TECHNICAL EFFICIENCY OF MICRO AND SMALL ENTERPRISES IN MALAWI: EVIDENCE FROM THE GEMINI BASELINE SURVEY

MASTER OF ARTS (ECONOMICS) THESIS

EKARI NDONE CHAULUKA

UNIVERSITY OF MALAWI

CHANCELLOR COLLEGE

JUNE, 2012

TECHNICAL EFFICIENCY OF MICRO AND SMALL ENTERPRISES IN MALAWI: EVIDENCE FROM THE GEMINI BASELINE SURVEY

Master of Arts (Economics) Thesis

By

EKARI NDONE CHAULUKA

Bachelor of Business Administration - University of Malawi

Thesis submitted to the Department of Economics, Faculty of Social Science, in partial fulfilment of the requirements for a degree of

Master of Arts in Economics

UNIVERSITY OF MALAWI

CHANCELLOR COLLEGE

June, 2012

DECLARATION

I, the undersigned, hereby declare that this thesis is my original work and has not been submitted to any other institution for similar purposes. Where other studies have been used, acknowledgments have been made.

Ekari Ndone Chauluka

____

Signature

____

Date

CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

Signature: ______________________________ Date:___________________

Ephraim W. Chirwa, PhD (Professor)

Supervisor

Signature: ______________________________ Date:___________________

Regson D. Chaweza, PhD (Lecturer)

Head of Department

DEDICATION

To my parents, brother and sisters.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to Prof. E.W. Chirwa for his most valued comments and guidance throughout the process of writing this thesis. I am also thankful to Dr R. Mussa, Dr L. Chiwaula, Dr R. Chaweza, Dr P. Kambewa, Dr G. Kumchulesi and all members of staff of Economics Department for their comments on this thesis as well as during the coursework.

Special thanks should go to my parents for the financial and moral support rendered to me throughout the course of this Masters programme. My siblings; Tsankho and Orama and very dear friends, Margaret and Garnet all deserve a special mention for the many words of encouragement to go on at moments when the going was tough.

I am also indebted to all my classmates and friends who have made this study bearable. In particular, Atamandike, Davies and the many hall-mates deserve a special thank you for the wonderful time we had chatting and arguing on all topics- academic or otherwise. I really appreciate your companionship throughout the study period.

Lastly, to my maker, defender, redeemer and friend; Jesus Christ, for granting me the strength and wisdom to live and excel in all things. To Him all the glory and honour should accrue.

ABSTRACT

This research analysed technical efficiency and its' determinants for off-farm micro and small enterprises (MSEs) in Malawi. A dataset from the GEMINI Baseline Survey of 2000 was used. This was a nationwide micro, small and medium enterprise survey and from this dataset, a usable sample of 2231 enterprises were analysed in this study.

The stochastic frontier model (SFM) was employed in the estimation of a *translog* production function which was estimated following Battese and Coelli (1995). The SFM results indicated that annual sales exhibit positive and significant elastisities with respect to labour, material and capital inputs. It was also seen that these enterprises are not technically efficient and they have a mean technical efficiency score of 72.82 percent.

It was also established that the number of businesses run by the entrepreneur, gender of the entrepreneur and location strata significantly affect technical efficiency while the age of the entrepreneur, duration that the business has been in operation, membership to business association, access to credit, level of education of entrepreneur and business training do not significantly affect technical efficiency.

The study recommends that concrete action should be taken to ensure that MSEs especially those based in rural areas and lakeshore areas have sustainable access to

markets and materials at affordable costs in order to enhance survival and growth of this sector.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

BUGS	Business Unit Growth and Support
CD	Cobb Douglas
CPI	Consumer Price Index
CUMO	Concern Universal Microfinance Organisation
DEA	Data Envelopment Analysis
DEMAT	Development of Malawian Enterprises Trust,
DF	Degrees of Freedom
DFP	Davidson-Fletcher-Powell
ECI	Ebony Consult International
EDEP	Enterprise Development and Employment-Creation Programme
FINCA	Foundation for International Community Assistance
GDP	Gross Domestic Product
GEMINI	Growth and Equity through Microenterprise Investments and Institutions
GoM	Government of Malawi

GPPP	Government Preferential Purchase Programme
ILO	International Labour Organisation
JCE	Junior Certificate of Education
LR	Log-likelihood ratio test
MARDEF	Malawi Rural Development Fund
MBS	Malawi Bureau of Standards
MEDI	Malawi Enterprise Development Institute
MDGs	Millennium Development Goals
MGDS	Malawi Growth and Development Strategy
MIPA	Malawi Investment Promotion Agency
MLE	Maximum Likelihood Estimation
MPRS	Malawi Poverty Reduction Strategy
MRA	Malawi Revenue Authority
MRFC	Malawi Rural Finance Company
MSCE	Malawi School Certificate of Education
MSE	Micro and Small Enterprises
NSO	National Statistical Office
OECD	Organisation of Economic Cooperation and Development
OIBM	Opportunity International Bank of Malawi

SACCOs	Savings and Credit Cooperative Societies
SAPs	Structural Adjustment Programmes
SEDOM	Small Enterprise Development Organisation of Malawi
SFM	Stochastic Frontier Model
TEVETA	Technical Education and Vocational Training Authority
TFP	Total Factor Productivity
TRANSLOG	Transcendental Logarithmic model

CHAPTER ONE

INTRODUCTION

1.1 Background

Micro and small enterprises (MSEs)[1] have over the years been seen as increasingly playing an important role in affecting the economic fortunes of countries. Organisations such as the World Bank and Organisation for Economic Cooperation and Development (OECD) have been advocating for a pro-MSEs led economic development agenda for quite some time. They stress on MSEs as a launch pad for economic growth through job creation and poverty alleviation (Green *et al,* 2006; Hallberg, 2000; Biggs *et al,* 1996; Marsden, 1990).

According to Beck *et al* (2005), small and medium scale enterprises enhance entrepreneurship and competition and thus have external benefits on economy-wide efficiency, innovation and aggregate productivity growth hence the immense support the World Bank Group has rendered to this sector. Between 1998 and 2002,

[1] In 1999 the official classification of enterprise size by the Ministry of Trade and Industry in Malawi was revised. It considers two parameters - employment and turnover: **Micro** 1-4 employees, turnover <MK120,000; **Small** 5-20 employees , turnover of MK120,001 to MK4million, **Medium** 21-100 employees, turnover MK4million to MK10million; **Large** above 100 employees, turnover above MK10million.
Other papers such as (Daniels and Ngwira, 1992) define micro, small enterprises to mean any non-agricultural activity undertaken for commercial ends with 100 or fewer employees and is inclusive of one-person as well as well organised larger enterprises. In this paper we use the former classification as our guide for defining MSEs.

US$10billion was spent in small and medium enterprise programmes and in 2003 alone US$1.3billion was committed to the same cause.

Proponents for MSE development have also argued that besides job creation at low cost and poverty alleviation through income generation particularly true for emerging economies, they also facilitate savings mobilisation, and the acquisition and incubation of entrepreneurial skills. Other arguments in favour of micro and small enterprises point to the fact that large enterprises focus on big markets in trying to realise economies of scale and thus neglect smaller market niches which are serviced primarily by micro and small enterprises. Utilisation of local resources which are usually untapped by big business which usually also require well developed infrastructure also comes in to favour pro-MSE economic agenda (Hossaim, 1998; Fosoranti *et al*, 2006)

Micro and small enterprises are of particular importance in developing countries because of their role in employment creation not only by demanding a lot of workers but also absorbing unskilled labour which is in excess supply in these countries. They therefore accord these masses the opportunity to increase their incomes and thus contribute to poverty reduction and creating a basis for sustained industrial development (Moodley, 2003).

The pro-MSE camp advocates for adequate resources to be devoted to ensuring that an enabling environment exists in order to encourage micro and small enterprises to flourish and graduate to medium then to large enterprises or even become exporters thus consolidating foreign exchange earning capability, economic growth and development.

In all, MSEs can provide an alternative avenue to economic transformation in a country through diversification of growth avenues and economic participation of diverse sections of the population in a developing country. As such, the development of MSEs should be actively evaluated and pursued (Parker *et al,* 1995)

In Malawi the micro and small business sector features prominently in the development agenda. This sector is considered to be critical in helping achieving the Millennium Development Goals (MDGs) in the area of sustainable economic growth. It has been recognised that enterprise performance need to be boosted and sustained if economic growth and development is also to be sustained (Goverment of Malawi 2002).

According to Ebony Consult International (ECI) and National Statistical Office (NSO) (2001), the MSE sector in Malawi employs 38% of the labour force of which 22% are in the off-farm sub-sector. This also represents 42% of women employment and an income contribution to a quarter of the population. The sector also contributes 15.6% of gross domestic product (GDP) with 80% of enterprises located in rural areas (ECI & NS0, 2001). These statistics show that the MSE sector is indeed vital to Malawi's economic development prospects and there is the potential for the sector to play a greater role if the right approach and effort is employed towards the sector.

1.2 Problem Statement and Significance of the study

Since the 1970's Malawi has experienced a rise in the emphasis of the importance of micro and small enterprises to the economy especially in the areas of off-farm employment and income generation such that emphasis has been shifted from large scale enterprises to small and medium off-farm enterprises (Daniels & Ngwira, 1992). The introduction of Structural Adjustment Programmes (SAPs) in the

1980's also exposed the previously shielded local enterprises to international competitors and micro and small enterprises have also borne the brunt.

The second Nationwide GEMINI Micro and Small Enterprise Baseline Survey conducted in 2000 showed some alarming activity in the MSE sector. In comparing the results from the first Nationwide GEMINI Baseline carried out in 1992 it was discovered that the overall numbers of off-farm MSEs had declined. It was also revealed that in the two years preceding the survey (1998 and 1999) there were more MSEs closed than had been opened. These results would signal the existence of problems within the MSE sector which require further investigations.

In addition to the Baseline survey, other studies on performance of MSEs in Malawi and other countries have also pointed out problems such as poor access to credit, markets and raw materials, lack of capital and managerial know-how, competition from both local (bigger firms) and international companies following market liberalisation, poor government policies and insufficient institutional framework (Daniels and Ngwira, 1992; Daniels and Mead, 1998; Chirwa, 2004; Maoni, 2008). One way for MSEs to overcome such challenges is to improve technical efficiency as it would enable them to achieve higher output from currently available resources. However to date there has not been thorough research to establish the level of technical efficiency of MSEs as well as determinants of technical performance of MSEs. The studies cited above shed more light on off-farm MSEs' performance in Malawi, however, these studies have mostly focused on issues of determinants of performance in financial, employment and survival terms, and also the impact of some social economic factors such as gender on these performance measures.

In Malawi, the study of technical efficiency has focused on large scale enterprises, government enterprises and privatised enterprises and to our knowledge no study has explored this phenomenon in MSEs. This research will therefore try to reduce the gap that exists in micro and small enterprise performance literature in Malawi by focusing on technical efficiency as the main area of investigation. It will also contribute to the growing body of literature on technical efficiency of micro, small and medium enterprises in Africa.

1.4 Research Objectives

This study seeks to estimate technical efficiency of off-farm micro and small enterprises in Malawi and examine the firm specific as well as social-economic determinants of their efficiency or inefficiency. The specific objectives of the study are;

- to analyse the effect of entrepreneurs' socio-economic characteristics impact on technical efficiency of off-farm MSEs;
- to analyse the effect of enterprise characteristics on technical efficiency of off-farm MSEs.

1.5 Research Hypotheses

In order to achieve the objectives stated above, the following hypotheses will be tested:

- Entrepreneurs' social-economic factors do not influence the technical efficiency level of the off-farm MSEs;

- Enterprise characteristics do not influence the technical efficiency level of the off-farm MSEs

1.6 Organisation of the Study

Having introduced the objectives of the study and as well as its motivation in this first chapter, the rest of study is organized as follows. Chapter Two discusses the profile of Micro and Small Enterprises in Malawi, Chapter Three presents the review of both theoretical and empirical literature. Chapter Four gives a detailed description of the methodology used in the study. Chapter Five provides the estimation results and their interpretation and finally Chapter Six provides a summary to the study, its limitations and implications for policy as drawn from the results presented in Chapter Five.

