TECHNICAL EFFICIENCY OF SMALL AND MEDIUM-SIZED ENTERPRISES IN KENYA

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DECLARATION

This project is my original work and it has never been presented for a degree award in any university.

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This project has been submitted for examination with my approval as a university supervisor

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DEDICATION

The paper is dedicated to my husband Peter Kioko and our children Faith Abigail and Emmanuel Kelly for their cooperation and understanding during my absence.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION AND ACRONYMS

AE	Allocative Efficiency
ARBT	African Review of Business Technology
GoK	Government of Kenya
KITP	Kenya Industrial Transformation Programme (KITP).
KNCCI	Kenya National Chamber of Commerce and Industry
SMEs	Small and Medium-Sized Enterprises
SFA	Stochastic Frontier Analysis
TE	Technical Efficiency
MC	Marginal Cost
US	United States

ABSTRACT

Small and medium-sized enterprises play a crucial role in the development of the Kenyan economy. The sector is not only a major source of employment but also plays a significant role in promoting competition, innovation and enhancing enterprise culture which is necessary for private sector development and industrialization. In order to formulate appropriate policy measures to improve the development of SMEs, it is important to examine their levels of efficiency. This paper employs a stochastic frontier production function to measure and explain the technical efficiency of SMEs in Kenya. Secondary data from enterprise survey data (2018) is used. The results indicate that technical efficiencies among SMEs are below average. According to the study physical capital is one of the major determinants of the firm's efficiency although its impact is weak. In addition, labor force, age of the firm and legal status of the firm are found to have a positive and significant relationship to technical efficiency. It is therefore recommended that SMEs need to enhance their quantity of physical capital which will enable them to have a competitive advantage due to enhanced technical efficiency. Investment in human capital development is highly recommended since labor has proven to be a key determinant of technical efficiency. There is also a need to encourage women to take jobs at the helm of organizations because of their significant impact on technical efficiency.

CHAPTER ONE: INTRODUCTION

1.1 Background

Efficiency of a company is determined by its ability to generate goods and services at the minimum possible costs or produce maximum returns to investment. Kumbhakar and Lovell (2000) reported that technical efficiency (TE) is the ability to make a rational decision which could lead to maximum yield at the very minimum set of inputs. Herrero and Pascoe (2002) gave a distinction between TE and allocative efficiency (AE) in the sense that AE refers to the utilization of inputs at an optimal level to ensure maximum returns on investment. Starting with the seminal paper by Farrell (1957), studies have employed frontier efficiency analysis to investigate TE, AE, scale efficiency, and distribution efficiency across the world (Alvarez & Crespi, 2001; Zahid & Moktar, 2007; Lee & Harvie (2010).

The efficiency of firms has always been associated with labor or human capital which is viewed as the key input in the production process. For instance, Rahmah (2012) reported that increased investment, especially through education and training in human capital, could produce knowledgeable manpower which enhances human capital productivity and therefore efficiency. Rahmah argues that enterprises with a substantial number of educated labor forces are well placed to adapt, control and sustain innovations, an important determinant of firm efficiency. Also, investment in human capital development improves the quality of labor hence generating skilled employees with an ability to learn quickly and be more creative.

The development of SMEs has become crucial in most developing countries as these countries see them as the means of providing employment and enhancing economic growth. This means that the SMEs development is seen as speeding up the achievement of wider economic and socio objective,

poverty reduction included (Cook and Nixon 2000). According to U.S Census Bureau Data 2006 indicated that US small company numbered 23million in 2003 and employed about half of the private sector workforce and also produced approximately half of the personal output.

1.1.1 Small and Medium-Sized Enterprises

Generally, the definition of SMEs is subjective and qualitative; therefore, different countries or regions define SMEs depending on the economic development level. The scale of classification tends to be smaller in developing countries especially in sub-Sahara Africa because of the nature of their economies. However, the commonly used criteria are; number of employees, sales turnover and/ or total investment (Forte et al., 2013). For example, in Japan, small scale business is outlined in keeping with the sort of business and also the variety of paid staff. Thus, manufacturing business is 300 million yen stated capital and three hundred paid workers, the wholesalers are said to trade with one hundred million yen and hundred workers, services trade with fifty million yen and one hundred workers and lastly those in retail trade with fifty million yens and fifty paid workers (Ministry of Economy, Trade, and Industry, 2013).

Economists believe that enhancing the development of SMEs is a powerful way of encouraging grassroots economic growth as well as equitable sustainable development (Kachembere 2011). The economic growth of any country according to the recent studies is closely connected with SMEs' development, for instance, SME sector size is strongly and positively related to economic growth (Beck 2005). Ayyagari (2007) observed that in the developed countries, formal SMEs have a lot of contribution which amounts to almost 50% of GDP on average. According to the study done by Ardic, Mylenko, and Saltane (2011) in Washington DC, most of the job opportunities are generated through the increased growth of the SME sector. The development of SMEs has become crucial in most

developing countries as these countries see them as the means of providing employment and enhancing economic growth (Egbetokum, 2010). SMEs work as both suppliers and consumers and this plays a very vital role if they are going to be competitive in the market with huge purchasing power, their demand for consumer goods will motivate the activities of their suppliers, this is just as their activities are being stimulated by the demand of their clients (Hatten 2012).

1.1.2 Small and Medium-Sized Enterprises in Kenya

Micro and Small Enterprise Act of 2012 defines an SME as a firm with less than 100 permanent employees (GoK, 2012). Specifically, a small enterprise has full-time employees between 10-49 while, a medium enterprise has 50-99 employees. SMEs are playing a key role in Kenya's growth and development. This is best explained by numerous job opportunities and wealth created by SMEs(GoK, 2005). This is believed that during the early stages of economic development, SMEs have unique opportunities especially for wealth creation as well as employment creation.in the year 1999, it was estimated that there were about 1.3 million SMEs in Kenya and these enterprises employed 2.4 million people (MSE Baseline survey, GoK 1999). Four years later, the number of people employed by the SMEs was about 5.1 million people and in 2015, 15,160.8 thousand people were employed by these enterprises. Moreover, this sector has enhanced entrepreneurial culture. Therefore, the sector is very critical for Kenya’s growth and development.

