Efficiency of Small and Medium-Sized Enterprises in Liberia: The Case of Monrovia

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Abstract

The study looks into the efficiency status of Small and Medium Enterprises (SMEs) in Monrovia, Liberia. Stochastic Frontier Analysis (SFA) techniques are employed to analyse primary data to investigate the technical efficiency of the selected SMEs. Estimation results show that SMEs in Monrovia are generally inefficient. The mean inefficiency is 21 percent, and around 11 percent of the SMEs interviewed have inefficiency of over 30 percent. Despite the meagre financial resources at the disposal of the SMEs in Monrovia, there is an apparent underutilisation that needs to be addressed. Moreover, the study used a Two-Limit Tobit model to identify factors that influence the efficiency of SMEs. The results indicate that entrepreneur experience, energy/electricity (the proxy for infrastructure), and access to credit do positively influence the efficiency of SMEs in Monrovia. One of the policy implications for post-conflict Liberia is that enhancing efficiency of SMEs requires the government to prioritise the formulation and implementation of requisite policies for building and strengthening SMEs entrepreneurial capacity and network.

***Key words**: Efficiency, SMEs, Stochastic Frontier Analysis, and Tobit Model*

Introduction

Prior to the 1960s, many economists attributed the continuous existence of small-scale enterprises in developing countries to lack of capital and entrepreneurial skills to manage large-scale businesses. However, economists began changing their perception in the mid-1960s when new approaches to Small and Medium-sized Enterprises (SMEs) development started to emerge due to three main factors. First, there were increasing concerns over low employment in large enterprises, especially regarding the policies that could not ensure absorption of rapidly increasing labour force. Second, there were concerns that the benefits of economic growth were not being equitably distributed partly due to the large-scale capital intensive enterprises. Third, empirical studies revealed that the causes of poverty were not limited to unemployment, because most of the poor people were employed in a large variety of small-scale low productivity activities (Ekpenyong and Nyong, 1992).

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Recently there has been growing assertion that the earlier emphasis on large-scale enterprises in developing countries[i] had minimum success in generating employment, economic growth and alleviating poverty (Rosenzweig, 1988; Brown *et al*., 1990). For this reason, many began to believe that providing a suitable macroeconomic environment that enhances the *self-development* of small and medium-sized enterprises is an effective way of stimulating growth and equity. A number of studies reveal that the contribution of SMEs to economic growth and GDP is quite substantial. For instance, it is estimated that SMEs contribute 50% of Bangladesh's industrial GDP and provide about 82% of the total industrial employment. Also, in India and Pakistan SMEs contribute about 30% of the GDP (Economic Survey of Pakistan 2008-09). In South Africa, SMEs account for 56% of private sector employment and 36% of the GDP (Ntsika, 2002).

Many developing countries, including Liberia have tried to implement policies that could enhance productivity and efficiency in SMEs; however, these policies have not had any significant impact on the performance of the SMEs. In some cases, particularly in Liberia, following the introduction of the Open Door Policy (ODP) in the late 1944, SMEs have continued to face competition from some larger foreign investors. Despite the competition, SMEs have continued to play a pivotal role in the economy by contributing significantly to employment, income generation, economic growth and poverty reduction (Republic of Liberia, 2010).

In spite of these contributions, SMEs in Liberia continue to encounter various challenges unique to the SMEs sector in almost all developing countries (Republic of Liberia, 2010). These challenges include managerial competence, access to finance or credit, investment in information and communication technology, government policy, access to markets, inadequate infrastructure, corruption and crime. Even so, SMEs contributions remain below the actual potential because of the numerous growth obstacles confronting them. This paper investigates SMEs' efficiency in Liberia taking into account the fact that within the resources constrained environment, any misallocation of available resources implicates an important economic problem that deserves to be studied.