CHAPTER TWO

PROFILE OF MICRO AND SMALL ENTERPRISES IN MALAWI

2.1 MSEs in Malawi[2]

MSEs in Malawi mostly consist of informal business endeavours which are started with relatively small amounts of capital outlay and they can be generally categorised as *on-farm* and *off-farm.* On-farm activities involve agricultural based activities such as crop production and fishing whilst the off-farm activities include commerce, trade and services, manufacturing and construction.

The second nationwide GEMINI Micro and Small Enterprise Baseline Survey in 2000 estimated that there were 747, 396 MSEs in Malawi with 83 percent being rural based and 74.6 percent were involved in off-farm activities. Approximately 558,000 enterprises were involved in off-farm activities. For the actual sectoral breakdown of the enterprises see Table 1 below.

Analysing MSE ownership by gender, women own 34% of the MSEs, men own 35 percent and 30 percent by married couples. The percent of women ownership is unusually low for an African country because on average women own about 75 percent of the micro and small businesses on the continent. However, with a distribution of 46% of women's enterprises in commerce and trade, and 43% in

[2] This section is mainly based on ECI and NSO (2000) - *Malawi National Gemini MSE Baseline Survey Report*

manufacturing, Malawi's sectoral distribution of women's MSEs is similar to other countries.

Table 1: Distribution of MSEs by Sector

		No. of MSEs	% of Total
Agriculture, Mining and Natural Resources	Crops	160,805	21.5
	Livestock	7,286	1
	Forestry	9,571	1.3
	Fishing	10,997	1.5
	Mining	888	0.1
	Subtotal	***189,548***	***25.4***
Manufacturing, Commerce and Services	Manufacturing	206,397	27.6
	Construction	6,475	0.9
	Commerce and Trade,Hotels	306,682	41
	Transport	4,701	0.6
	Services	33,594	4.5
	Subtotal	***557,848***	***74.6***

Source: Malawi National Gemini MSE Baseline Survey Report 2000

On the profitability front, MSEs were seen to generate an average annual gross sales value of MK 47billion (US $790 million using 2000 exchange rates), which is substantial for a relatively poor country like Malawi. They have a total annual profit of MK 16.7 billion (US $280 million using 2000 exchange rates) which amounts to about 15.6 percent of Malawi's GDP (adjusted to 2000 prices). This was a substantial contribution to the economy by a sector that does not receive much support or is largely neglected.

ECI and NSO (2000) estimated that the sector employed over 1.7 million people, of whom approximately 42 percent are women. This is a significant contribution to employment as these people get incomes which enhance their families' livelihood and they also gain work experience in the process. It was also estimated that MSE activities provide profit-based income to about 25 percent of all of the households in the country. They are significant, and critical, sources of income for both rural and urban households, with the rural households deriving more incomes from such enterprises than their urban counterparts. To illustrate this point, in small towns, rural areas, and lakeshore areas, MSEs provide between 62% and 73% of the household incomes.

The MSE sector has a lot of problems or constraints that have hampered their progress and these include: shortage of managerial capacity, lack of capital to operate the business, unavailability of public utilities such as water and electricity, high costs of inputs and public transport, government's heavy handed approach and issues with labour.

Most of these problems are to be expected to be in a MSE sector of a relatively poor country like Malawi. School attendance is very low and business support services (especially those dealing in training) are at very minimal levels such that the managerial abilities of the entrepreneurs are highly compromised. The people also have meager savings which they use as start-up capital and this is in most cases not adequate to run a sustainable enterprise. Inadequate investment in public infrastructure by government leads to the problem of low utility coverage and poor road network especially in small towns and rural areas and adversely impacts on MSEs because of high costs that prevail in the absence of the said facilities (ECI and NSO, 2002).

2.2 Institutional and Policy Framework

The focus of Malawi's development policy in the years just after attaining Independence in 1964 was on large scale agriculture and industries and thus small scale enterprises were ignored (GoM, 1970). However, since the late 1970's government has realised the importance of the MSE sector and has come up with initiatives such as support institutions in order to help the sector grow. It is however sad to note that a specific and deliberate MSE policy was not existent until 1999.

The policy aims at creating a favorable environment for the MSEs to excel and it is hosted by Ministry of Commerce and Industry under the Small and Medium Enterprises Directorate. In the policy the Small and Medium Enterprises Directorate undertakes to sensitise existing and potential small entrepreneurs on issues dealing with business start ups and management. These include such as, access to credit facilities, establishment of venture capital funds and encouraging business registration. They also work with other organizations such as the Malawi Bureau of Standards (MBS), Malawi Investment Promotion Agency (MIPA) and Malawi Revenue Authority (MRA) in sensitizing the MSE sector on product and service quality, investment options and incentives and the tax system respectively.

Government policies on procurement are also another area that needs to be reviewed in order to enhance participation of MSEs. Despite establishment of the Government Preferential Purchase Programme (GPPP) in 2000 (GoM, 2000), the scheme was never scaled up to significantly boost the sector. With time, the proposed scheme for the bulk purchase and distribution of raw materials to MSEs which was seen as a way of improving competitiveness of MSEs as well as ensuring access to raw materials has completely stopped.

In addition to the GPPP, other similar initiatives that were not scaled up or fully operationised include the Small and Medium Enterprise Support Fund and the Enterprise Development and Employment-Creation Programme (EDEP).

In 2002, the Government of Malawi launched the Malawi Poverty Reduction Strategy (MPRS) paper. The MPRS had five thematic areas and the first goal under the first theme was identifying sources of growth. Under this, the following six sub-goals were identified: agriculture, natural resources, *micro, small and medium enterprises*, manufacturing and agro-processing, tourism and small-scale mining. In 2006, Malawi started implementing the Malawi Growth and Development Strategy (MGDS) as a replacement of the MPRS. These strategies have helped in raising the profile of MSEs in Malawi's policymaking arena. However, the devotion to really develop MSEs remains low (Kambewa and Tekere, 2007).

Another recent initiative by government is the launch of the Business Unit Growth and Support (BUGS). This was launched to help small scale enterprises in their growth endeavor by providing training and financing as well as providing other business support services. Under this initiative, the Business Registration System is being automated, thus simplifying and shortening the enterprise registration process (GoM, 2008). Other initiatives undertaken by government include the One Village One Product (OVOP) scheme, Malawi Rural Development Fund (MARDEF) which are supposed to provide markets and financing especially for low level MSEs.

In 2010, the government introduced a new differentiated tax – Revenue Tax which mostly caters for small scale enterprises and it simplifies the tedious tax calculations involved in normal corporate taxation as it is just 10% of revenue (GoM, 2010). It could be argued however that this move may not have been carried out to help MSEs but rather for government to expand its tax base by capturing MSE using an easier taxation system tailored for this sector.

2.3 Business Support Organisations

In a bid to enhance the small business management skills and provide MSEs with tailored financing arrangements, government set up the Malawi Enterprise Development Institute (MEDI), Development of Malawian Enterprises Trust (DEMAT), Small Enterprise Development Organisation of Malawi (SEDOM) and Malawi Rural Finance Company (MRFC) in the 1980s and early 1990s to facilitate training and provide loans to micro and small enterprises. In the case of MEDI and DEMAT, they focus on the development of entrepreneurial and managerial skills in proprietors of MSEs. Technical Education and Vocational Training Authority (TEVETA) was also formed in the late 1990s to also offer training. SEDOM focuses on both training and provision of loans to MSEs while MRFC focuses on the provision of small business financing.

It has been noted however, that the use of business support services by MSEs is quite limited (ECI and NSO, 2001). Some of the reasons why such is the case include the fees charged by such organizations as MEDI, DEMAT and TEVETA for provision of their services as well as the lack of awareness as to the existence of these organizations and their respective services.

Other initiatives taken by government in recent years have been the finalization of the Cooperatives Societies Act and Microfinance Policy. These are expected to benefit MSEs through better regulation of Savings and Credit Cooperative Societies (SACCOs) and Microfinance Institutions (MFIs) thus curtailing member or client exploitation.

Government has also helped in fast tracking operations of several MFI to add to those who pioneered microfinance - Malawi Rural Finance Company (MRFC), Foundation for International Community Assistance (FINCA). These new entrants include Opportunity International Bank of Malawi (OIBM), Pride Africa, Microloan Foundation, Concern Universal Microfinance Organisation (CUMO) and other NGOs. Most of these institutions are privately owned and offer their services in both in rural and urban areas.

Government also established its own revolving credit fund called MARDEF to cater for the poor in rural and urban areas who wish to start or expand their enterprises. Despite such numerous providers of services, there are still some limitations in accessing such credits. Among them include the high interest rates in excess of 50 percent charged, very short period to repay installments which are due, very small amount of funds allowed to borrow at a time, and most of them are group based services.

All these concerns on policy either directly or indirectly impact on the efficiency of enterprises. There is need to reevaluate these policies in order to help MSEs become more competitive and efficient.

CHAPTER THREE

LITERATURE REVIEW

3.1 The Concept of Efficiency

One way of describing the performance of firms or production units is in terms of 'efficiency'. Efficiency analysis tries to measure how production units utilise resources in reference to the current production technology in use. It involves comparing observed output (whether in terms of number of units produced, sales volume or cost of sales) versus the maximum potential output that can be attained from given inputs. If a firm's actual output is below the maximum potential output, then the difference is regarded as an indicator of the production units' inefficiency (Debreu, 1951).

There are several forms of efficiency that are of concern to economists. These are; technical, allocative, economic and X – efficiency.

3.1.1 Technical, Allocative and Economic Efficiency

Farrell (1957) posited that the efficiency of a decision making unit (DMU) comprised of three component parts namely: technical, allocative and economic efficiencies. Technical efficiency is defined as the ability of a DMU to produce a given level of output with a minimum quantity of inputs under a certain technological regime. Allocative efficiency refers to the ability to choose optimum input levels for given factor prices. Economic efficiency which in essence is total efficiency is the product of technical and allocative efficiencies.

An economically efficient input-output combination would be on both the frontier function and the expansion path.

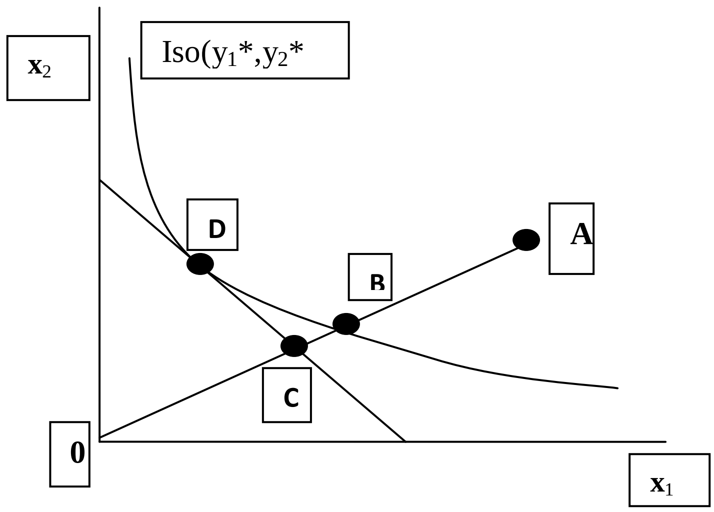

Figure 1: Allocative, Economic and Technical Efficiencies

Figure 1 above gives an illustration on these terms. In the figure point **A** is an observation along a DMU's output of a two inputs production process. At this point, the DMU utilises two input factors, x_1 and x_2 to produce a single output. Iso (y_1*,y_2*) is an efficient Isoquant estimated with a particular technology. Point **B** on the Isoquant represents an efficient observation of point **A** whilst point **C** the Isoquant represents an inefficient observation of the same. It is therefore expected that a rational firm will and should aspire to operate at point **B**, along the isoquant than at point **C** which is less efficient in terms of resource allocation.