SMEs contribute to macroeconomic resolutions of the nation, and their development is vital for an effective market, work absorption, and production. According to Shelly 2004, the importance and

contribution of SMEs especially in achieving the macroeconomic goals of a nation, has attracted the attention of scholars, especially in less developed countries. In both developed and developing economies, policymakers consider the Complex global environment in which SMEs survive, grow and prosper as an important objective. SMEs are generally known for their local use of resources and also their labor-intensive activities. Since SMEs contribute to the national and international economic growth supporting them should be seen as a common theme.

The Kenyan government has recognized the role played by SMEs by implemented various policies to enhance performance. These initiatives include the Sessional Paper No.2 of 2005 on the Development of MSMEs for wealth creation and also employment creation which leads to poverty reduction (GOK, 2018). In particular, this paper focused on the challenges affecting SMEs and measures to overcome them. Also, Vision 2030 which recognizes SMEs as a major contributor to economic growth has incorporated measures to enhance their growth in the Medium-Term Plans. More recently, Kenya has launched the Kenya National Industrial Policy and Kenya Industrial Transformation Programme (KITP). One of the key agendas for this policy framework is to build the capacity of SMEs to enhance their holistic performance (KNCCI), 2018).

1.2 Statement of the Problem

SMEs' role in the economic growth and development of the Kenyan economy cannot be refuted. SMEs contribute significantly towards employment creation, domestic and international trade enhancement and poverty reduction. The realization of these goals depends on the efficiency and therefore, productivity of the enterprises. Although SMEs play a foremost part in the economy, they still encounter different challenges which are both internal and external (Nyambura, 2013). The

internal challenge includes; managerial competence, access to finance or credit, location of the firms, investment in information and communication technology and networking. While external challenges include; government policy, access to markets, inadequate infrastructure, corruption, and crime.

The government of Kenya has legislated various policy frameworks to enhance the capacity of SMEs in terms of financial, managerial and capital development as well through Sessional Paper No.2 of 2005, Vision 2030 and the recent KITP. However, despite all these policy initiatives, it remains unclear about the efficiency levels of SMEs in Kenya as well as the determinants of TE. This is attributed to the limited literature on technical efficiency concerning Kenya's SMEs. This study sought to fill these gaps by employing the Cobb-Douglas production frontier efficiency model with robust econometric analyses.

1.3 Research Questions

What is the level of TE of Kenyan SMEs?

1.4 Objectives

The overarching objective of this study was to assess the levels of efficiency in SMEs in Kenya. The Specific, objectives were;

To examine factors explaining technical efficiency among Kenya's SMEs;

To determine the level of TE of Kenya's SMEs;

To conclude and recommend policies for improving the performance of SMEs depending on the findings.

1.5 Significance of the study

Kenya's vision 2030 identifies SMEs as key pillars towards an industrialized economy by the year 2030. However, there is limited evidence on the efficiency levels of these enterprises in Kenya. The

study bridged the gap by enriching both theoretical and empirical literature. Also, by investigating the determinants of technical efficiency, the study hopes to recommend policy measures which if implemented, could lead to improved efficiency of SMEs and therefore, their productivity. Furthermore, findings of the study are likely to generate academic debate which could stimulate further studies.

1.6 Organization of the Study

The rest of the report is organized as follows: the second chapter presents a discussion of both theoretical and empirical literature. The chapter ends with an overview of literature which establishes a research gap. The third chapter comprises the study methodology which discusses the theoretical framework for the study and the empirical model. Besides, the chapter presents a description of variables and their operationalization, as well as model specification. While chapter four presents findings and discussion, chapter five summarises these findings and draws conclusions and policy recommendations.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

Chapter two provides literature related to the efficiency of SMEs. Both theoretical and empirical literature is discussed. Finally, the chapter presents an overview of the reviewed literature which established research gaps.

2.2 Theoretical Review

2.2.1 Concept of efficiency

Efficiency is described as the ability to avoid wastage of energy, materials, time, efforts and money in doing something or producing the desired results. Two types of efficiency are mostly distinguished in economic literature and these are; allocative and technical efficiency. Technical efficiency is defined as the effectiveness with which a given set of inputs is used to produce an output. A firm is said to be technically efficient if it produces the maximum output from a minimum quantity of input such as labor, capital, and technology. A measure of technical efficiency of the i^{th} firm can be defined as $TE=Yi/Yi^*$ where, Yi is actual Output and Yi* is Maximum possible output

On the other hand, allocative efficiency is described as the level of output where the price of a good or service and the marginal cost (MC) of the production are equal to each other.

The firm is said to be economically efficient if it has both technical and allocative efficiency (Papadas and Dahl, 1991).

Farrell (1957) introduced a measure of productive efficiency where the efficiency of a firm is measured relative to an efficient production frontier. The efficient frontier gives the output that a perfectly efficient firm could obtain from any given combination of inputs. These concepts can be shown graphically using a simple example of Farrell's output-oriented technical and allocative efficiencies. Output oriented measures indicate how much output quantities can be expanded without altering the input quantities used.

Figure 2.2.1 Farrell's Output Oriented the Technical and the Allocative Efficiencies