The paper makes an important contribution to the literature in this field as it underscores not only the status of efficiency of SMEs but also unearths important sources of inefficiency in Liberia's SMEs. The general conclusion is that SMEs in Monrovia are generally inefficient. These findings may not be unique to Liberia as a developing country in Africa, and thus the policy implications of this paper can be relevant to other sub-Saharan countries. As theoretical models applied to measure and diagnose sources of inefficiency have not been applied in the SMEs sector in most of the African countries, this paper adds to the empirical test of SFA in this category of businesses, especially in sub-Saharan Africa.

The rest of the paper is organised as follows: the next section dwells on theoretical perspectives of efficiency studies before reviewing empirical literature. After literature review, the paper discusses methods of analysis before presenting estimation results and interpretation of results. Finally, it presents the summary of the key conclusions and policy implications.

Theoretical perspective of efficiency studies

Efficiency in economic is studied and given great attention for both positive and normative reasons. The positive underlying principle that drives efficiency analysis stems from the urge to create and enhance tangible value. Had there been no value at all, firms would have been less concerned about efficiency of alternative methods of their operations. The normative raison d'être for efficiency analysis is founded on the basis of the challenge to obtaining useful policy information. Economic efficiency in conjunction with other necessary informative criteria is used by economists and analysts to figure out the merits of alternative situations (Schenk, 2004).

From the production theory, which underlies efficiency, studies such as one by Vilfredo Pareto, an early mathematical economist, set a condition for efficiency, that is, if there is a change which makes at least one individual better off without making any one else worse off, that change is efficient, i.e. is one of the higher value (Debreu, 1959; Varian, 1992; Schenk, 2004).

Theoretical aspects of production efficiency are intimately related to that of profit maximisation. A situation is efficient (in some particular respect) if it cannot be improved, i.e. if there is no possible situation that is superior to it (Friedman, 1990). For efficiency analysis, Pareto optimality has been the main assessment criterion in economics. Nevertheless, Pareto efficiency does not guarantee that the situation that is efficient is necessarily superior to the one that is inefficient. However, there are other important issues such as equity-related aspects that are not quantified by Pareto criterion.

Another theoretical criterion that is less popular but is probably more rigorous than Pareto efficient condition it is the Marshall Optimality. Whereas in production, the Pareto efficient situation occurs when you cannot increase one output without decreasing some other output, the Marshall efficient situation is characterised by the sum of gains and losses due to a change aimed at improvement. If the sum is a net gain there is a Marshall improvement and vice versa. Efficient condition is, therefore, fulfilled where no further Marshall improvement is tenable. Although Alfred Marshall was, in some respects, a more important figure in history of economics than Vilfredo Pareto, Marshall's criterion has almost disappeared from modern economics. The reason is perhaps the difficulty that is apparent in the applicability of Marshall condition in the empirical analysis.

When one looks at the efficiency, especially, of SMEs, one has to also be guided by the theory of entrepreneurs learning (Deakins and Freel, 1998) in addition to the production theory per se. SMEs are in most cases a result of individuals' entrepreneurial effort to invest and, at times, within financial constraints. Small business management and entrepreneurship literatures show that although planning may be important for SMEs to evolve, learning and experiences are fundamental to the creation of capabilities and competencies in this area (Pedler, Burgoyne *et al.*, 1991). The abilities to network at an early stage, to assimilate experience and opportunity, to learn from past successes and mistakes, and to access critical resources, including human resources to build the entrepreneurial orientation are imperative and can be acquired through the learning process. This way, learning makes it possible for those dealing in SMEs to be more effective in undertaking their functions and to lead them to the realisation of efficient results.

Efficiency has been defined and studied in different perspectives as follows: (i) Scale efficiency, which refers to the relationship between the level of output and the average cost; (ii) Scope efficiency, which underlines the relationship between average cost and production of diversified output varieties; and (iii) Operational efficiency, which is a wide concept sometimes referred to as x-efficiency that measures deviations from the cost efficient frontier that represents the maximum attainable output for the given level of inputs. Regarding the various definitions, inefficiency is, therefore, a versatile concept with several meanings depending on the perspective in which it is used (Leibenstein, 1966).