A DMU's technical efficiency (TE) is measured by the ratio:

$$TE = \frac{OB}{OA} \tag{3.1}$$

It takes values between 0 and 1, 0 representing no efficiency at all and 1 for full efficiency. In the figure above point **B** is efficient because as stipulated in firm production theory in microeconomics, it lies both on the ray and the isoquant.

In scenarios where the input-price ratio is also known, the allocative efficiency (AE) is given by the ratio:

$$AE = \frac{OD}{OB} \tag{3.2}$$

Where, AE represents allocative efficiency. Economic efficiency (EE) then is defined by the ratio:

$$EE = \frac{OD}{OA} \tag{3.3}$$

3.1.2 X - efficiency

X-efficiency is a concept that looks at the existence of efficiency in a DMU beyond economic efficiency. Leibenstein (1966) posits that X-inefficiency arises from the fact that "neither individuals nor firms work as hard, nor do they search for information as effectively, as they could."

More simply, Berger (1993) defines X-efficiency as the ratio of the minimum costs that could have been expended to produce a given output bundle to the actual costs expended. Such an analysis allows economists to capture inefficiency that would otherwise have not been identified or its' causes just speculated. Leibenstein (1966) identifies three elements which are possible determinants of X-efficiency in a DMU namely; (i) intra-plant motivation, (ii) external motivational efficiency and (iii) nonmarket input efficiency.

3.2 Measurement of Technical Efficiency

The work on efficiency was pioneered by Farrell (1957). He defined technical efficiency as the ratio of observed output to the maximum potential output that can be attained from given inputs. This actually means that if a firm's actual output is below the maximum potential output, the shortage can be seen as an indicator of inefficiency. This interpretation may be ruled out in orthodox microeconomics which presupposes that there is no inefficiency in a competitive market but it may be inappropriate to apply Farrell's approach to developing countries where market failure is prevalent and the government deeply intervenes in the market as posited by Nikaido (2004).

Technical efficiency measurement can broadly be divided into two methodological groups: non-parametric and parametric approaches. The non-parametric approaches do not impose functional form restrictions on the production function and also do not make assumptions about the error term. Works that have used this methodology include Farrell (1957), Aigner and Chu (1968) and Richmond (1974).

An example of a non-parametric approach in technical efficiency measurement is the Data Envelopment Analysis (DEA). The DEA methodology focuses on analysing technical efficiency using a deterministic production function with parameters computed using mathematical programming techniques[3].

[3] See Coelli (1996).

Since such methods are deterministic in nature or non stochastic, all deviations from the efficient production frontier (noise and inefficiency) are captured by the error term. This however, presents a limitation in statistical inference because of the inadequate characteristic of the assumed error term which tends to make statistical inference on the parameters and resulting efficiency estimates difficult if not disputable. Secondly, the estimations of inefficiency are heavily susceptible to the influence of outliers or extreme values. Thirdly, it ignores the assumption of non-constant returns to scale and lastly, it does not consider uneconomic areas of the production function where inefficiency is not defined (Admassie and Matambalya, 2002; Coelli *et al*., 2005).

In order to deal with the weaknesses of the DEA method alluded to above, a decomposition of the error term into a stochastic component and an inefficiency measure, a Stochastic Frontier Model (SFM) was developed independently by Aigner *et al* (1977) and Meeusen and van den Broeck (1977). The stochastic frontier production function is parametric in nature, thus it places specific restrictions on the functional forms as mathematical representations of the production frontier. The SFM has been extended to handle all kinds of data sets as shown in the works of Pitt and Lee (1981), Battese and Coelli (1993, 1995), Huang and Liu (1994). Regularly, in the SFM approach the Cobb-Douglas and the *translog* production functions are employed as the mathematical representation of the production frontier.

We can model the transition of the frontier approaches from the deterministic model to the SFM as follows:

$$Y_i = f(X_i;\beta)\exp(-U_i) \qquad (3.4)$$

Consider equation (3.4) above, this is a mathematical representation of a deterministic frontier where $f(X_i;\beta)$ represents the production function for the i th enterprise or firm, Y_i is the output of the i th enterprise or firm, X_i is the vector of inputs used in the production of output Y_i, β denotes a vector of slope coefficients. U_i represents a non-negative random variation ($U_i \geq 0$) associated with firm specific inefficiency and is bounded between 0 and 1. To calculate the parameters of β, mathematical programming or statistical techniques can be employed. As discussed earlier, deterministic approaches have a fundamental weakness of combining both firm specific factors and environmental factors in their estimation of inefficiency. Thus the influences of measurement errors, bad lack, bad weather or even any statistical noise are all lumped up together with actual technical inefficiencies. This tends to overestimate the level of technical inefficiency as it ignores the fact that in the real world, the performance of a firm is from time to time affected by factors that are totally outside its control (Admassie and Matambalya, 2002).

The SFM was developed as an improvement of the deterministic frontier approach and it specifically addresses the problem of overestimation of firm technical inefficiency (or underestimation of firm technical efficiency). It thus assumes that the observed level of technical inefficiency is due in part to random events and reflecting measurement errors and statistical noise and also due to actual firm-specific inefficiencies.

The error term in this framework is decomposed into two parts; the systematic and systematically distributed component which captures the events outside of the firm's scope of control or random variations across firms. We can denote it as V_i, and

V_i is a two-sided, $-\infty < V_i < \infty$ normally distributed random term with mean 0 and variance $\sigma^2{}_V$. The other component is a one-sided non negative term as in the deterministic frontier ($U_i \geq 0$) which captures the firm-specific technical inefficiency of the ith enterprise or firm relative to the estimated stochastic function.

Assuming we have i =1,2,3,....,N where N is the number of production units of enterprises, the SFM production function for the ith enterprise or firm can be expressed as

$$Y_i = f(X_i, \beta)\exp\varepsilon_i \tag{3.5}$$

Where $f(X_i;\beta)$ represents the production function for the ith enterprise or firm, Y_i is the output of the ith enterprise or firm, X_i is the vector of inputs used in the production of output Y_i, β denotes a vector of parameters to be estimated. In the model above the possible production Y_i is bounded from above by the stochastic quantity $f(X_i;\beta)\exp\varepsilon$. The error term ε is stochastic in nature composed of the two independent error terms V_i and U_i. Therefore, we can write this error term as:

$$\varepsilon_i = V_i - U_i \tag{3.6}$$

Where V_i is a two-sided normally distributed random term $-\infty < V < \infty$ with mean 0 and variance $\sigma^2{}_V$ and U_i is a one-sided non negative term as in the deterministic frontier ($U_i \geq 0$) which captures the firm-specific technical inefficiency of the ith enterprise or firm relative to the estimated stochastic function. It should be noted that V_i measures the variation in output from the maximum value realisable given the stochastic frontier $f(X_i\beta)+V_i$. On the other hand, U_i is assumed to be independently and identically distributed and has been hypothesised to assume the following distribution: half-normal with mean zero and variance σ^2_u, (Aigner *et al,* 1977), exponential $u_i \sim iid$ Exponential (Meeusen and van den Broeck, 1977), truncated at zero of normal distribution with mean μ and variance σ^2_u (Stevenson, 1980) and gamma distribution (Greene, 1982). However, many studies assume U_i to be distributed in half-normal and truncated-normal fashion. The two error terms V_i and U_i are assumed to be independently distributed of each other and explanatory variables.

Maximum likelihood estimation techniques can then be applied on equation 2 above, to get estimators for β, σ^2 and λ. Note that $\sigma^2 = \sigma^2_V + \sigma^2_U$ and $\lambda = \sigma_U / \sigma_V$. Aigner *et al* (1977) provided the means of calculating the maximum likelihood estimators as follows:

$$\ln L(y \mid \beta, \lambda, \sigma^2) = N \ln \frac{\sqrt{2}}{\sqrt{\Pi}} + \ln \sigma^{-1} + \sum_{i=1}^{N} \ln[1 - F^*(\varepsilon_i \lambda \sigma^{-1})] - \frac{1}{2\sigma^2} \sum_{i=1}^{N} \varepsilon_i^2 \quad (3.7)$$

The measure of technical inefficiency will then follow Jondrow *et al* (1982) specification for the half-normal and truncated (at zero) case and will be

$$E(U_i / \varepsilon_i) = \frac{\sigma_\mu . \sigma_v}{\sigma} . \left(\frac{f(\varepsilon_j \lambda / \sigma)}{1 - F(\varepsilon_i \lambda / \sigma)} - \frac{\varepsilon_i \lambda}{\sigma} \right) \quad (3.8)$$

Where $\lambda = \sigma_U / \sigma_V$, $\sigma^2 = \sigma^2_V + \sigma^2_U$ while $f(.)$ and $F(.)$ are the standard normal density and cumulative distribution function respectively evaluated at $\varepsilon \lambda/\sigma$. The second point estimator for u, the mode of the conditional distribution, is the minimum of μ_* and zero, which can be written as

$$M(u \mid \varepsilon) = -\varepsilon(\sigma_u^2 / \sigma^2) \quad \text{if} \quad \varepsilon \le 0$$

$$M(u \mid \varepsilon) = 0 \quad \text{if} \quad \varepsilon > 0 \tag{3.9}$$

The mode $M(u \mid \varepsilon)$ can be given an appealing interpretation as a maximum likelihood estimator; it can be derived by maximizing the joint density of u and v with respect to u and v, subject to the constraint that $v - u = \varepsilon$. Also note that the expressions in (3.5) and (3.6) are nonnegative, and monotonic in ε. Also, the more general truncated normal distribution yields similar results (Jondrow *et al*, 1982).

We define enterprise-specific technical efficiency as the ratio of observed output Y_i, to the corresponding frontier output Y_i^* using the available technology derived from the result of the equation (3.5) above as:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{E(Y_i / \mu_i, X_i)}{E(Y_i / \mu_i = 0, X_i)} = E\left[\exp(-U_i) / \varepsilon_i\right] \tag{3.10}$$

In this framework, TE takes values within the interval [0, 1]. Where 0 indicates a totally inefficient enterprise and 1 is for an enterprise which is fully efficient. This therefore means that technical inefficiency of enterprise i is given by $1 - TE_i$.

3.3 Empirical Research on Technical Efficiency of MSEs using the Stochastic Frontier Approach

There have been different studies that have looked at efficiency of small scale enterprises. These works have focused on analysis of both allocative and technical efficiency of non-farm enterprises using the stochastic frontier methodology but emphasis will be placed on the technical efficiency part which is our concern in this study.

Mengistae (1995) analysed the link between age-size effects in firm growth and the underlying distribution of firms by technical efficiency in Ethiopia applying the two-step estimation procedure on panel data set that was unbalanced. It observed that, the age-size effects detected in the growth of firms are matched by time-invariant inter-firm differences in technical efficiency. There were also age-size effects in efficiency that is bigger firms are more efficient given age, and older firms are more efficient given size. Thirdly, owner human capital and location variables significantly affected efficiency scores. Human capital variables considered included level of formal education and experience. Social capital captured by proprietor's access to business networks and ethnicity also had significant effects on the enterprise technical efficiency. However, this research used methodology that does not control for the biases alluded to by Battese and Coelli (1995).