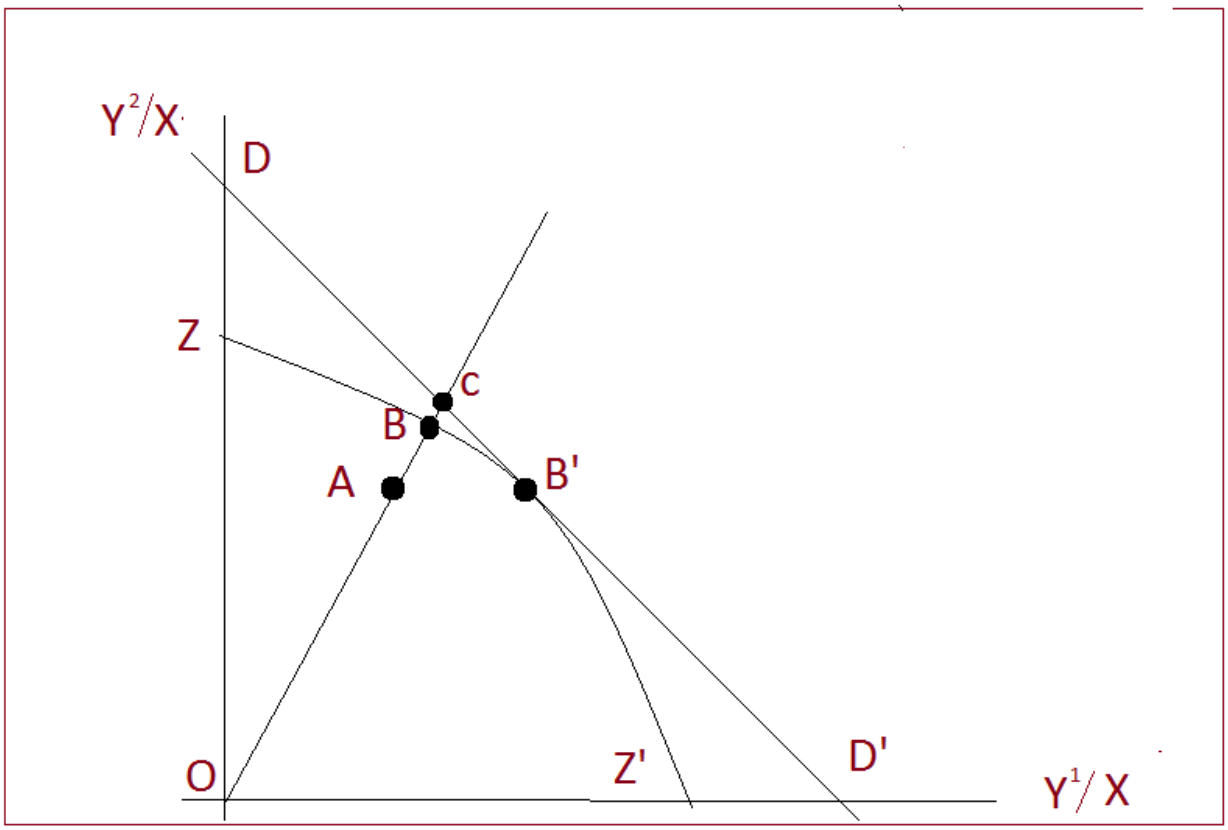

Figure 2.2.1 represents a case where there is a production of two outputs Y_1 and Y_2 and a single input X. Arc ZZ' is the unit production possibility curve (PPC). Point A lies below the PPC; therefore, point A is the inefficient point. Distance AB represents the point which is technically inefficient, that is, there

is no need for the extra input in order to increase the amount of output. Output-oriented TE can be given by the ratio: TE=OA/OB. An isorevenue line is represented by line DD' which is a line representing all combinations of 2 products that will generate the same level of total revenue and with it, allocative efficiency can, therefore, be defined as AE=OB/OC. The economic efficiency can be described as a product of these two measures, that is; EE= (OA/OC) × (OB/OC).

Efficiency in economics is given both positive and normative reasons. The positive underlying principles that drive efficiency analysis stems from the urge to create and enhance tangible values while the normative reason is founded on the basis of the challenge to obtaining useful policy information from the production theory such as Viltredo Pareto who set a condition for efficiency, that is; the change is efficient if it makes an individual better off without making anyone else worse off (Debrrue 1959, Virian 1992, Schenk 2004).

The theoretical aspect of production efficiency is intimately related to that of profit maximation. A situation is efficient if it cannot be improved that is if there is no superior to it (Friedman 1990). For efficiency analysis, Pareto optimality has been the main assessment criterion in economics. Nevertheless, Pareto efficiency does not guarantee that the efficient situation is necessarily superior to the inefficient one.

Marshall Optimality is a theoretical criterion in efficiency. The Marshall efficient situation is characterized by some of gains and losses due to a change aimed at improvement. If the sum is a net gain, there is Marshall Improvement and vice versa. Efficient condition is therefore fulfilled where no further Marshall improvement is tenable.

2.2.2 Theory of Production

The production theory establishes a fundamental basis for analyzing firm efficiency. The theory focuses on how inputs are combined in the production process to produce a defined output level (Kokkinou, 2010). Production can be defined as a process of transforming inputs into outputs. The theory argues that capital goods are combined with labor and other raw materials to produce outputs. These processes aim to create value for consumers and profits for the producer or service provider. Entrepreneurship is measured by the level of managerial expertise and technology is also considered as part of the inputs in the production process.

Kokkinou argues that efficiency within production is very critical for achieving the firm's goal of maximizing profits. The determination of efficiency is very critical for guiding decision making in firms. Efficiency characterizes how resources are employed in the production process. Kokkinou noted that efficiency has many dimensions which require the satisfaction of allocative and dynamic efficiency. The need for optimum efficiency is that goods and services be produced at the very lowest possible cost. Maximum possible output results from two sources. First, the efficient use of each input contributes individually to the potential output which can be measured by the magnitude of the varying random slope coefficient and second, when all inputs are used efficiently, they produce a combined output over and above the individual input contributions which can be measured by the varying random intercept term.

2.2.3 Resource-based Theory

This theory was proposed by Wernerfelt (1984) and it argues that the strategy of a company is determined by the resources it possesses. Also, this theory asserts that the success of firm dependents on its resources and strategy. Thus, the strategic management of enterprises is anchored on the resources of the firm. The theory further states that firm resources are limited to attributes

that enhance efficiency. The meaning of this approach in the context of this study is that the management practices of SMEs are determined by resource base and that SMEs which are well resourced could be more efficient. Besides, the performance of SMEs relies on the management practices adopted.

Literature has classified techniques of measuring efficiency into two categories, that is, parametric and non-parametric methods (Alvarez & Crespi, 2001). The parametric approach uses an econometric technique based on the assumption that the disturbances term constitutes two elements. The first represents the statistical noise or randomness; while the second represents technical inefficiency, which is assumed to follow a one-sided distribution. The parametric approach is Stochastic Frontier Analysis (SFA) introduced by Farrell (1957) in his seminal paper. The merit of using this model is that it captures the effects of exogenous shocks beyond the control of analyzed units besides incorporating the efficiency term in its analysis (like deterministic approaches); The simplest and restricted form of the SFA is the Cobb Douglas production frontier given as;

$Y_i = X_i \beta (V_i + U_i)$ i= 1, 2……n

Where Y_i is output or logarithm of production of the i^{th} firm, X_i is the vector of inputs of the i^{th} firm, β is the vector to be estimated, V_i represents the random variables which are assumed to be independently and identically distributed, U_i represents the random variables that are presumed to account for technical inefficiency in production and usually assumed to be independently and identically distributed.

