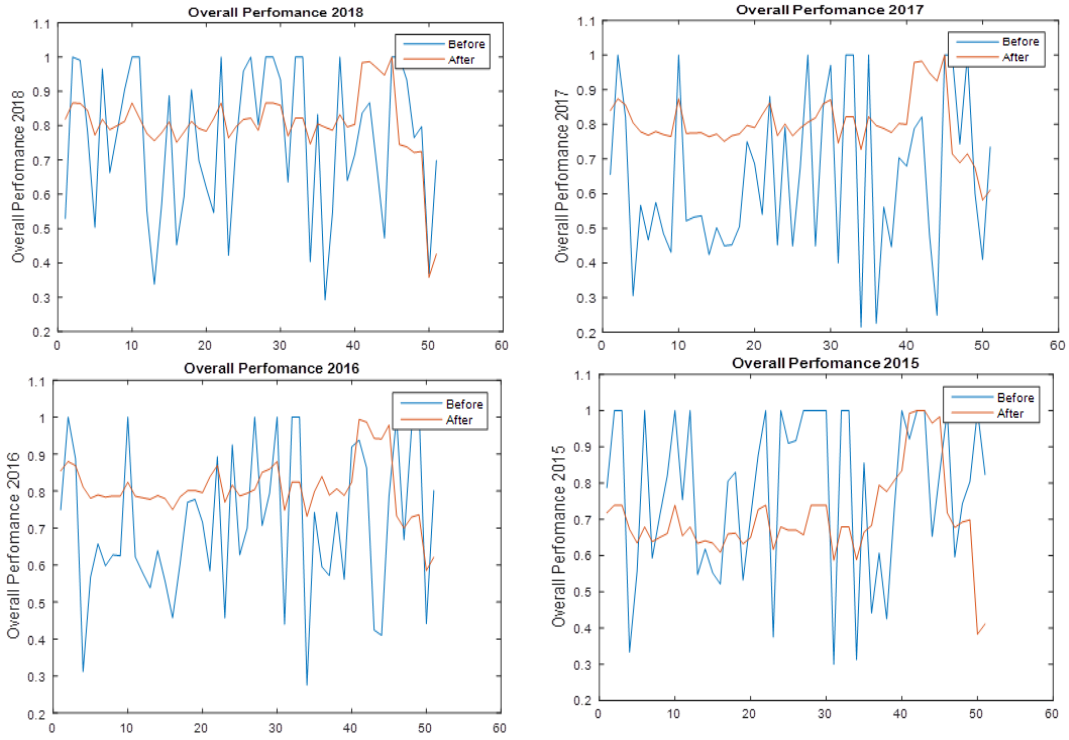

Figure 2: Company's Overall Performances in Various Measures Before and After Combination, 2015-2018