In Tanzania, a study on the technical efficiency of small and medium enterprises showed that technical inefficiencies exist whilst employing the one-step estimation procedure of Battese and Coelli (1995) on cross-sectional survey data. It was observed that on average the firms were operating at 50 percent of their potential which is not impressive at all. The study showed that technical efficiency is significantly impacted by human capital attributes of management and employees, location advantages arising from different knowledge levels which vary with geographical location. It was also seen that firm age has a positive bearing on the technical efficiency of the firm and it is argued that this is so because the enterprises get better as they learn from doing and adopt new technology which was proxied by the use of ICT related services. This also leads to another supposition that over time, inefficient firms fall out of business while those that have been increasing their knowledge stock become efficient and thus prosper. They also carried out an inter-industry comparison of levels of technical efficiency. Three industries were analysed; Tourism, Textile and Tourism (Admassie and Matambalya, 2002). It was noted that textile was the most technically efficient with a mean level of 71 percent whilst the other two industries were each at 47 percent. It can be argued that such inter-industry comparison was made easily possible because of the few industries (only three) that were surveyed and the small sample size (95) which in a way makes it easier to control for firm variations within industries.

Ajibefun and Daramola (2003) used the one-step SFM approach on cross-sectional data to analyse the economic efficiency of Nigerian micro enterprises engaged block-making, metal fabricating and sawmilling enterprises. This study revealed that the entrepreneurs' age, level of education, business experience, number of employees as well as the level of investment are all significant determinants of technical efficiency and economic efficiency. Age, it was argued, has a negative impact on technical efficiency because there is a diminishing effect as the entrepreneur grows. The rest of the variables were seen to have a positive influence on technical efficiency of micro enterprises.

Fonsoranti *et al* (2006) also employed the one-step SFM approach to investigate the impact of micro-credit and training on the technical efficiency of a cross-section of small scale entrepreneurs who were engaged in baking, furniture making, and burnt-brick making. It was observed that credit access, business experience, training experience, working capital and initial capital outlay significantly exert a positive effect on technical efficiency of small scale enterprises while age of the owner has a negative impact on technical efficiency.

However, Admassie and Matambalya (2002), Ajibefun and Daramola (2003) and Fansoranti *et al* (2006) all carried out their analysis using an efficiency analysis software package Frontier 4.1., which can only run an inefficiency model if the inefficiency effects follow a truncated normal distribution otherwise it does not give any results.

This is a problem because they had to first of all ensure that their data conformed with this requirement which makes their analysis somewhat biased since they cannot analyse for any other form of distribution for the inefficiency term.

Nikaido (2004) analysed the technical efficiency of small-scale industries in India using the two-step stochastic frontier approach. In his paper the relationship between the measured technical efficiency and firm size and location was explored. He used a stochastic frontier model that measured output per worker to capture firm size effects. The results revealed that on average the small scale industries were operating at 80 per cent of the potential maximum potential, although diversification among industry groups was observed. It was also seen that agglomeration of firms had a positive effect on technical efficiency, while the firm size has a negative effect on it. The source of technical efficiency explored was the Location Quotient (LQ) which was used to capture the effect of cluster location of industries on technical efficiency. Locating in such clusters had advantages of accelerating skills (knowledge) transfer and lowering input costs leading to further improvement in returns to scale.

However, Nikaido (2004) cautions that the agglomeration of firms engaged in similar related activities makes them vulnerable to exogenous shift in production as well as technology and the problem will be further exacerbated in cases where such clusters are isolated or distant from markets.

The weakness with Nikaido (2004), is that a two-step estimation procedure was used yet it does not cater for the possible biases which may arise at the second stage of analysis as posited by Battese and Coelli (1995).

Vijay and Wisdom (2002) assessed the impact of micro finance operators on the technical efficiency of microenterprises. They put forward an argument that technical efficiency is influenced by human capital variables which determine or contribute to the decision-making process of micro-entrepreneurs; hairdressers, dressmakers and wood processors in Cape Coast, Ghana. These variables include level of education, business experience, and entrepreneurs' age. They also reported that social-economic as well as institutional variables that could influence an entrepreneurs' ability to implement their decisions at the enterprise level without impediments affect the level of technical efficiency. These social-economic variables include loan interest, loan size, level of contact with the lender and competition amongst enterprises whilst training programmes and experience available to entrepreneurs and their employees with other developmental initiatives constitute institutional variables. It is therefore necessary to analyse the impact of these factors in order to formulate well informed policies on various initiatives meant to improve productivity of MSEs.

From the foregoing, we see that analysis of technical efficiency of off-farm MSEs helps us understand and empirically test various theoretical underpinnings on how technical efficiency of such enterprises is influenced by the various owner/firm-specific as well as environmental factors. It also helps policy makers appreciate the dynamics of small enterprise efficiency thus giving them more insight for the formulation of better interventions for the sector.

CHAPTER FOUR

METHODOLOGY

4.1 Analytical Framework

This study is employing a stochastic production frontier model to analyse the technical efficiency of the firms as outlined by Aigner *et al (1977)* and Meeusen and Van den Broeck (1977).

We use the formulations of the stochastic frontier model discussed in section 3.2 above. We express the stochastic frontier model as

$$Y_i = f(X_i, \beta)\exp\varepsilon_i \qquad (4.1)$$

$$\varepsilon_i = v_i - u_i \qquad (4.2)$$

Substituting equation (4.2) in equation (4.1) and then writing the new equation in logarithm form presents

$$\ln Y_i = \alpha + \beta' x_i + v_i - u_i \qquad (4.3)$$

In equation (4.2) , V_i is a two-sided normally distributed random term $-\infty < V < \infty$ with mean 0 and variance $\sigma^2{}_V$ and U_i is a one-sided non negative term as in the deterministic frontier $(U_i \geq 0)$ which captures the firm-specific technical inefficiency of the i th enterprise or firm relative to the estimated stochastic function. V_i measures the variation in output from the maximum value realisable given the stochastic frontier $f(X_i\beta)+V_i$. On the other hand, U_i is assumed to be independently and identically distributed in a half-normal manner with mean zero (0) and variance $\sigma^2{}_u$. The two error terms V_i and U_i are assumed to be independently distributed of each other and explanatory variables captured in X_i.

In equation (4.1), enterprise i faces an individual stochastic frontier

$$Y_i = f(X_i,\beta)\exp v_i \tag{4.4}$$

in which the deterministic part $Y_i = f(X_i,\beta)$ is common for all enterprises. Technical efficiency can therefore be given by

$$TE_i = \frac{f(X_i,\beta)\exp(v_i - u_i)}{f(X_i,\beta)\exp(v_i)} = \exp(-u_i) \tag{4.5}$$

This means that technical efficiency for enterprise i will be between 0 and 1 i.e. $0 < TE_i \leq 1$.

The maximum value of Y_i is $f(X_i,\beta)\exp v_i$ and the best technical efficiency measure $TE_i = 1$ is only achievable $u_i = 0$. In all other circumstances, will not be equal to zero and thus there is observed output shortfall from the maximum potential output.

Maximum Likelihood (ML) estimation method will be applied on equation (4.3) in order to estimate potential output. Then firm specific measures will be calculated using the approach in Jondrow *et al* (1982) as they present the point estimator of u_i, thus $E[u_i \mid \varepsilon_i]$, given $\varepsilon_i = \ln Y_i - (\alpha + \beta' x_i) = v_i - u_i$.

Using the econometric analysis software STATA 11 the stochastic frontier model that includes estimates of the standard deviations of the two error components v and u will be estimated. The analysis in this software uses the one-step procedure proposed by Battese and Coelli (1995). The estimation output given by STATA includes the log likelihood estimate of the total error variance, $\sigma_s^2 = \sigma_v^2 + \sigma_u^2$, and the estimate of the ratio of the standard deviation of the inefficiency component to the standard deviation of the idiosyncratic component, $\gamma = \sigma^2 / \sigma_s^2$ which measures the magnitude of the variance associated with inefficiency effects.

The generalised likelihood ratio test is employed to test several hypotheses in the analysis of technical efficiency. In equation (4.6) below is the presentation of this likelihood ratio test.

$$\lambda = -2[Log(H_0) - Log(H_1)] \qquad (4.6)$$

This test is used to ascertain the validity of assumptions given that there is a restricted frontier model as specified by the null hypothesis H_0 and alternative hypothesis H_1. H_0 and H_1 are log likelihood values produced by the estimations under the null and alternative hypothesis respectively. The test statistic λ has a Chi-square or a mixed Chi-square distribution with degrees of freedom which are comprised of the difference between parameters involved in the null and alternative hypotheses.

The computed test statistic is then compared to the critical values from Table 2 of Kodde & Palm Table (1986), at the chosen level of significance and corresponding degrees of freedom (DF). The degrees of freedom are equal to the difference between the parameters estimated in the restricted and unrestricted model.

4.2 Sources of Technical Inefficiency

After analysing the technical efficiency level of enterprises, identity of the sources of inefficiencies is paramount if the analysis is to offer any meaningful insights. Literature on enterprise-level technical efficiency provides two approaches of carrying out this analysis. The first one involves a two–stage estimation procedure. Firstly, the stochastic frontier is estimated whence from is derived the technical efficiency indices. In the second stage, technical efficiency indices are regressed on explanatory variables using either Tobit regression or ordinary least squares[4]. This methodology has been criticised by some researchers such as Battese et al (1989) and Battese and Coelli (1995) who argue that enterprise-specific factors may directly influence technical efficiency and thus justifies the need to directly incorporate these variables into the stochastic frontier model.

To deal with the shortfalls of the two-stage estimation procedure, a one-stage simultaneous estimation of the stochastic production function and efficiency scores was developed[5]. We therefore model the technical inefficiency effects following Battese and Coelli (1995) by expressing U_i as a function of a host of the enterprise and owner specific characteristics. Thus we define technical inefficiency effects as

$$u_i = \delta_0 + \sum \delta_i z_i + w_i \qquad (4.7)$$

Where Z_i is a (1*M) vector of explanatory variables associated with technical efficiency effects; δ is a (M*1) vector of unknown parameters to be estimated; and w_i

---

[4] See Nikaido (2004) and Timmer (1971) for an application of the two-stage estimation procedure respectively employing the Tobit regression and ordinary least squares in the second stage.

[5] See Battese and Coelli (1995) for a discussion on the one-stage simultaneous procedure.

capture the unobservable random variables which are assumed to be independently and identically distributed and U_i is non negative.

4.3 Model Specification and Variable Definition

This section will discuss the specification of the model to be used in analysis of technical effciency of MSEs as well as offer a difinition of the variables included in the model.

4.3.1 Model Specification and Variable Definition for the production function

Following the analytical framework discussed above, we will employ a stochastic frontier model that allows for the decomposition of the error term into the enterprise specific and the random (environmental) effects in the estimation of the technical efficiency for the enterprise.

The production frontier is defined in a way that incorporates the factors that impede that enterprise from achieving its optimal level of efficiency as suggested by Battese and Coelli (1995) and thus fully takes advantage of the good features of a stochastic production function as discussed in section 3.2.

The efficacy of both the Cobb-Douglas production function and the transcendental logarithmic (*translog*) production function is tested to find out which functional form better fits the data. The better model is chosen basing on the results of the likelihood ratio test performed on the estimates of the two models. The model that will be found to fit the data used in this research better will be adopted.

Therefore, the functional forms that are considered for possible adoption in this study are the Cobb-Douglas production function and the *translog* production[6] function specified below in equation (4.8) and (4.9) respectively:

$$\ln Y_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \varepsilon_i \tag{4.8}$$

$$\ln Y_i = \beta_0 + \sum_{i=1}^{n} \beta_i X_i + \frac{1}{2}\sum_{j\leq 1}^{3}\sum_{i=1}^{3} \beta_{jk} \ln(X_{ij}) \ln(X_{ij}) + \varepsilon_i \tag{4.9}$$

$$\varepsilon_i = v_i - u_i \tag{4.10}$$

In equation (4.8) and (4.9) above, subscript i denotes the i th enterprise and *ln* represents the natural logarithm employed to linearise the production function.

β_i and β_{jk} are parameters to be estimated. Y_i is the observed output annual sales expressed in Malawi Kwacha.

x_1 represents the capital used to start the business venture (expressed in Malawi Kwacha specifically at 2000 constant prices[7]). x_2 represents the labour input (expressed in man-hours), x_3 represents the value of material inputs or supplies and their associated costs such as transportation (expressed in Malawi Kwacha) and ε_i is a decomposable error term that contains v_i and u_i as defined in equation (4.3) above.