A number of economists have classified the techniques of efficiency estimation into two categories: the *parametric* method, and the *non-parametric* method. The parametric approach uses an econometric technique based on the assumption that the disturbance term constitutes two components. The first represents the statistical noise or randomness whereas the second represents technical inefficiency which is assumed to follow a one-sided distribution (Alvarez and Crespi, 2001, 2003). The parametric approach is the Stochastic Frontier Analysis (SFA), which was introduced by Farrell (1957) in his seminal paper and subsequently developed by Aigner, Lovell and Schmidt (1977), Meeusen and van den Broeck (1977) and Battese and Corra (1977). The important feature of this model is that, besides incorporating the efficiency term into the analysis (like the deterministic approach) it also captures the effects of exogenous shocks beyond the control of the analysed units. The simplest and restricted form of the SFA is the Cobb-Douglas production frontier of the form:

$$Y_i = X_i\beta + (V_i + U_i) \qquad i = 1, 2, \ldots, n \tag{1}$$

Where, Y_i is the output (or logarithm of production) of the ith firm; X_i is the vector of inputs of the ith firm; β is the vector to be estimated; V_i represents the random variables which are assumed to be independently and identically distributed (iid); U_i denotes the random variables which are assumed to account for technical inefficiency in production and usually assumed to be iid.

Parametric models start from the specification of the production function, which defines the technological relationship between the level of inputs and the resulting level of outputs. This is a unique attribute of this approach and an advantage over the non-parametric models, which do not take into account the specific forms of production functions producing outputs from the inputs employed (Coelli, *et al*., 1998). Another potential advantage of the parametric model (stochastic frontier approach) over non-parametric model (data envelopment analysis) is that random variations in catch can be accommodated, so that the measure is more consistent with the potential harvest under normal working conditions. One of the main shortcomings of the parametric model would be the impossibility of applying this approach in a case where the sample size is not large enough. Another disadvantage of the parametric technique that needs one to note is that, although it can model multiple output technologies, doing so is somewhat more complicated, requires stochastic multiple output distance functions, and raises problems for outputs with zero values (Charnes *et al*., 1978).

The non-parametric approach uses the Data Envelopment Analysis (DEA), which is an approach that applies a mathematical programming model to estimate the optimal output level of firms, given their inputs mix (Charnes *et al*., 1978; Banker *et al*., 1984). This approach does not distinguish between technical inefficiency and statistical noise; however, it has a number of advantages: (a) it does not place any restriction on the functional form of the production function; (b) it makes no a priori distinction between the relative importance of outputs and inputs considered as relevant in the firm decision-making process; (c) it is insensitive to the model specification problems, and can accommodate multiple inputs and outputs simultaneously. According Coelli and Perelman (1996), this method also has a number of shortcomings that are worth noting: (a) it is insensitive to variables selection and data errors; (b) it focuses on relative efficiency (efficiency of one firm with respect to others), and not the absolute efficiency (the optimal amount of output that can be produced using a set of inputs; and (c) the linear programming solution of DEA produces no standard error and leaves no room for hypothesis testing, hence a deviation from the frontier is treated as inefficiency and there is no provision for random shock.

Some of the weaknesses of the DEA have steered a contention that this method is somewhat subjective, and so DEA results may not necessarily be as convincing as that of the stochastic frontier since they lack underlying theoretical backing of its production technology. In addition, because the distinction between technical and stochastic factors influencing efficiency is not done in DEA, there is a charge that this approach may not produce the kind of conclusions that can be directly applied in policy without some further analysis (Coelli and Perelman, 1996).