The non-parametric approach uses the Data Envelopment Analysis (DEA) which applies mathematical programming models in estimation of the optimal output level of the firm and it is the non-statistical approach, (Shiu & Zelenyuk 2011). The main shortcomings of this approach are; it does not differentiate between statistical noise and technical inefficiency and it is sensitive to

variables selection and data errors. DEA only looks at relative efficiency and not absolute efficiency hence the inefficient firm may be considered efficient. Also, it does not accommodate the randomness that may affect the efficiency of the firms and lastly it employs linear programming instead of least square regression analysis, this produces no standard error and leaves no room for hypothesis testing hence deviation from the frontier is treated as inefficiency and there is no provision for a random shock. However, Shiu and Zelenyuk argue that DEA has several advantages. First, no restrictions are placed on the functional form of the production function. Second, it makes no distinction between the relative importance of output and input considered as relevant in the firm decision-making process. Third, DEA is insensitive to model specification, hence the efficiency measurement is similar if it is estimate oriented to inputs or oriented to outputs, and lastly DEA has the ability to accommodate several inputs and output at the same time.

2.3 Empirical Review

Existing theoretical and empirical literature has identified various determinants of firm performance and hence efficiency. These include ownership structure, amount of fixed capital, an industry in which the firm is operating, quality of manpower, age of the enterprise and competition (Djankov & Murrell, 2002). Several empirical studies have been conducted in both high and less income countries on the efficiency of SMEs.

Alvarez and Crespi (2001) conducted a study on the determinants of efficiency in small firms among the Chilean manufacturing industries the study used the Deterministic Frontier Method (DEA) which is a nonparametric method. Plant survey data collected in 1998 was used in this study. The study found out that there was a positive correlation between efficiency and the workers' experience, modernization of physical capital and product innovation. The study also found that there was no

significant impact on firm efficiency on public program participation, outward orientation, and education of the owner or job experience.

Admassie and Matambalya (2002) for the case of Tanzania applied Cobb-Douglas stochastic production frontier to investigate the extent and determinants of TE using cross-sectional data. The study analyzed a total of 148 SMEs drawn from key sectors of the economy. The study reported that the sampled SMEs had high levels of technical inefficiencies which led to a significant decline in productivity. Similarly, a study conducted by Batra and Tan (2003) for the case of six developing countries, with three from East Asia, found that TE was positively significant to the size of the firm. However, this study noted that there was a huge overlap in the distribution of TE across the firms at different levels of operation. Some small firms were operating at the same or higher level of efficiency than some large firms. Thus small firms are not inherently inefficient.

Ajibefun and Daramola (2003) examined the efficiency levels of microenterprises in Nigeria by applying the stochastic frontier production function whereby Cross-sectional data was used collected on 180 micro enterprises selected from different sectors which includes; block making sector, metal fabrication, and also sawmilling sectors. The finding of the study was that the efficiency levels vary across firms. They also found that the education of the enterprises' owner was the most important determinant of efficiency in microenterprises as it was statistically significant. Furthermore, there was a negative relationship between the age of the owner and the efficiency; that is, as the owner's age increase beyond certain level efficiency tends to decline.

Bigsten, Kimuyu, and Lundvall (2004) carried out a comparative analysis on TE for formal and informal manufacturing firms in Kenya. It was found out that in general, efficiencies were very low. The study further discovered that formal firms that are managed by Africans, were less efficient than formal firms managed by Asians. Concerning the determinants of firm efficiency, the study found that

capacity building, infrastructure, credit access, and firm networks were significantly associated with TE.

Nikaido, (2004) investigated the TE of small scale industries in India. The study applied a stochastic production frontier model in analyzing the data. The effect of firm size and geographical agglomeration on the measured TE was analyzed. The study used industry state-wise data from the second census of small scale industries in India of 1992. The study showed that geographical agglomeration and clustering of firms had a positive impact on TE but the firm's size had a negative effect on efficiency.

Zahid and Moktar (2007) investigated TE levels among Malaysian manufacturing SMEs by applying a Cobb-Douglas stochastic production frontier. This study used Cross-sectional data. The study found out that the production function coefficients are positive and significant. In addition, the study established that the average efficiency level of the SMEs was 76%, this meant that manufacturing SMEs in Malaysia have 24 percent production inefficiency

Alibefun (2007) did a study in Nigeria to analyze the TE of MSEs. The study used the stochastic production frontier model whereby the cross-sectional data which was collected from the northern, southern regions of Nigeria. The subsectors included were the sawmilling, metal fabricating and block making subsectors. The results indicated that education level had a significant effect on efficiency, as well as the level of investment and number of employees while the age of enterprises, as well as the age of enterprises' operator, had a negative influence on the level of TE.

A study by Tran et al. (2008) investigated the levels of efficiency on non-government SMEs within the Vietnam manufacturing sector using a stochastic frontier model between 1996 and 2001. The study

established that non-state manufacturing SMEs increased their efficiency performance over the study period. In addition, the study found that those SMEs found in the metropolitan regions had higher efficiency levels as compared to SMEs in other areas. The study had the conclusion that increased availability of educated labor force, as well as more market opportunities, was the cause for better performance of SMEs in the metropolitan area as opposed to non-metropolitan localities. Furthermore, the study reported that the firm's age was connected with reduced efficiency levels. The study attributed this to the inherent discrimination of SMEs in the private sector.

Radam, Abu, and Mahir (2008) investigated the TE of 7360 SMEs in Malaysia by applying a stochastic production frontier model. This study established that small enterprises had high-efficiency levels than medium firms. Also, micro firms were the least efficient from among all the categories of firms. This discovery implies that there is no absolute correlation between TE and firm size.

The study done by Lee and Harvie (2010) examined the TE in the manufacturing SMEs in Vietnam applying Stochastic Frontier Analysis to firm-level data collected from 2002 to 2007. Their study found out that there was average technical efficiency on non-state manufacturing SMEs in Vietnam. Technical efficiency averaged 89.71 percent for the three surveys in 2002, 2005 and 2006 and 2007 were 84.25 percent, 92.55 percent, and 92.34 percent respectively. Their study established that high technology electronics and electrical equipment have low TE compared to the low technology furniture and wood sub-sector. The coefficient for labor and intermediate inputs is significant and positive for many cases, while capital input is negative, small and insignificant in most cases. This indicates that human capital and raw materials are important inputs in production for

manufacturing SMEs in Vietnam. Hence it suggests that Vietnamese manufacturing SMEs rely more on labor and materials to increase their output.