In order to come up with figures for material inputs we have used the method of Chirwa (2004), which was used to calculate profit figures for the data. Since the

---

[6] The number of interaction terms is determined by using the formula **r**= **t** (**t**-1)/2, where **r** is number of interaction terms and **t** is the number of factors of production.

[7] A series of CPI numbers used to deflate the capital figures is presented in Appendix 1. Ideally this capital inputs is represented as a flow variable such as current book value of assets or depreciation but we do not have that option in our data hence the use of initial capital outlay figures.

survey data collected this data with reference to the previous week and therefore we assumed that the weekly ratio of material input to sales remained the same over the year. This assumption then allows us to use monthly information on sales level (high, average and low sales) to compute the monthly sales average. These figures were then used to derive the corresponding material input values[8].

The V_i is assumed to be independently and identically distributed as a normal random variable with mean zero and variance σ^2_V and independent of u_i. As alluded to in the preceding discussion, u_i captures non-negative technical inefficiency effects, assumed to be independently distributed. u_i is thus obtained by a normal distribution with mean zero and variance σ^2_u.

4.3.2 Model Specification and Variable Definition for the inefficiency model

Following in the fashion of Battese and Coelli (1995) we define the technical inefficiency model as follows:

$$u_i = \delta_0 + \delta_1 NBUS + \delta_2 OWNERAGE + \delta_3 OWNERAGE\ sq + \delta_4 BUSAGE + \delta_5 BUSAGEsq + \delta_6 BUSASSOC + \delta_7 CREDIT + \delta_8 CPRIMARY + \delta_9 ABOVEJCE + \delta_{10} BUSTRAIN + \delta_{11} MALE + \delta_{12} FEMALE + \delta_{13} URBAN + \delta_{14} RURAL + \delta_{15} LAKESHORE + w_i \quad (4.10)$$

The number of businesses that an entrepreneur manages is said to also influence the efficiency level of the enterprises. NBUS captures the number of enterprises that

[8] See ECI & NSO (2000) for a detailed presentation on the method used to calculate sales.

are owned by the entrepreneurs understudy. It is expected that the sign of δ_1 will be positive, indicating the inverse relationship between number of businesses and efficiency postulated.

OWNERAGE representing the age of the entrepreneur is an important factor of efficiency for enterprises because in it is encapsulated maturity which is associated with good decisions. On the inverse, young entrepreneurs are considered to be more risk-loving and thus we would expect enterprise-level efficiency to decline with increasing proprietor age. As such, either a positive or negative sign for δ_2 is expected.

We also consider OWNERAGESQ. Squaring the age gives us a measure of diminishing efficiency as the entrepreneur becomes older (moves away from the prime years). As the entrepreneur grows in age, it is expected that efficiency will be improving but at decreasing rate. The parameter δ_3 is therefore expected to be positive.

BUSAGE measures the length of time in years that the business has been in operation. This is used as a proxy for business experience in this study. δ_4 is expected to have a negative sign because experience should ideally lead to more knowledge about ways of minimizing production costs and wastage while maximising output.

BUSAGESQ captures the diminishing efficiency effects of experience. It is argued that the longer a firm stays in business past its “teething” stage the more inefficient the firm becomes. It is said that the level of learning and innovation declines because the owners or managers are happy with the returns and thus render the operation inefficient and it is anticipated that δ_5 will have a positive sign.

BUSASSOC is a dummy variable that captures membership to a business association. It is argued that such associations serve as a hub where knowledge about best practices as well as new technology is shared. It takes on the value 1 if the entrepreneur is a member to any such association and 0 otherwise. It is expected that enterprises whose owners are members of business associations will be more technically efficient than the ones that do not belong to business associations. It is expected that δ_6 will be negative.

Access to credit has also been argued to influence firm performance. In our case the variable CREDIT is a dummy (1,0) capturing whether the entrepreneur has access to credit or not. It emanates from the response to the question of whether the entrepreneur borrowed the whole or part of his or her capital. It is also anticipated that access to credit will have a positive influence on technical efficiency and thus, the parameter δ_7 is expected to be negative.

Education is considered a major determinant of efficiency. It is argued that the more education a proprietor acquires the higher the ability to produce higher output using the available inputs. In this study this variable is captured by three (3) dummies namely; SPRIMARY, CPRIMARY, ABOVEJCE. SPRIMARY represents proprietors who only did some part of primary but did not complete primary school. In this data set, all proprietors were at least exposed to some primary schooling. CPRIMARY represents those who completed primary school but did not qualify for the Junior Certificate Examination certification in secondary school. ABOVEJCE represents those proprietors that have a secondary school education level of Junior Certificate of Education (JCE) or higher. This includes, completion of secondary school (thus attainment of the Malawi School Certificate of Education-MSCE) and those who hold any other post secondary level academic qualification such a University Diploma and vocational education qualifications. The base variable in this category is SPRIMARY.

It is argued that the more education a proprietor acquires the higher the ability to produce higher output using the available inputs. The other side to the entrepreneur's education argument is that if people get more education especially reaching tertiary levels they tend to concentrate more on other activities rather than running micro and small businesses. It is therefore expected that all coefficients capturing the impact of proprietor's level of education on technical efficiency (δ_8 and δ_9) will be negative. This comes from the fact that it is expected that all the higher achievement levels should help a proprietor be a better performer relative to the one who only attended some part of primary school.

Business training (BUSTRAIN) is also seen as an important factor in explaining the technical efficiency of micro and small enterprises. The argument is that those who have undergone some form of business training whether formal or informal are better performers than those who have never had any training in this regard. This variable is a dummy that captures whether entrepreneurs have ever undergone some form of business training whether through family experiences, underwent an apprenticeship or some special training programme as well as those that were self-taught in running a business. The dummy captures those who have undergone business training as 1 and zero otherwise.

It is expected that the coefficient δ_{10} will have a negative sign because it is expected that those with some entrepreneurial or business knowledge should perform better than those without such knowledge.

The differences in enterprise performance with respect to the gender of proprietors, has over the years received a lot of attention especially in studies involving micro and small enterprises. Female owned enterprises are seen as underperforming when compared to their male owned counterparts. Proprietor's gender component is represented by three dummy variables; FEMALE representing female-owned enterprises, MALE representing male-owned enterprises and MIXEDOWNED representing mixed ownership (both male and female owners). We define mixed ownership as the base category and there is an *a priori* expectation of a positive relationship for the male-owned enterprise and a negative one for the female owned enterprise relative to the base variable. Thus we expect δ_{11} to have negative sign whilst δ_{12} to have a positive one.

The last explanatory variable in the inefficiency model captures the impact of location of technical efficiency. Location, it is argued matters in the performance of firms because of knowledge transfer and competition. Certain locations make exchange of information especially that concerning business operations and best practice easier than others. Other locations also influence on performance of enterprises because there is higher level of competition hence enterprises that do not perform well easily go out of business. In the Malawian context, urban areas are expected to be knowledge hubs and highly competitive locations for micro and small enterprises.

From the GEMINI Baseline survey classification[9], location is divided into seven areas. These are: Urban High Income areas, Urban Low Income areas, Urban Commercial areas, Urban Industrial areas, Small Towns (SMALLTOWN), Rural

[9] Check the GEMINI Baseline Survey (2000) Report for a detailed explanation on the location classification.

Areas (RURAL) and Lake Shore (LAKESHORE) areas. It is postulated that such a location classification is necessary because the different areas have got different conditions and thus may uniquely influence business performance. However in this study, we have combined all the urban strata to form one category Urban Area (URBAN).

We set small town (SMALLTOWN) as the base for this category and we expect that firms located in the urban area (URBAN) to perform well because there is a big market, high knowledge transfer and stiff competition. Thus coefficient δ_{13} is expected to have a negative sign. On the other hand we expect enterprises located in lakeshore areas (LAKESHORE) (away from lakeshore towns such as Mangochi, Salima, Nkhotakota, Nkhata-bay and Karonga) and rural areas (RURAL) to perform worse off compared to those in small towns. We therefore expect coefficients δ_{14} and δ_{15} to be positive.

Other factors that may influence the level of efficiency for micro and small enterprises such as ethnicity of entrepreneur, distance between the business location and place of residence, religion and many others not explicitly included in this model are assumed to be captured by the error term, ω_i .

Table 2 below, presents a summary of the foregoing discussion of the inefficiency model, its coefficients and the expected sign of the coefficient. It is important to note that the expected signs of the coefficients have been stated with reference to technical efficiency and thus the opposite applies for technical inefficiency application.

Table 2: Summary of Technical Inefficiency Model

VARIABLE NAME	COEFFICIENT	EXPECTED SIGN
Intercept	δ_0	Positive (+)/ Negative(-)
NBUS (Number of Enterprises owned)	δ_1	Positive (+)
OWNERAGE (Age of Proprietor)	δ_2	Positive (+)/ Negative(-)
$OWNERAGE^2$ (Square of proprietor's age)	δ_3	Positive (+)
BUSAGE (Length of time enterprise has been in operation)	δ_4	Negative (-)
$BUSAGE^2$(Square of business age)	δ_5	Positive (+)
BUSASSOC (membership in business association)	δ_6	Negative (-)
CREDIT (access to credit)	δ_7	Negative (-)
CPRIMARY (completed primary school education)	δ_8	Negative (-)
ABOVEJCE (have got a qualification of JCE or higher)	δ_9	Negative (-)
BUSTRAIN (Business Training)	δ_{10}	Negative (-)
MALE (Male-owned enterprise)	δ_{11}	Negative (-)
FEMALE (Female-owned enterprise)	δ_{12}	Positive (+)
URBAN(Urban Area Location)	δ_{13}	Negative (-)
RURAL (Rural Area)	δ_{14}	Positive (+)
LAKESHORE (Lake Shore Area)	δ_{15}	Positive (+)

4.4 Data Analysis

The data will be analysed following the one-step estimation procedure advocated by Battese and Coelli (1995). This method will involve simultaneously estimating of the frontier production function and the inefficiency model to establish the existence of technical inefficiency, predicting efficiency scores and analysing the determinants of technical efficiency for micro and small enterprises This analysis will provide the estimates of $\beta, \sigma_s^2 = \sigma_v^2 - \sigma_u^2$, $\lambda = \sigma_u{}^2 / \sigma_v^2$ through econometric analysis software program STATA (version 11.2).

In coming up with the maximum likelihood estimates, STATA maximizes the log-likelihood function of a stochastic frontier model by using the Newton–Raphson iterative method, and the estimated variance–covariance matrix is calculated as the inverse of the negative Hessian (matrix of second partial derivatives). This method offers estimates that are slightly different yet asymptotically the same with other programs which also estimate stochastic production functions most commonly, FRONTIER 4.1 which uses the Davidson-Fletcher-Powell (DFP) iterative procedure in coming up with maximum likelihood estimates (StataCorp., 2009).

4.5 Diagnostic Tests

4.5.1 Tests on Model Specification and Functional Form

In econometric analysis, various tests are carried out to verify the assumptions made about the data and model specification so that results and conclusions are credible. Since the method of estimation used in the derivation of the stochastic production function and efficiency scores is maximum likelihood, we will employ the Generalised Log-likelihood Ratio Test to ascertain several assumptions made about the data and to also decide which functional form best fits the data.

We alluded earlier that both functional forms (equation 4.8 and 4.9) of the Stochastic Frontier Model are permissible to be used for the analysis of the data. A log-likelihood ratio (LR) test will be carried out to test the hypotheses that the simple CD functional form is nested in or better than the more complicated *translog* production model.

The assumed distributions of the error terms also show to have different effects on the spread technical efficiency differentials estimated. The LR test will also be used to ascertain which distribution is better and efficiently captures the technical efficiency. As indicated above there are four major distributions of the non-negative error term namely: The half-normal distribution, truncated-normal distribution, exponential distribution and the gamma distribution.