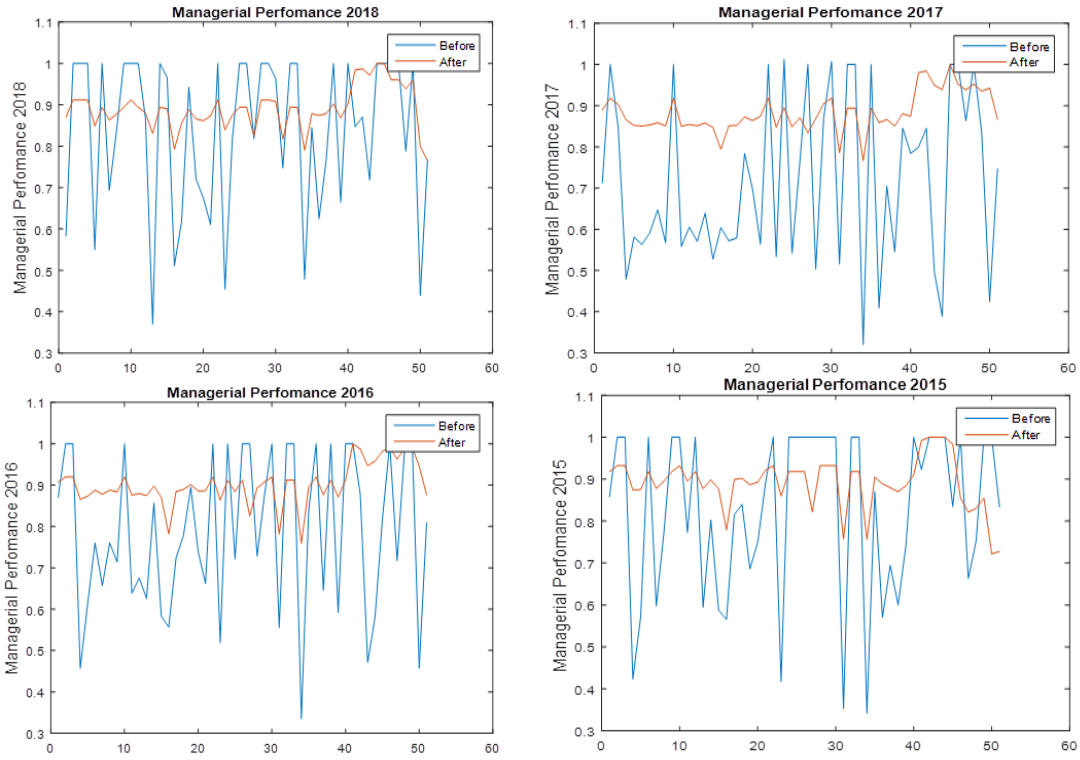

Figure 3: Company's Managerial Performances in Various Measures Before and After Combination, 2015-2018

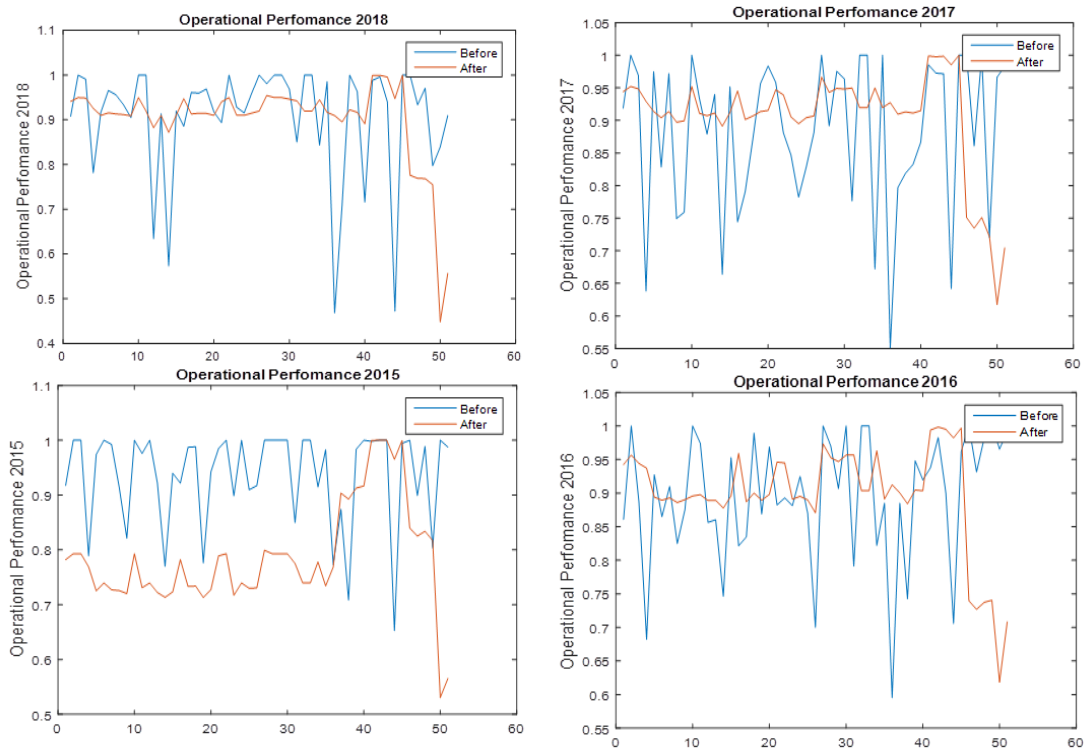

Figure 4: Company's Operational Performances in Various Measures Before and After Combination, 2015-2018