Seema and Milind,(2010) analyzed the technical and as well as scale efficiency of the state-wise cluster in the registered small scale sector using input-oriented Data Envelopment Analysis in India. They used data from the India census of small scale industries of 2001-2002. They used Charnes and Cooper's (1984) model in their analysis to estimate the technical and scale efficiencies of these as the Decision-Making Unit (DMUs). Their findings showed that only seven states were technically efficient while the rest were either moderately or technically inefficient. To improve technical efficiency and scale efficiency they proposed better credit facilities, improved infrastructure, proper marketing, technological innovation, and better management abilities.

Hussein et.al (2010) did an investigation on SMEs' development through the public-private partnership (PPP) in Pakistan where he used primary data. The study used two models based on the study of Bezing et.al (2009) and ADB (2005) to determine the Critical Success Factor and Critical Failure Factor. The study established that managerial competencies had a significant and positive impact on SMEs' performance.

Mosomi (2011) examined the level and determinants of TE among the Kenyan SMEs using cross-sectional data. The study used a Cobb-Douglas Stochastic Production Function. The results show that on average Kenyan SMEs are technically efficient. Also, the results indicate that the age of the owner, owner's education level and capacity building were negatively related to technical inefficiency. In addition, the study reported high technical inefficiency in SMEs which are headed by a female.

Bhatt (2014) applied a Cobb-Douglas production function to investigate the productivity efficiency of SMEs in India. This study reported that the labor force was a better determinant of firm efficiency than fixed capital. Also, the study found that the firm's age, as well as its working capital, significantly determined the efficiency of SMEs, particularly in the garment industry. This study also found that determinants of efficiency differ depending on the firm's size. Firms that were large were found to be more efficient than smaller ones.

2.4 Overview of Empirical Literature

Various studies have investigated the concept of efficiency and its determinants among firms in both developing and developed economies. There is evidence that most of the studies investigating the extent of firm efficiency and its determinants have used a Cobb-Douglas Stochastic Production Frontier model (Zahid & Moktar, 2007; Tran et al., 2008; Lee & Harvie, 2010; Mosomi, 2011; Bhatt, 2014). However, the reviewed studies indicate that there are mixed findings on the extent of efficiency among SMEs. While some firms find high level of efficiency (Alvarez & Crespi, 2001; Zahid & Moktar, 2007; Lee & Harvie, 2010), other studies (Admassie & Matambalya, 2002; Bigsten, Kimuyu & Lundvall, 2004), have reported low-efficiency levels among small and medium-sized enterprises. Difference in variable selection and also the different methods of analysis led to disagreement in findings. It is still debatable whether small firms are efficient or less efficient than large firms. The literature also reveals that TE varies across enterprises' scale of operation and regions. Also, there is limited evidence on this topic in Kenya. The most recent study by Mosoni (2011) analyzed the 1999 data set and given the time lag a lot has changed in terms of policy and macroeconomics. Furthermore, it remains unclear how the previous study dealt with the issue of endogeneity and multi-collinearity due to scanty information. This study, therefore, aims at improving the

understanding of the determinants of TE and provides current estimates of technical efficiency in Kenya.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The main contribution of this chapter is to describe the methodology employed to investigate the efficiency of SMEs in Kenya. Therefore, the chapter focuses on the theoretical framework, empirical model and variable description. Also, data types and sources, as well as estimation strategy are presented.

3.2 Theoretical framework

This study follows the stochastic approach framework proposed by Battese and Coelli (1995) to model the TE of SMEs in Kenya. There are three reasons for the choice of this approach: First, the stochastic frontier model can capture factors for which the firm is not in a position to control as well as control of factors that are specific to a particular firm. The second reason is its ability to separate random variables of the frontier in the firms, to isolate the effects of measurement errors and random shocks from the effects of firm inefficiencies. Thirdly, this model can accommodate factors explaining inefficiency simultaneously alongside the estimation of technical efficiency. The equations are presented as:

$Y_i = f(x_i\alpha + W_i - Z_i)$ ..... (3.1)

$E_i = f(-Z_i) = f(-Q_i\,\delta - R_i)$ ..... (3.2)

Where for equation 3.1, Y_i refers to output for firm *i,* x_i is a vector of observed production inputs related to firm *i,* α refers to unknown parameters to be estimated, W are randomly distributed random errors and Z is a vector of positive random variables related to technical inefficiency of production, assumed to be distributed independently in the sense that Z_i is generated by truncation at zero of the normal distribution with the mean $q_i\ \delta$ and varianceσ_v^2. Concerning equation 3.2, Q_i represents a vector of factors explaining the technical inefficiency of firm production, δ are unknown

parameters to be estimated and R_i is the random variable determined by truncation of the normal distribution with the mean of zero and the varianceδ.

In this model, the of the production of TE of the production of firm *i*, is expressed as $TE_i = f(-Z_i)$. This measures the output of firm *i*, in relation to the output that the same firm could have produced when the firm was fully efficient by utilizing a similar vector. TE takes the value of between 0 and 1 in the stochastic production frontier. The production function is given in the Cobb-Douglas form as:

$Y_i = A\pi_j^k X_{ij}^{\beta j} e^{\varepsilon i}$ ..... (3.3)

WhereY_i is the output, X_{ij} is exogenous input, A efficiency parameter and

εi is a stochastic disturbance term.

3.3 Empirical model

The empirical model is derived from the theoretical framework. The study estimated the stochastic frontier production function (equation 3.3) in the Cobb-Douglas form, which has also been used by Admassier and Matambalya (2002). Thus, the estimation equation is expressed as:

$\ln(Y_i) = \alpha_0 + \alpha_1 \ln(K_i) + \alpha_2 \ln(L_i) + \alpha_3 In\ (AF_i) + \alpha_4 In\ (exp_i) + \alpha_5 In\ (G_i) + \alpha_6\ In\ (Jtr_i) + \alpha_7 In\ (Oship_i) + (W_i - Z_i)$..... (3.4),

Where ln Y_i, is the natural log of the output of firm *i,*

ln K_i, is the natural log of physical capital,

ln L_i, is the natural logarithm of labor,

ln AF_i is the natural log of the age of the firm,

ln exp_i is the natural log of the experience of the owner,

ln G_i is the natural log of the gender of the owner,

ln Jtr_i is the natural log of job training,

$\ln \text{Oship}_i$ is the natural log of ownership of the firm.