Review of some empirical studies on SMEs' efficiency

A number of empirical studies have been conducted on SMEs in both developing and developed countries. Some of those studies are reviewed here:

Starting with Liberia, Kaliba *et al*. (2010) used a one-dimensional Rash model to quantify the macro environment of Liberia businesses using the September 2008 to February 2009 World Bank Enterprise Survey Data. The results show that it is very difficult to start and maintain growth of business in Liberia. The study found that corruption and infrastructure have the highest impact on creating an unfavourable business environment in the country. The study also found that other factors such as access to finance, theft, robbery, vandalism and arson also impact on the business environment negatively. This study focused on the macro business environment while leaving out other factors such as owner's education, entrepreneur's age, experience, and training that also affect the performance and efficiency of SMEs. Our study, on the other hand, incorporates these factors, in addition to the macro business environment, using the Stochastic Frontier Analysis to bridge the aforementioned gap.

Lee and Harvie (2010) evaluated the technical efficiency in the manufacturing SMEs in Vietnam. Applying Stochastic Frontier Analysis to firm level data collected from 2002 to 2007. Lee and Harvie's (2010) study revealed that Vietnamese's non-state manufacturing SMEs on aggregate have a relatively high average technical efficiency. Technical efficiency averaged 89.71% for the three surveys in 2002, 2005 and 2007. The mean technical efficiency for 2002, 2005 and 2007 were 84.25%, 92.55% and 92.34%, respectively. The study also revealed that high-tech electronics and electrical equipment have lower technical efficiency than low-tech wood and furniture sub-sector. This could be attributable to low-tech activities having had such a longer experience and specialisation that the rate of capacity utilisation has come to almost the maximum. On the other hand, the high-tech activities are still in some learning curve with room for making further improvements. The coefficients for labour and intermediate inputs are significant and positive for many cases whereas capital input is insignificant in small and negative in most cases. The major issue here is that for developing countries there is a higher demand for labour than capital in most production activities, and this can often leave some capital underutilised as compared to labour.

Hussain *et al*. (2010) conducted a study on SME development through the Public Private Partnership (PPP) in Pakistan using primary data. They found that access to credit, and managerial competence significantly and positively impact the performance of SMEs.

Among the studies done using a large sample in Africa include Ajibefun and Daramola (2003), who investigated the efficiency of micro-enterprises in Nigeria using the stochastic frontier production function for cross-sectional data collected from 180 micro-enterprises selected from the block-making, metal fabricating and sawmilling firms. The study found that the level of efficiency varies across firms. The study also established that the enterprise owners' education was the most important determinant of efficiency in micro-businesses as it was highly significant. Furthermore, the age of owner was found to affect efficiency negatively; that is, as owner's age increases beyond a certain level, efficiency tends to decline, primarily because age can be one of the limiting factors to performance, especially where one may be ineffective in executing one's duties owing to old age infirmities.

Alvarez and Crespi (2001) studied the determinants of efficiency in small firms in the Chile's manufacturing industries using the non-parametric deterministic frontier method to plant survey data collected between April and July, 1998. They found that efficiency positively correlates with the experience of workers, modernisation of physical capital, and product innovation. They also established that outward orientation, owner's education or job experience, and participation in some public programmes do not significantly influence a firm's efficiency. They did not absolutely establish a positive relationship between the firm's size and efficiency.

Although there are some studies carried out in Africa on this subject, no study that uses multidimensional analysis for SMEs' efficiency had been undertaken in Liberia. Most of different efficiency studies done for Liberia have employed macro variables. This study applies micro variables that are related to the SMEs' performance such as specific characteristics of personnel, *inter alia*, to analyse SMEs' performance. Although the general status of contribution of SMEs to economic performance of Liberia is roughly known from the national statistics, there is no clear information on the remaining output gap that could be covered if the country's SMEs operated at their full production possibilities. Establishing the efficiency status of SMEs entails the analysts and policy makers using the results of this study to ascertain the remaining scope of efficiency that can be harnessed and the extent to which it could contribute to an increase in output.