In this thesis we will test for three distributions for the non negative error term: the half-normal, truncated normal and exponential distribution as per analysis software capability.

4.5.2 Tests on Technical Efficiency Effects, Input Variables and Determinants of Inefficiency

Other assumptions made about the data include that there are technical inefficiency effects, the enterprise and owner specific characteristics influence the technical efficiency scores and that the linear input variables are jointly not equal to zero. These hypotheses will be tested using the generalised log-likelihood ratio test described in equation (4.6). The results of these tests and other analysis are presented in the next chapter.

CHAPTER FIVE

ECONOMETRIC ESTIMATION AND DISCUSSION OF RESULTS

5.1 Summary Statistics

Summary statistics of the variables of importance in this study are presented in Table 3 below. A total usable sample of 2,231 off-farm enterprises was analysed in this study. Output in terms of volume of annual sales (ASALES) averaged MK1,021,745, with a minimum of MK3,900 and maximum of MK5,174,400. The average capital input (CAPITAL) was MK72,607.84, with the minimum of MK5.63 and maximum of MK33,500,000. Labour input (LAB) measured in man-hours ranged from 2 hours to 3240 hours with a mean value of 204 hours. The value of material input averaged MK17,169.44 with a minimum value of MK6.00 and a maximum value of MK4,064,418.70.

Number of enterprises owned by proprietor (NBUS) ranged from 1 to 5 and the average was 1.16 which tells us that the majority of entrepreneurs have got just one business undertaking. The average age of enterprises (BUSAGE) was 6 years (72months) and this period of operation ranged from 0.083years (1 month) with the longest operating period of 30years (360months). On the other hand, the average age of an entrepreneur (OWNERAGE) was 32.5years with a minimum of 13years and maximum of 78years.

Table 3: Summary Statistics for the variables used in the production function and technical inefficiency model

Variable	Obs	Mean	Std. Dev.	Min	Max
Production Function					
SALES	2231	1,021,745	1,090,151	3,900	5,174,400
CAPITAL	2231	72,607.84	1,038,547	5.63	33,500,000
LABOUR	2231	204	181.80	2	3,240.0
MATERIALS	2231	17,169.44	26,318	6	406,418.70
Inefficiency Model					
NBUS	2231	1.16	0.43	1	5
OWNERAGE	2231	32.52	10.41	13	78
OWNERAGEsq	2231	1,165.73	796.5501	169	6,084
BUSAGE	2231	6.03	6.02	0	30
BUSAGEsq	2231	72.58	149.27	0	900
BUSASSOC	2231	0.02	0.15	0	1
CREDIT	2231	0.08	0.27	0	1
SPRIMARY	2231	0.58	0.49	0	1
CPRIMARY	2231	0.25	0.43	0	1
ABOVEJCE	2231	0.17	0.38	0	1
BUSTRAIN	2231	0.27	0.45	0	1
MIXEDOWNED	2231	0.16	.36	0	1
MALE	2231	0.35	0.48	0	1
FEMALE	2231	0.50	0.50	0	1
URBAN	2231	0.56	0.50	0	1
SMALLTOWN	2231	0.22	0.42	0	1
RURAL	2231	0.17	0.38	0	1
LAKESHORE	2231	0.05	0.20	0	1

Source: Authors' computation.

5.2 Results of various diagnostic tests

As discussed in the later part of chapter four, there were several tests carried out to ascertain the validity of assumptions made in this study about the data and expected results.

5.2.1 Test on model specification and functional Form

The results of the diagnostic tests carried out on the data are presented in Table 4 below, namely: tests on the functional form, existence of technical efficiency effects, distribution of the non-negative error term and the joint significance of the technical inefficiency factors.

Table 4. Log-likelihood tests of models

H_o	Null Hypothesis	Critical value	Λ	DF	P-Value	Conclusion
H_0:β_{jk}=0	CD form is correct Frontier formulation	11.911	**96.03**	6	<0.01	**Reject H_0**
H_0: Sigma_u = 0	Technical inefficiency effects are nonexistent	25.69	**131.21**	16	<0.01	**Reject H_0**
H_0: u_i half-normally distributed	Non-negative error term is half-normal	16.27	**11.59**	9	<0.01	**Fail to Reject H_0**
H_0:δ_j=0;j=1,…15	Technical inefficiency factors are not jointly significant	24.38	**72.68**	15	<0.01	**Reject H_0**

Note: Λ – LR Test Statistic; DF – Degrees of Freedom; Critical Value – from Table A1, Kodde & Palm (1986) at 5% level of significance

The two possible functional forms were tested and the log likelihood ratio (LR) test was employed for this test as was alluded to earlier in the methodology section. We compared the CD production function against the TL production function in order to find out which one better describes the data. The results of this test (H_0:β_{jk}=0) are presented in Table 4. This test yielded a statistic of 96.03 with 6 degrees of freedom and was significant at the level of 5 percent leading to the rejection of the null hypothesis. This indicates that the CD production function was not a good enough representation of the data. We therefore went on to estimate the TRANSLOG production function in this study.

5.2.2 Test on distribution of the non-negative error term u_i

We explained in the methodology section that in this thesis we assume that the non-negative error term u_i is either normally distributed with mean zero and constant variance or it may be exponentially distributed. We also utilised the LR test to determine the distributional form of u_i. In the Table above the results for this LR test (H_0: u_i half-normally distributed) indicate that a statistic of 11.59 was obtained against a critical value of 16.27 at 9 degrees of freedom for a significance level of 5 percent. This result led us to fail to reject the null hypothesis that u_i is half-normally distributed and we thus went on to estimate an inefficiency model that assumed u_i to be half-normally distributed[10].

5.2.3 Test on existence of the technical inefficiency effects

After testing for the correct functional form and the distribution of the non-negative error term u_i, we tested for the existence of technical efficiency effects. This test yielded a statistic of 131.44 which is significant at the 5 percent level with 16 degrees of freedom. This therefore indicates that technical inefficiency effects are present and thus estimating the average response function through ordinary least squares (OLS) techniques would be an inadequate representation of the data since it assumes that the enterprises are technically efficient.

[10] An attempt to find out whether u_i follows a truncated-normal distribution was made but the MLE frontier model did not converge. We then went ahead to test for the two forms; half-normal and exponential.

5.2.4 Test on the joint significance of technical inefficiency effects

We also tested whether the technical inefficiency effects except the intercept are all equal to zero. This test yielded a statistic of 77.62 which is significant at the 5 percent level, with 15 degrees of freedom. In such a case the null hypothesis was rejected thus, we concluded that the technical efficiency effects are jointly significant.

5.3 Results of the econometric model

This section presents the results and interpretation of the estimated *translog* production function for the micro and small enterprises. These results are for both the stochastic frontier production function as well as the inefficiency model described in section 4.3.

5.3.1 The Estimated Stochastic Frontier Production Function

Table 5 below presents these results as estimated using statistical computer program STATA 11.2. The results are categorised into estimates of parameters for the ordinary least squares (OLS) and maximum-likelihood estimation (MLE) methods of the *translog* production functions.

If there was no technical efficiency effects the coefficients of the *translog* production frontier model estimated through the MLE technique should have been the same as those estimated through OLS technique. This serves to reinforce the tests in section 5.2.2 which proved that there is the existence of technical inefficiency effects.

It should be noted that because of the composite nature (square and interaction terms included) of the production function estimated, the z-scores can not be used to test the statistical significance of the factor inputs. We then made use of the log-likelihood ratio test to ascertain the statistical significance of the factor inputs.

It should be noted that other studies point out the fact that the interpretation of the individual parameters of the *translog* production function may not offer very meaningful insights about the nature of the production practices of the economic agents under investigation (Kim, 1992). However, Vestergaad *et al* (2002) argued that the interpretation of the first order terms of the factor inputs offers quite meaningful insights on the production practices of the economic agents. We therefore proceed to narrow down our interpretation of the *translog* production model results only to the first order terms.

These coefficients shown in Table 5 are elastisities of output with respect to the individual factors of production and they give an indication as to how an increase in a particular factor leads to an increase in output in this case annual sales.

The results show that all the factor inputs are significant at 1 percent level of significance meaning that capital, labour and materials significantly influence the annual sales output.

It is interesting to note that the elasticity of annual sales with respect to man-hours (LABOUR) is the highest at 1.19 followed by the elasticity of annual sales with respect to materials inputs and other related expenditure (MATERIALS) at 0.57 and lastly elasticity of annual sales with respect to capital (CAPITAL) is 0.24. This means that hours of operation and the total number of workers has a very high impact on the annual sales an enterprise is able to reach, followed by the material inputs and then capital whose elasticity is not very big magnitude.

Table 5: Maximum likelihood estimates for the parameters of the *Translog* stochastic frontier production function

VARIABLE	PARAMETER	ESTIMATE	STD. ERROR	ESTIMATE	STD. ERROR
		OLS		**MLE**	
Intercept	β_o	**3.44***	0.69	**4.13***	0.68
Ln(CAPITAL)	β_1	**0.22***	0.068	**0.24***	0.07
Ln(LABOUR)	β_2	**1.22***	0.18	**1.19***	0.17
Ln(MATERIALS)	β_3	**0.59***	0.12	**0.57***	0 .11
Ln(CAPITAL)^2	β_4	**-0.004**	0.003	**-0.003**	0.003
Ln(LABOUR)^2	β_5	**-0.09***	0.02	**-0.09***	0.02
Ln(MATERIALS)^2	β_6	**0.03***	0.007	**0.03***	0.007
Ln(CAPITAL *LABOUR)	β_7	**0.04***	0.012	**0.04***	0 .01
Ln(CAPITAL* MATERIALS)	β_8	**-0.03***	0.006	**-0.04***	0.006
Ln(LABOUR* MATERIALS)	β_9	**-0.05****	0.02	**-0.05****	0.02
Variance parameters					
sigma_v	σ_v^2	-		0.70	0.03
sigma_v	σ_u^2	-		0.76	0.08
sigma2	σ_s^2	-		1.06	0.08
Lambda	λ	-		1.1	0.10
Number of enterprises		2231		2231	

Notes: Significance levels of 1and 5 percent indicated by * and ** respectively
Source: Authors' computation – OLS and frontier production function.

This research however, is not mainly focused on the derivation and interpretation of the factor input elastisities for MSEs but rather on the technical efficiency of MSEs. In trying to estimate technical efficiency of these MSEs we are thus required to look at the input – output relationship hence the discussion on these elastisities. A discussion on the primary goal of this research, technical inefficiency analysis now follows.

5.3.2 Results from the technical inefficiency model

The results for the inefficiency model are presented in Table 6. It is important to note that since the dependent variable is technical inefficiency as such a positive sign for a coefficient in the technical inefficiency model indicates a rise in technical inefficiency thus a decline in technical efficiency while a negative sign for a coefficient in the technical inefficiency model indicates a fall in technical inefficiency thus a rise in technical efficiency.

Table 6: Maximum likelihood estimates for the parameters of the inefficiency model

VARIABLE	PARAMETER	ESTIMATE	STD. ERROR
Intercept	δ_0	-1.87*	0.65
NBUS	δ_1	0.38*	0 .11
OWNERAGE	δ_2	0.02	0.03
OWNERAGEsq	δ_3	-0.00003	0.0004
BUSAGE	δ_4	0.0004	0 .03
BUSAGEsq	δ_5	0.001	0.001
BUSASSOC	δ_6	-0.39	0.43
CREDIT	δ_7	-0.31	0.20
CPRIMARY	δ_8	-0.06	0.13
ABOVEJCE	δ_9	0.09	0.16
BUSTRAIN	δ_{10}	-0.03	0.13
MALE	δ_{11}	0.72*	0.18
FEMALE	δ_{12}	0.06	0.17
URBAN	δ_{13}	-0.36*	0.14
RURAL	δ_{14}	0.46*	0.16
LAKESHORE	δ_{15}	0.18	0.26
Log likelihood		-2687.2023	
Number of enterprises		2231	
Technical efficiency levels			
Mean technical efficiency		**60.58%**	
Minimum technical efficiency		4.2%	
Maximum technical efficiency		86.26%	
Standard Deviation		14.6%	

Notes: Significance levels of 1, 5 and 10 percent indicated by *, ** and *** respectively
Source: Authors' computation – inefficiency effects.