W_i is a two-sided error related to the production function of firm *i*, while Z_i represents a one-sided error term related to inefficiency effects.

On the other hand, a technical inefficiency effect of the equation is expressed as:

$Z_i = Q_i\,\delta + R_i$ .....(3.5)

Where Q is a vector of factors hypothesized to determine technical firm inefficiency. These factors include specific characteristics of the owner such as sex, exp, age, and training. These variables are proxies for human capital development following Schultz (1961) who argued that investment into manpower increases the productivity of the firm. The study considered the age of the firm, education of the firm's Chief Executive Officer (CEO), Sex of the owner or CEO and staff training. Also, this vector includes characteristics specific to the firm such as firm assets, capital as well as ownership type following Mukras (2003) who noted that a firm's operating capital is key to the performance of an enterprise.

Furthermore, this study incorporated other infrastructural control variables like water availability and electricity. Incessant power blackouts and water shortage is likely to hamper firm productivity (see Bigsten, Kimuyu & Lundvall, 2004)

3.4 Description of Variables

Table 3.1 presents an explanation of variables and their operationalization.

Table 3.1: Description of Variables

Variable name	Description	Measure
Y	Firm's output	Measure as value-added (sales-costs) in Kshs.
K	Physical capital	Shall be measured as a sum of starting capital plus additional capital in Kshs.
L	Firm labor forces	Shall be measured as a sum of the total labor force (hired plus family labor and apprentice)
Age	Age of the firm	Age of the firm in years (from the date established)
Exp	Experience of the owner or CEO	Years of experience in the industry
Gender	Sex of the owner or CEO	1=male, 0=female
Jtr	Job training	1=employees have undergone on the job training, 0 otherwise
Oship	Ownership of the firm	1=family 2=Sole proprietorship

		2=Company

3.5 Data Type and Sources

Enterprise survey data (ES) was used in this study. This is the latest data set since it was collected in 2018 by the World Bank. Standard instruments are used to collect these types of data worldwide from key firms. The 2018 Kenyan data had 1001 firm-level observations. All variables of interest are in this data set which include capital, labor, output, firm ownership, age of the firm, capacity development for the staff, as well as owners or senior managers' characteristics like highest level of education and gender.

3. 6 Estimation of the Model

The study employed a maximum likelihood method following Battese and Coelli (1995). Stochastic production frontier and the inefficiency effects models were estimated simultaneously using a one-stage estimation procedure.

3. 7 Diagnostic Tests

To ensure the estimated results were valid, the study conducted various tests. These included normality, multicollinearity, and heteroscedasticity tests.

3.7.1 Normal Distribution Test

The normal distribution is symmetric where most observations are concentrated around the central peak. The maximum likelihood method suggested in this study assumes a normal distribution. The study employed Skewness and Kurtosis coefficients to find out if the distribution is normally distributed. If the data is found not to be normal, the study sought to correct this by removing outliers

in the distribution. For the distribution to be normally distributed, the Skewness coefficient should be in the range of -2 and +2, while the Kurtosis coefficient should be in the range of -3 and +3

3.7.2 Multicollinearity Test

Multicollinearity is a challenge in data analysis where one explanatory variable in multiple regressions such as in the present study could be explained accurately by another explanatory variable. In other words, the problem occurs when independent variables are correlated. This problem could lead to under or overestimation and therefore, wrong interpretation and conclusions. The study employed a Variable Inflation Factor (VIF) to diagnose this challenge. The absence of Multicollinearity is confirmed when VIF coefficients are less than 10 and 1/VIF coefficients are more than 0.1.

3.7.3 Heteroscedasticity Test

This problem occurs when variances of values differ across the range of distribution. This results in different sizes of error term across values of explanatory variables, which could lead to under or overestimation of the size of coefficients, and hence, wrong inferences. The Breusch Pagan Test was employed in this study. The null hypothesis of the test is whether error terms are normally distributed. A reject of this hypothesis implies that the error terms are not normally distributed.

CHAPTER FOUR: FINDINGS AND DISCUSSION

4.1 Introduction

The findings and discussions of the study are presented in this chapter. The chapter is divided into two sections. While section one focuses on descriptive statistics, section two comprises econometrics analysis which response to the study objective.

4.2 Descriptive Statistics

This section analyses means standard deviation, minimum and maximum values of all the variables under investigation. This was aimed to gain a better understanding of the variable prior to investigating the level of TE and factors explaining the TE. Table 4.1 presents summary statistics

Table 4.1: Summary Statistics

Variable	Obs	Mean	Std Dev	Min	Max
Y(profit)	834	102.971	375.0053	-480	8002
K(capital)	834	11.16499	187.4423	0	5000.3
L(labour)	834	22.90767	20.73511	0	98
age	834	20.29496	17.77887	0	124
exp(experience)	834	15.08633	11.02207	0	65
gender	834	.8285372	.3771391	0	1
jtr(job training)	834	.3884892	.4876992	0	1

Source: ES Data, Stata output, (2019)

Summary statistics indicate that a total of 834 SMEs was included in the study. With regard to in depended variable, Y(profit), the study shows that the mean output of SMEs in the year 2018 was Kshs. 102.971 million and ranged between a min of Kshs. (480) million and a max of Kshs. 8002 million with a standard deviation of about 375 million. Concerning physical capital, the study has

found that during the year 2018, SMEs' capital ranged between Kshs. 0 and Kshs. 5000.3 million with a mean of Kshs. 11.16 million and standard deviation of Kshs. 187.4423 million. In addition, the mean labor force of SMEs is 22.9 with a maximum of 98 and a standard deviation of 20.735. With regard to the age of firms, the study found that the average number of years SMEs had operated at the time of the survey was 20.29 with a maximum of 124 years and a standard deviation of 17.78 years. Furthermore, statistics indicate that the average number of years of experience of the top management in the sector was 15 with a maximum of 65 years and a standard deviation of 11. This means that the high number of SMEs surveyed had competent managers.