The significant mean difference can be observed when performance of the various companies before and after combination with other components is compared. Table 6 summarised the independent t-test conducted in all three measures from 2015 to 2018. In all four years, the significant difference of managerial performance before and after combination was observed with $p \leq 0.05$. Only during 2018 there was no significant difference in the

performance of listed companies before and after considering the performance of other components in overall and operational performance as the $p \geq 0.05$. Some inconsistences also have been observed in the years which is 2017 and 2016 where the overall and managerial performance of the listed companies has been significantly affected by the country's economy, stock market, and economic sector transformations which took place within the region while operational performance was not affected. Contrary to 2015 where all three measures were significantly interrupted by the changes that took place in the country's economy, stock markets, and economic sectors. The existence of significant difference in previous years 2015 to 2017 was associated by wide gap between company performance and other fundamental components. However, such gap observed to lessened in the resent years as the performance difference before and after combinantion found not significant. An interesting observation was found on the variability of the performance scores before and after the combination. The variances of the average performances have minimized and even approach zero when other components were included in the model.

Table 6: Independent t-test of Company Performance before and After Combination

Year	Performance Measure	Before		After		P-value	Decision
		Mean	Variance	Mean	Variance		
2018	Overall	0.76	0.05	0.80	0.010	0.090	Not Significant
	Managerial	0.83	0.03	0.89	0.003	0.020	Significant
	Operational	0.90	0.02	0.90	0.010	0.430	Not Significant
2017	Overall	0.64	0.06	0.80	0.006	0.000	Significant
	Managerial	0.71	0.04	0.88	0.002	0.000	Significant
	Operational	0.88	0.01	0.90	0.006	0.114	Not Significant
2016	Overall	0.71	0.04	0.81	0.006	0.000	Significant
	Managerial	0.78	0.04	0.90	0.006	0.000	Significant
	Operational	0.89	0.01	0.89	0.006	0.473	Not Significant
2015	Overall	0.78	0.05	0.70	0.010	0.017	Significant
	Managerial	0.83	0.04	0.89	0.004	0.014	Significant
	Operational	0.93	0.01	0.79	0.01	0.000	Significant

It is worth saying, country economy, stock markets, and economic sector performance play a major role to normalize the listed companies' performance. Technically, this will increase confidence to investors and the scope of selecting shares to be included in the portfolio.

Selected Companies

The minimum average performance after combination for each measure from any year shown in Table 6 was used as a benchmark of identifying shares which can be used for portfolio construction. Therefore, the qualified shares are all shares with an overall performance score of 70 percent and above, a managerial performance score of 88 percent and above as well as an operational performance score 79 percent and above throughout from 2015 to 2018. The selection criteria are more tolerable compare to that of Jothiami, et., al. (2017) who strictly consider the shares with 100 percent performance throughout for the period of 8 years where out 523 stocks only 41 stocks were qualified. Table 7 summarised the selected shares which meet the minimum required criteria. All companies from Uganda and Rwanda and all companies from the service and manufacturing sectors in the region were underperformed therefore were excluded for further analysis. Only some companies fall under the industry sector in Kenya and Tanzania were shortlisted as they meet the minimum requirements. Out of 11 companies, 6 are from Kenya which is equivalent to 16 percent of the total companies, and 5 from Tanzania which is equivalent to 56 percent of the total companies evaluated from Kenya and Tanzania, respectively.