The mean technical efficiency level is 60.58 percent minimum efficiency of 4.2 percent and a maximum efficiency of 86.26 percent. This means that the least efficient micro and small enterprise operates at 95.8 percent below their full potential while the most efficient is still 13.74 percent below their full potential. This shows that there is a lot of wasted productive capacity because the enterprises are simply not transforming the inputs (capital, labour and materials) into sales.

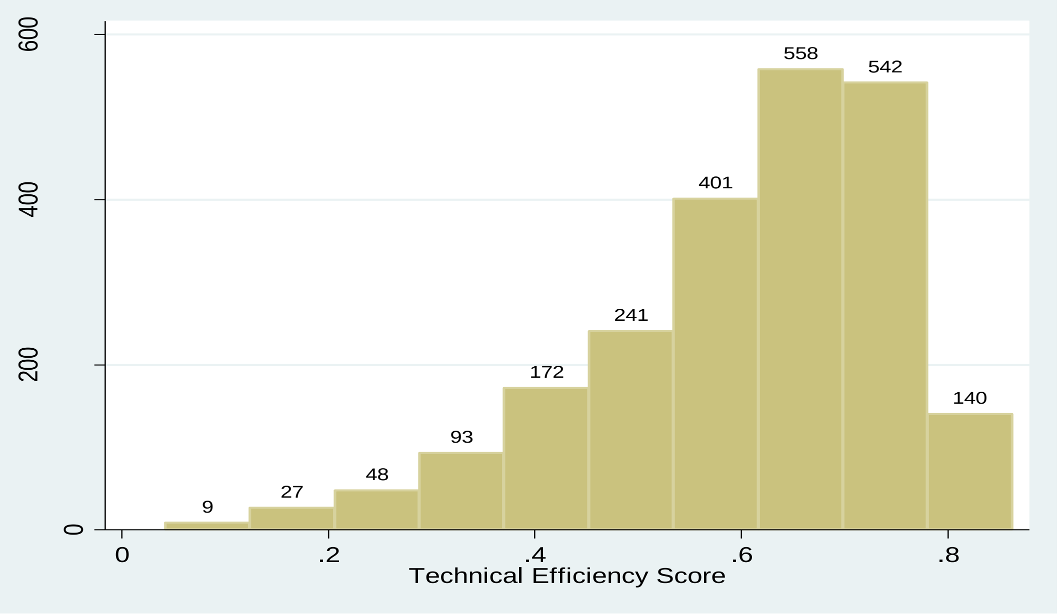

Figure 2: Distribution of Technical Efficiency Scores

As can be seen from Figure 2 above, the majority of the enterprises have efficiency scores above 60 percent (the average technical efficiency level) which is fairly good considering the poor state of the Malawian economy.

This mean level of technical efficiency is comparable to levels found in other African countries such as in Tanzania: 56 percent (Admassie and Matambalya, 2002) and Nigeria: 75 and 53 percent by Ajibefun and Daramola (2003) and Alao and Kuje (2010) respectively.

The technical inefficiency model gives some interesting and surprising results. Overall a mixed picture emerges from the results with some factors affecting technical inefficiency while others do not. This can be deduced from the signs as well as the level of significance of the regressors. The results show that some variables significantly (statistically) affect technical efficiency positively or negatively whilst others do not significantly affect technical efficiency.

It is important to note that the model estimated was an inefficiency model and its results will be interpreted in the reverse when referring to our object of interest technical efficiency. This means that a positive sign of a coefficient in the inefficiency model presented above is interpreted as a negative impact on technical efficiency. On the other hand, a negative sign of a coefficient in the inefficiency model presented above is interpreted as a positive impact on technical efficiency.

The number of enterprises or businesses owned by the entrepreneur (NBUS) has got a negative influence on technical efficiency and it is statistically significant at 1 percent level. The sign of the coefficient is in line with the *a priori* expectation that the number of businesses operated has a positive impact on technical inefficiency of the firms. For every additional business run by the entrepreneur, there is a 0.38 drop in technical efficiency. Such a conclusion concurs with Mengistae (1995) who noted that as the entrepreneurs' span of control broadens in terms of number of business units under one's supervision, the overall levels of technical efficiency decline.

Age of the entrepreneur (OWNERAGE) has got the expected positive sign for its' coefficient δ_2, thus indicating that it negatively influences technical efficiency of the enterprise though statistically insignificant. The coefficient for square for owner age (OWNERAGEsq) δ_3 has got a negative sign contrary to our expectation but it is insignificant.

The coefficient for the duration that the enterprise has been in operation (BUSAGE) δ_4, has got a positive sign which is contrary to the expected effect on technical inefficiency but it is statistically insignificant. The square for the duration that the enterprise has been in operation (BUSAGEsq) also has got the expected negative effect on technical efficiency since its coefficient is positive yet it is also statistically insignificant.

Membership to a business association (BUSASSOC) as captured by coefficient δ_6 has got a negative sign as expected though it is statistically insignificant. δ_7 the coefficient of access to credit (CREDIT) also has got the expected negative sign indicating that it positively affects technical efficiency as was the *a priori* expectation but it is statistically insignificant.

All education variables are statistically insignificant yet their coefficients give conflicting signs. Completing primary school (CPRIMARY) has got a negative sign as expected while educational attainment of JCE or higher (ABOVEJCE) has got a positive sign which is not in line with the expectations. This is quite surprising considering the fact that human capital has been documented to be a very important determinant of technical efficiency. This scenario in Malawi may be explained by the fact that these business undertakings are quite small and they do not really require heavy intellectual ability. δ_{10} the coefficient for the business training (BUSTRAIN) variable has a negative sign as expected but it is not statistically significant.

Relative to mixed-owned enterprises, male ownership (MALE) of MSEs has a positive impact on technical efficiency as signalled by the negative sign of coefficient δ_{11},-0.72 which is also statistically significant at the 1 percent level. On the other hand, female ownership (FEMALE) has got a positive coefficient of 0.06 indicating that there is a negative relationship with technical efficiency though it is statistically insignificant. Studies that have investigated technical efficiency of MSEs and gender of the entrepreneur have mostly been for farm enterprises for example Obwona (2006), Nyemeck *et al* (1999) and Mochebelele and Winter Nelson (2000). They all find that there is a significant influence of gender of entrepreneur and technical efficiency levels as is the case in our analysis.

The effect of location strata is in line with our *a priori* expectations relative to a small town (SMALLTOWN) location. Operating from an urban area (URBAN) positively affects technical efficiency and the coefficient of -0.36 was realised which is significant at the 1 percent level. On the other hand, rural area (RURAL) localities negatively impact on technical efficiency and a coefficient of 0.46 was realised which is significant at the 1 percent level. The coefficient for operating from a lakeshore area (LAKESHORE) δ_{15} also yields the expected positive sign though it is statistically insignificant. Admassie and Matambalya (2002), Nikaido(2004), Sharma and Sharma (2010) also found similar results on the effects of location on performance including technical efficiency of MSEs. All of them found that being located in or close to an urban area has got a positive impact on technical efficiency while rural settings have got a negative impact on technical efficiency.

CHAPTER SIX

SUMMARY OF RESULTS, LIMITATIONS AND CONCLUSION

6.1 Summary of results

This study has looked at the level of efficiency in off-farm micro and small enterprises in Malawi with concentration on technical efficiency. A dataset from the second nationwide GEMINI Baseline Survey of 2000 was used. This survey looked at micro, small and medium enterprises in all industries and from this dataset, a usable sample of 2231 enterprises were analysed in this study.

The stochastic frontier approach was employed in this study because it allows for the separation of the real factors under the firm control from environmental factors. We estimated a *translog* production function after LR test revealed that it was a better representation of the data compared to the *Cobb-Douglas* production function. It was also established using the LR test that there were inefficiencies present in all the enterprises in the sample and that the inefficiency term followed an exponential distribution.

The results of the *translog* production function indicated that there are positive and significant elastisities on annual sales with respect to labour, materials and capital. The labour input has the largest effect at 1.19, followed by materials at 0.57 and lastly capital has a magnitude of 0.27.

An inefficiency model that followed the formulation in Battese and Coelli (1995) was estimated and the results indicate that off-farm micro and small enterprises in Malawi are not technically efficient with a mean level of 72.82 percent. The most technically efficient enterprises only operate at 90.47 percent of their potential and the least technically efficient are at 4.55 percent.

It has also been established that the number of businesses run by the entrepreneur, gender of the entrepreneur and location strata significantly affect technical efficiency while the age of the entrepreneur, duration that the business has been in operation, membership to business association, access to credit, level of education of entrepreneur and business training do not significantly affect technical efficiency.

It was also found that the mean level of technical efficiency is comparable to levels in other African countries such as Nigeria, Kenya and Tanzania. However it has been noted that contrary to our African counterparts, education, access to credit and business training do not significantly influence technical efficiency.

These findings reiterate observations made by other researchers on off-farm MSEs in Malawi of the need to improve the operating atmosphere through the provision of an enabling environment if these enterprises are to survive and blossom into a reliable sector of the economy. Furthermore, MSEs need to improve on their resource utilisation if they are to survive such a challenging economic setting.

6.2 Limitations of the study

This study may be limited in the following aspects. Firstly, this study made use of cross-sectional dataset which offers a static view of enterprises' production behaviour just for one period (in this case the year 2000) but we know from economic theory that productivity is also influenced by time and other changes which are not captured by cross-section studies.

The second limitation, the data set used in the study is fairly old since it was collected eleven years ago but in the absence of more recent data the results presented by this research is very relevant as it offers a starting point for discussion on the issues tackled.

6.3 Conclusion and areas for future research

Valuable insights on the performance specifically, efficiency (technical efficiency) of MSEs in Malawi have been unearthed by this research. However, future efforts can focus on analysing inter-industry comparison of technical efficiency. Also, other measure of productivity such Total Factor Productivity (TFP) can also be explored in order to have a richer appreciation of the performance of MSE in Malawi.

REFERENCES

Admassie, A. and Matambalya, F. A. (2002). Technical Efficiency of Small and Medium-Scale Enterprise: Evidence from a Survey of Enterprises in Tanzania. *Eastern Africa Social Science Research Review (EASSRR) , XVII* (2), 1-29.

Aigner, D. and Chu, S. (1968). On Estimating the Industry Production Function. *American Economic Review , 58*, 826-835.

Aigner, D., Lovell, K. C., and Schmidt, P. (1977). Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics* , 21-37.

Ajibefun, I. A. and Daramola, A. G. (2003). Determinants of technical and allocative efficiency of micro-enterprises: Farm level evidence from Nigeria. *Afican Development Review , 15,* 353-395.

Alao, J. and Kuje, E. (2010). Determination of technical efficiency and production function for small scale furniture industry in lafia metropolis, Nasarawa State, Nigeria. *Journal of Agriculture and Social Sciences , 6*, 64-66.

Battese, G., Coelli, T. and Colby, T. (1989). Estimation of Frontier Production Functions and Efficiencies of Indian Farms using Panel Data from ICRISAT's Village Level Studies. *Journal of Quantitative Economics , 5(2)*, 327–348.

Battese, G. and Coelli, T. (1995). A model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data . *Empirical Economics* , 325-332.

Battese, G. and Coelli, T. (1993). Frontier Production Functions Technical Efficiency and Panel Data: With Application to Paddy Farm in India. *Journal of Productivity Analysis , 3*, 153–208.