On Gender of the top manager, findings show that the majority of the top managers were male with a mean 82.85 while the remaining 17.15 were female. This implies that the management of SMEs in Kenya is still dominated by men despite many years of calls for gender equality in access to opportunities. Finally, concerning job training, 38.85% of the firms had conducted training for its employees in the year 2018, while the majority, 61.15% did not. This means that, despite the impact of on-the-job training on the technical ability of the enterprise, the majority of the SMEs have not taken the challenge. This could probably be due to the meager financial resources of most SMEs.

Next, Table 4.2 presents a summary of SMEs' legal status.

Table 4.2: SMEs Ownership

Legal Status of the Firm	Freq.	Percent
Shareholding company with tradable shares	17	2.04
Shareholding company with non-traded shares	168	20.14
Sole proprietorship	277	33.21
Partnership	93	11.15
Limited partnership	279	33.45
Total	**834**	**100.00**

Source: ES Data, Stata output, (2019)

Table 4.2 shows that the high number of the SMEs in Kenya, 279(33.45%) are limited partnership followed by SMEs owned by individuals (sole proprietors) at 33.21%, and 20.14% (168) SMEs which are shareholding companies with non-traded shares. In addition, 93(11.15%) of the SMEs are partnership while the minority, 17(2.04) of the SMEs are companies with tradeable shares.

4.3 Correlation coefficients

The study conducted analysis on correlation coefficient whose findings are shown in Table 4.3.

Table 4.3: Correlation Coefficients

lnY	lnK1	lnL	lnage	lnexp	lngender	lnjtr
lnY	1.0000					
lnK1	0.1967	1.0000				
lnL	0.1256	0.1013	1.0000			
lnage	0.2093	0.0375	0.2146	1.0000		
lnexp	0.0368	0.0515	0.1118	0.4370	1.0000	

gender	-0.0234	0.0257	0.1789	0.0780	0.1594	1.0000
lnjtr	.	.	.	.	.	.

Source: ES Data, Stata output, (2019)

The correlation coefficients indicate the nature and how strong or weak variables are related to each other. Looking at the results in Table 4.3, there is a weak correlation between the output variable, Y, and all the independent variables. In addition, apart from gender, all other independent variables (physical capital, labor force, age, and experience) are positively correlated to the output variable. Furthermore, there is a weak and positive correlation among all the explanatory variables.

4.4 Econometric Results

The study aimed at assessing the levels of TE of Kenya's SMEs. This study had two specific objectives which were: to examine factors explaining technical efficiency among Kenya's SMEs and to determine the level of TE of Kenya's SMEs. The study employs a stochastic production frontier and the inefficiency effects models.

4.4.1 Results from SFA - Input Elasticities and Gamma Parameters

The study conducted SFA with technical inefficiency effects as presented in Table 4.4. For comparison purposes, both SMEs and Large enterprises were incorporated.

Table 4.4: Maximum Likelihood Estimates for Parameters of the Stochastic Frontier Model with Technical Inefficiency Effects by SMEs and Large enterprises

Variables	**SMEs**		**Large Firms**	
Observations	834		167	
LnY	Coefficients	St. Deviation	Coefficients	St. Deviation
In K	.004502***	.0000112	.0987884**	6.47e
In L	.196924**	.0001603	.241858*	.0001293
In age	.2792525***	.0000777	.5882914***	.0000599
In exp	-.0259628**	.00009	-.2675738**	.0001006
In Gender	-.464748***	.0002201	-2.624897	.0001143
In jtr	0	(omitted)	0	(omitted
In ltd Companies	2.00434*	.000228	-.4829658**	.0001377
Sole proprietors	-0.98464**	.0001598	-1.247533	.0001689
Partnerships	2.96789***	.0002149	-.266652	.0002266
Limited partners	-1.89601***	.0001551	.9885121**	.0000931
_cons	14.1397**	.0003989	12.41226	.0009927
Gamma	.682***	.1061258	0.79**	.4811272
Prob >=chibar2	0.000		0.000	
Log of Likelihood	-828.95621		-484.25627	
Mean TE	0.21		0.18	

Returns to scale	2.07	1.65

Note: Std errors are in brackets; *, ** and *** indicate that the coefficients are statistically significant at 10%, 5%, and 1%, Respectively

Source: ES Data, Stata output, (2019)

Table 4.5 shows the findings of the maximum likelihood estimation of SMEs and Large-scale enterprises. These findings indicate that there is increasing returns to scale for both SMEs and large enterprises in Kenya. This is shown by the combined value of the coefficients of inputs of 2.07 and 1.65 for SMEs and large businesses respectively. This is because these values are greater than unity (1). The estimation of the variance parameter, gamma (γ) of 0.682 for SMEs, and 0.79 for large enterprises imply that all the deviations in production are attributed to technical inefficiencies (Coelli et al., 2005).

With regard to the level of TE, findings reveal that technical efficiency is relatively higher among SMEs than large enterprises. This is presented by a mean of 0.21 for SMEs and 0.18 for large enterprises. This means that SMEs in Kenya make the best use of their resources, or they have the best production technologies as compared to larger enterprises surveyed in the year 2018. However, these efficiency levels are extremely lower implying that there are a lot of inefficiencies among Kenyan enterprises.

Turning to the determinants of TE, the results indicate that physical capital is positively related to the firm's output for both SMEs and large enterprises. This variable is also statistically significant at a 1% level for SMEs and a 5% level for capital. This implies that physical capital is one of the major

contributors to SMEs' technical efficiency. These findings are consistent with those of Bhatt (2014) who applied a Cobb-Douglas production function to investigate the productivity efficiency of SMEs in India. The study noted that capital was a key indicator of technical efficiency. But, looking at the size of the coefficients, physical capital has a greater impact (0.0987884) on technical efficiency among large firms than for SMEs (0.004502).