Table 7: Summery of Selected Companies

Sn	Code	Company	Market	Country	Business	Sector
1	BAT	BAT Kenya	NSE	Kenya	Cigarette	Industry
2	BERG	Berge Paint	NSE	Kenya	Paints	Industry

3	FTGH	Flame Tree Group Limited	NSE	Kenya	Plastic	Industry
4	TOTL	Total Kenya	NSE	Kenya	Oil	Industry
5	UNGA	Unga Group Plc	NSE	Kenya	Food	Industry
6	EABL	East African Breweries	NSE	Kenya	Beer	Industry
7	TBL	Tanzania Breweries Plc	DSE	Tanzania	Beer	Industry
8	TCC	Tanzania Cigarette Company	DSE	Tanzania	Cigarette	Industry
9	TCCL	Tanga Cement Company	DSE	Tanzania	Cement	Industry
10	TOL	TOL Gas Limited	DSE	Tanzania	Gas	Industry
11	TPCC	Tanzania Portland Company	DSE	Tanzania	Cement	Industry

V. Conclusion

This study able to demonstrates the technique of quantifying the operational and managerial performance of fundamental components using DEA models. It reveals a different level of performance of each component which are country economy, economic sectors, stock markets as well as shares listed in East African Stock Exchanges. It was found that when all components are integrated, the combined score of the listed companies was changed in all three measures. The independent t-test confirmed that there are significant mean differences in the performance of the various companies before and after combination with other components.

The theoretical gaps addressed in this study is on computation and combination of operational performance as well as the managerial performance of a country's economy, stock market, economic sector, and company fundamentals computed by DEA using top-down approach. The study found that combining the performance of various components has a major impact on screening the stocks to be used for portfolio construction. The developed hybrid model combined various scholarly works including the study of Rose (1976) addressed the influence of country economy proxies, Calderon-Rossell (1991) suggested the importance of stock market development, Lewis (1954); Kuznet (1966); Chenery (1975), and Kuznet (1979) hypothesized on economic sector growth, also Graham and Dodd (1934) who focused on company fundamentals.

The practical implications of the findings can be observed by stakeholders in EACMs such as capital markets authorities, individuals' investors, institutional investors, etc. When the combined effect of the managerial and operational performance is understood would give a signal to the authorities of capital markets, investors, policymakers and other regulatory bodies to take immediate measures on designing policies and practices. Therefore, this study recommends that.

- The capital market authorities within the region must ensure the growth of managerial and operational performance of stock exchanges. This can be achieved by increasing the number of listed shares, market capitalization, market turnover as well as a market index of the respective stock exchange.
- Regulatory bodies, policymakers, and higher-level administration of each country within the region must take responsibility to uplift the country's economy and economic sectors. They can reduce the inflation rate, public debt, government spending, and increase country investment for the case of country economy. Also, they can increase the labour force, value-added as well as the growth rate of various economic sectors such as the service sector, industry, and agriculture.
- The board of directors and management of listed companies should formulate strategies to improve both managerial and operational performance. They can raise the company's equity, total assets, revenue, company profit as well as proper management of cash flow including operating, financing, and investment cash flows.

Among the limitations of this study are the data used in this study were collected in a short time frame which is from 2015 to 2018 and only for four countries. Although the data are aging but also was due to the nature of the stock markets as they are still very young, some of them were opened from 2011 with a limited number of listed shares and other country like South Sudan do not have a stock exchange. This study employed top-down approach to combine various components instead of using both bottom-up and top-down approaches, although it is a recommended approach when the combined components involve more than one country. Also, the methodology is still new in the field of stock selection, also limited literature demonstrated DEA performance evaluation of each

component. Therefore, this study would suggest possible future studies to be conducted with a long-time frame and a wide range of countries, stock markets, economic sectors, and company fundamentals to validate these study findings. Also, employing both bottom-up and top-down approaches when combining the performance scores of various components and compare the results. It might be likely that a different number and type of stocks can be generated. Also, combining both and observe the list of stocks which qualify for further analysis.

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