Beck, T., Demirguc- Kunt, A., Laeven, L. and Levine, R. (2005). Finance, firm size and growth. *World Bank Policy Research Working Paper No. 3485* .

Berger, A. (1993). 'Distribution Free' Estimates of Efficiency in the U.S. Banking Industry and Tests of the Standard Distributional Assumptions. *Journal of Productivity Analysis , 4*, 261–29.

Biggs, T., Shah, M. and Srivastava, P. (1996). Technical capabilities and learning in African enterprises. [Regional Program of Enterprise Development Case Study Series (RPED), no.67] . Washington D.C.: World Bank.

Chirwa, E. W. (2004). Gender and Performance of Micro and Small Enterprises in Malawi. (*Wadonda Consult Working Paper WC/01/04).* Zomba: Wadonda Consult.

Coelli, T. (1996). A Guide to FRONTIER Version 4.1: a Computer Program for Stochastic Frontier Production and Cost Function Estimation. *Centre for Efficiency and Productivity Analysis* , (Working paper 96/07). Armidale: University of New England.

Coelli, T., Rao, D. and O'Donnell, C. a. (2005). *An Introduction to Efficiency and Productivity Analysis* (2nd ed.). New York: Springer.

Daniels, L. and Mead, D. C. (1998). The Contribution of Small Enterprises to Household and National Income in Kenya. *Economic Development and Cultural Change , 47* (1), 45-71.

Daniels, L. and Ngwira, A. (1992). Results of a National-wide Survey on Micro, Small and Medium Enterprises in Malawi. (*GEMINI Technical Report No. 53).* Washington D.C.: USAID.

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica*, 19(3):273–292.

ECI (Ebony Consulting International) and NSO (National Statistical Office) with assistance from Kadale Consultant and Wadonda Consult for the Department for International Development (DFID), (2001). (Malawi District Level GEMINI MSE Baseline Survey 2000). Zomba: NSO.

ECI (Ebony Consulting International) and NSO (National Statistical Office) with assistance from Kadale Consultant for the Department for International Development (DFID), (2002). (Malawi National GEMINI MSE Baseline Survey 2002). Zomba: NSO.

Farrell, M. (1957). The Measurement of Productive Efficiency, *Journal of the Royal Statistical Society A*, *General*, 120, 253–281.

Fosoranti, M.M., Akinrinola, O.O. and Ajibefun, I.A. (2006). The Impact of Micro-Credit and Training on Efficiency of Small-Scale Entrepreneurs: Evidence from National Directorate of Employment (NDE) Loan/ training Programmes in Nigeria. *The Social Sciences* , *1* (4), 264-269.

Governement of Malawi. (2003). Economic Report. National Economic Council. Zomba: Government Printer.

Government of Malawi. (1999). Economic Report. National Economic Council. Zomba: Government Printer.

Government of Malawi. (2000). Economic Report. National Economic Council. Zomba: Government Printer.

Government of Malawi. (2001). Economic Report. National Economic Council. Zomba: Governemnt Printer.

Government of Malawi. (2002). Economic Report. National Economic Council. Zomba: Government Printer.

Government of Malawi. (2004). Economic Report. Ministry of Economic Planing and Development. Zomba: Government Printer.

Government of Malawi. (2008). Economic Report. Lilongwe: Ministry of Economic Planing.

Government of Malawi. (2006). Malawi Growth and Development Strategy Paper. Lilongwe: Ministry of Finance and Economic Planning.

Government of Malawi. (2002). Malawi Poverty Reduction Strategy Paper. Lilongwe: Ministry of Finance and Economic Planning.

Government of Malawi. (2010). Budget Document No. 1. Lilongwe: Ministry of Finance.

Government of Malawi. (1999). Micro and Small Enterprise Policy Statement. Lilongwe: Ministry of Commerce and Industry.

Government of Malawi. (1970). Statement of Development Policy. Zomba: Office of President and Cabinet, Government Print.

Green,C.J., Kirkpartrick, C.H. and Murinde, V. (2006). Finance for Small Enterprise Growth and Poverty Reduction in Developing Countries. *Journal of International Development , 18,* 1017–1030.

Greene, W. H. (2000). Econometric Analysis (4th ed.). London: Prentice-Hall.

Greene, W. H. (1982). Maximum Likelihood Estimation of Stochastic Frontier Production Models. *Journal of Econometrics , 18,* 285-289.

Gujarati, D. N. (2003). Basic Econometrics (4th ed.). New York: McGraw-Hill.

Gutierrez, R.G., Carter, S. and Drukker,D. M. (2001). sg160: On boundary-value likelihood-ratio tests. *Stata Technical Bulletin , 60,* 15–18.

Hallberg, K. (2000). *A Market-Oriented Strategy for Small and Medium Scale Enteprises*, (International Finance Corporation Discussion Paper No.40), The World Bank, Washington DC.

Huang, C., and Lui, J. (1994). A Non-neutral Stochastic FrontierProduction Function. *Journal of Productivity Analysis , 5*, 171–180.

Hussaim, M. (1998). *Credit for the alleviation of rural poverty; The Grammen Bank in Bangladesh.* International Food Poliy Research Institute, Washington DC.

Jondrow, J., Lovell, K. C., Materov, I. S. and Schmidt, P. (1982). On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model. *Journal of Econometrics , 19*, 233-238.

Kambewa, P. and Tekere, M. (2007). The impact of Economic Partnership Agreements on Micro, Small and Medium Sized Enterprises in Malawi: The Example of Tobacco, Sugar Cane and Garments Producers. (Ministry of Trade and Provate Sector Development - Intergated Farmework Policy Analysis Working Paper Series No. 5). Lilongwe: Government of Malawi.

Kodde, D., and Palm, F. (1986). Wald Criteria for Jointly Testing Equality and Inequality Restrictions. *Econometrica , 54*, 1243–1248.

Kumbhakar, S., Ghosh, S. and McGuckin, J. (1991). A Generalized Production Frontier Approach for Estimating Determinants of Inefficiency in US Dairy Farms. *Journal of Business and Economic Statistics , 9,* 279–86.

Leibenstein, H. (1966). Allocative Efficiency vs "X-Efficiency". *The American Economic Review , 56* (3), 392-415.

Lundvall, K., and Battese, G. (2000). Firm Size, Age and Efficiency: Evidence from Kenyan Manufacturing Firms. *The Journal of Development Studies , 36* (3), 146-163.

Maoni, F. M. (July 2008). Survival Chances of Off-farm Micro and Small Enterprises: The Case Study of Lilongwe District. *Unpublished masters thesis, Chancellor College, University of Malawi* .

Marsden, K. (1990). African Entrepreneurs Pioneers of Development. (*The World Bank* , Discussion Paper No. 9). Washington D.C.: World Bank.

Masakure, O. (2009). Performance of microenterprises in Ghana: A Resource-based View. *Journal of Small Business Enterprise , 16* (3), 466-484.

McPherson, M. (1996). Growth of Micro and Small Enterprises in Southern Africa. *Journal of Development Economics , 48* (1), 253-277.

Mead, D. C. and Liedholm, C. (1998). The Dynamics of Micro and Small Enterprises in Developing Countries. *World Development , 26* (1), 61-74.

Meeusen, W. and van Den Broeck, J. (1977). Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error. *International Economic Review , 18* (no. 2), 435-444.

Mengistae, T. (1995). Age-Size Effects in Productive Efficiency: A Second Test of The Passive Learning Model. *Centre for the Study of African Economies , Institute of Economics and Statistics* (Centre for the Study of African Economies WPS/96-2). Oxford: University of Oxford.

Mochebelele, M. T. and Winter-Nelson, A. (2000). Migrant Labour and Farm Technical Efficiency in Lesotho. *World Development , 28* (1), 143-153.

Moodley, S. (2003). E-commerce and Export Markets. Small Furniture Producers in South Africa. *Journal of Small Scale Business Management , 41*, 317-324.

Nicholson, W. (1998). Microeconomic Theory: Basic Principles and Extensions. New York: Dryden Press.

Nikaido, Y. (2004). Technical Efficiency of Small-Scale Industry: Application of Stochastic Production Frontier Model. *Economic and Political Weekly, Vol. 39, No.6* , 592-597.

Nyemeck, B. J., Sylla, K., Diarra, I. and Nyambi, G. (2003). Factors affecting Technical Efficiency among Coffee Farmers in Cote d'Ivoire: Evidence from the Center West Region. *R & D Management , 15* (1); 66-76.

Obwona, M. (2006). Determinants of technical efficiency differentials amongst small- and medium-scale farmers in Uganda: A case of tobacco growers. *AERC Research Paper 152* . Nairobi: African Economic Research Consortium.

Page, J. (1980). Technical efficiency and economic performance: Some evidence from Ghana. *Oxford Economic Papers , 32*, 319-339.

Parker, M., Riopelle, R. and Steel, W. (1995). *Small enterprise adjusting to liberalisation in five countries.* Washington DC: World Bank.

Pitt, M.M. and Lee, L.F. (1981). The Measurement and Sources of Technical Inefficiency in the Indonesian Weaving Industry. *Journal of Development Economics , 9*, 43-64.

Richmond, J. (1974). Estimating the efficiency of production. *Journal of Political Economy , 79*, 776-794.

Rozen, M. E. (1985). Maximizing Behavior: Reconciling Neoclassical and X-Efficiency Approaches. *Journal of Economic Issues , 19* (3), 661-685.

Sharma, S. and Sharma, M. (2010). Analysing Technical And Scale Efficiency of Small Industries in India:State-wise Cluster Study. *Measuring Business Excellence , 14* . (no. 2), 54-65.

StataCorp. (2009). *Stata Manual: Release 11*. Texas: Stata Press.

StataCorp. (2009). *Stata: Release 11. Statistical Software.* College Station, TX: StataCorp LP.

Stevenson, R. (1980). Likelihood Functions for Generalized Stochastic Frontier Estimation. *Journal of Econometrics , 13* (1), 58–66.

Tan, H. W. and Batra, G. (2003). *SME Technical Efficiency and Its Correlates: Cross-National Evidence and Policy Implication.* (World Bank PSD Occassional Paper No. 19). Washington DC: World Bank.

Timmer, C. (1971). Using a Probabilistic Frontier Production Function to Measure Technical Efficiency. *Journal Of Political Economy , 79*, 776-794.

USAID. (2001). Conceptual Framework for Assessing the Impact of Microenterprises Services : *Assessing the Impact of Microenterprises Services (AIMS)*. Washington D.C.: USAID.

Vandenberg, P. (2006). Poverty reduction through small enterprises: emerging consensus, unresolved issues and ILO activities. (*SEED Working Paper No. 75*). Geneva: ILO.

Vestergaad, N., Dale, S., Frank, J. and Andersen, J. L. (2002). Technical Efficiency of the Danish Trawl Fleet: Are the Industrial Vessels Better Than Others? (*IME Working Paper 32/02*). Esbjerg: University of Southern Denmark.

Vijay, K. and Wisdom, A. (2002). *Impact of micro-finance enterprises on efficiency of micro enterprises in Cape Coast, Ghana.* IFLIP Research Paper. Geneva: International Labour Organisation.

APPENDICES

APPENDIX 1 – SERIES OF CPI USED TO DEFLATE CAPITAL FIGURES

Year	**CPI**
1970	0.647473
1971	0.70089
1972	0.727112
1973	0.768874
1974	0.89157
1975	0.898207
1976	0.973152
1977	1.075938
1978	1.19912
1979	1.334442
1980	1.579187
1981	1.741843
1982	1.896603
1983	2.150852
1984	2.38773
1985	2.744627
1986	3.150478
1987	3.993763
1988	5.246059
1989	6.071973
1990	6.766816
1991	7.321694
1992	9.026932
1993	11.08404
1994	14.92083
1995	27.35147
1996	37.63703
1997	41.08134
1998	53.32251
1999	77.17553
2000	100