The study has also found a positive relationship between the labor force and output for both SMEs and large enterprises. The coefficient size shows that labor has a higher contribution to the firm's technical efficiency as compared to physical capital. This is shown by the value of the coefficients of 0.197 for SMEs and 0.242 for large enterprises. These findings agree with those of Lee and Harvie (2010) for the case of Vietnam. This study argued that labor and in particular its characteristics were the main determinant of technical efficiency among manufacturing SMEs in Vietnam.
The age of the firm has been in existence has a positive effect on the TE of both SMEs and large enterprises according to the estimated results in Table 4.5. In addition, these coefficients have a significant level of 1%. Furthermore, the size of these coefficients (0.279 for SMEs and 0.588) implies that the age of the firm has a greater impact on TE among Kenyan firms. However, the impact of large enterprises is found to be extremely higher (about 58.82%). This shows that the more the number of years a firm operates, the more it enhances its technical efficiency. This could be attributed to more exposure and adoption of highly productive technologies. Bhatt (2014) observed similar findings.

With regard to years of owner's/top manager's experience, the study found out that, there was a negative relationship between the experience of the top manager and TE for both SMEs and large enterprises. The variable have a significant level of 5%. The results indicate that owners' years of

experience has a negative effect on the firm's TE. Similar results are established regarding the gender of the firm owner/top manager. The negative coefficients for gender indicate that women have a positive contribution to firms' technical efficiency.

Concerning dummies for firm legal structure, limited companies and partnerships are positively related to the firm's output, while sole proprietorship and limited partnerships kind of businesses are found to have a negatively related to SMEs firm's output. This implies that technical inefficiencies are more pronounced among sole proprietors and limited partnerships.

CHAPTER FIVE

SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary, conclusions, and recommendations of the study. Both summary and conclusions are presented as per the objectives. Recommendations are based on key study findings.

5.2 Summary

The aim of the study was to investigate the levels of technical efficiency among SMEs in Kenya. Specifically, the study sought to answer two objectives, that is, to establish the level of TE, and secondly, to determine factors that affect technical efficiency among SMEs in Kenya. World Bank Enterprise Survey data for 2018 from the World Bank was used in this study. Both descriptive and regression analyses were conducted. For regression, stochastic production frontier and the inefficiency effects model was used.

Descriptive results indicate that profit for SMEs in the year 2018 oscillated between Kshs. 8,002 million and a loss of Kshs. 480 Million with an average of Kshs. 102.971. This implies that there is a huge deviation regarding the profits of SMEs which could be attributed to the differences in scope and even operations. The study shows that the mean physical capital of SMEs was Kshs. 11.6 million with a standard deviation of Kshs. 187.4423. While the minimum number of employees in the SMEs was 22.9, the maximum number of employees was 98. These statistics further show that some SMEs have operated in Kenya for more than a century (maximum of 124 years) with a mean of 20.29 years. With regard to the experience of the topmost managers, the study has revealed that the mean number of years a manager has been in this industry was 15 years with a max of 65 years. Further,

the study shows that the majority of SME managers are male (82.85%). Moreover, the study has found that only 38.85% of the SMEs had conducted in-service training of their staff in the year under survey, and finally, statistics on legal status indicate that the majority of the SMEs were limited partnerships, followed by sole proprietorships.

Concerning econometric results, the study shows that there is very low technical efficiency among both SMEs and large enterprises in Kenya. However, the comparative analysis shows that technical efficiency among SMEs is relatively higher (0.21) as compared to that of large enterprises (0.18). This implies that SMEs and not large enterprises make the best use of their resources. In addition, SMEs could be having more efficient methods of production and service delivery.

With regard to the determinants of TE, the study found that physical capital was significantly and positively related to TE. This means that firms with more physical capital have higher levels of technical efficiency. Similar results were established by Bhatt (2014). Concerning the labor force, the study has also established a positive and highly significant relationship with TE. This implies that SMEs in Kenya have a competent workforce. In addition, the study has revealed that the labor force has more impact on SMEs' technical efficiency compared with that of physical capital.

The number of years of SME's has been in operation is also found to be statistically significant and also positively related to the TE of both SMEs and large enterprises based on findings in Table 4.5. In addition, the age of a firm has a huge impact on both SMEs and large enterprises than physical capital and labor force. This could be attributed to more exposure and adoption of highly productive technologies. Bhatt (2014) observed similar findings. However, regarding the number of years of the

top manager's experience, the study has revealed that this variable is negatively and statistically significant with SME's TE. Similar results are established regarding the gender of the firm owner/top manager. The negative coefficients for gender indicate that women have a positive contribution to firms' technical efficiency.

Dummies for firm legal structure reveal that limited companies and partnerships have a positive relationship with firms' output, while sole proprietorship and limited partnerships kind of businesses were found to be negatively related to a firm's output for SMEs. The implication of these results is that sole proprietors and limited partnerships have higher levels of technical inefficiency.

5.3 Conclusion

The study draws several conclusions from the findings. First, technical efficiencies among Kenya's SMEs are below the average. Secondly, physical capital is a key determinant of the firm's TE, although, its impact is weak. Third, the organization's labor force is a very critical input in SMEs, and particularly, technical efficiency. Fourth, women at the top play a critical role in the organization's technical efficiency. Fifth, SME's years of experience are important with regard to their technical efficiency. Finally, the study concludes that limited companies and partnerships have a significant impact on TE.

5.4 Recommendations

The study made several recommendations based on the findings and conclusions. First, SMEs need to enhance their quantity of physical capital. This will give them a competitive advantage due to enhanced technical efficiency. Secondly, there is a need for SMEs to invest in human capital development because labor has proven to be a key determinant of technical efficiency. Finally, there

is a need to encourage, and/or promote women to take jobs at the helm of organizations given the revelation that they have an impact on the TE of SMEs.

5.5 Limitation of the study

This study had one major limitation which was finding the panel data of SMEs in Kenya, theoretically panel data could have been more appropriate for the estimation of the economic relationship. The study, therefore, used cross-sectional data which give information at a given point in time leaving out the time element, this forced the study to have unrealistic assumptions of time-invariant in technical efficiency. In addition, data limitation also made it difficult to control the unobserved firm-specific factors.

5.6 Suggestion for Future research

The study found out that large enterprises in Kenya have relatively low technical efficiency than SMEs contrary to the expectation. Therefore, there is room for more research to establish the reasons behind the low technical efficiency in large enterprises compared to SMEs.

This study examined seven variables that determine technical efficiency levels using the stochastic model. There is a need for further studies that include other variables such as access to credit, availability of raw materials, location of the business and so on.

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