Data sources and methodology

Definition of SMEs and Data

The definition of SMEs is generally subjective and qualitative, therefore different countries define SMEs based on their respective levels of economic development. The scale of classification tends to be smaller in developing countries, especially in sub-Saharan Africa, because of the nature of their small economies, and Liberia is not an exception. However, the commonly used criteria are the number of employees, total investment, and/or sales turnover. For example, in the US, Britain, and Canada, small-scale enterprises are defined in terms of their annual turnover and the number of paid employees. In Britain, any business that makes an annual turnover of at most two million pounds and with less than 200 paid employees is considered a small-scale enterprise. In Japan, a small-scale industry is defined according to the type of industry, the amount of paid-up capital and the number of paid employees. Industries with a paid-up capital of 100 million yen (US$123,533), and up to 300 paid employees are SMEs (Ekpenyong *et al*., 1992).

In Liberia, enterprises are classified according to the number of paid employees (part-time and/or full-time). Enterprises with four to 20 employees are considered small; enterprises with 21 to 50 employees are considered to be medium-sized enterprises whereas enterprises with more than 50 employees are considered to be large enterprises (MoCI, 2010). This study, therefore, adopts the definition of SMEs as classified in Liberia for consistency in definition since the focus is on the country. Consequently, the data used in this study were collected from the SMEs based in Monrovia as defined in Liberia's national context.

This study uses primary data collected from 125 small and medium-size enterprises engaged in concrete blocks-making, furniture-making and mineral water production based on responses gathered from a set of questionnaires. There were 47 concrete blocks, 66 furniture and 12 mineral water producing SMEs.

The survey used a multistage stratified random sampling technique to select SMEs that took part in the study to ensure that samples were representative of various parts of Monrovia. The advantage of this sampling technique is that it does not require any sampling frame and it was deemed most appropriate for this study because the majority of the SMEs in Liberia (especially the small enterprises which are in large number) operate in the informal sector. Hence, there was no official document or listing that could be referenced as a sample frame for the conduct of the survey.

Monrovia was divided into six zones, consisting of Central Monrovia, Sinkor (including Fiamah and Air Field), Congo Town (including Old Road), Paynesville, Gardnerville, and Bushrod Island. Fifteen percent of the concrete blocks and furniture producing SMEs were sampled from each zone using random sampling technique to minimise the sampling bias. On the other hand, all the mineral water-producing firms were enumerated because they are very few in Monrovia.

Of the 125 SMEs sampled, some 100 valid questionnaires from 43 concrete blocks, 50 furniture, and seven mineral water producing SMEs. Out of the 25 invalid questionnaires, four entrepreneurs refused to participate in the survey, nine entrepreneurs gave incomplete responses whereas 12 gave inconsistent responses. The types of SMEs that are indicated here are the ones mostly found in Monrovia, probably owing to the high demand for their products. The choice of these SMEs was motivated by two reasons: first, each group produces homogenous products and second, they are easily accessible.

Frontier estimation

In view of advantages of the parametric models, especially where the data allow the use of stochastic frontier approach, i.e. regarding the availability of a large sample, and also to ensure high degree of confidence in our results, in this study we opted to use the stochastic frontier model. According to Mas-Colell *et al*. (1995), a production vector $y \in Y$ is efficient if there is no $y' \in Y$ such that $y' \geq y$ and $y' \neq y$.

This concept means that a production vector *y* is efficient if there is no other feasible production vector *y*' that generates as much output as *y* using no additional inputs. This philosophy is the basis of the concept of illustrative Production Possibility Frontier (PPF) with efficient production points on it representing the maximum combination of outputs given resources and technology. Frontier analysis methods which are applied in this study originate ideally from this context.

To investigate the efficiency of SMEs, this study adopts a trans-logarithmic[ii] Stochastic Frontier Analysis (SFA) to examine the technical efficiency of SMEs. SFA has also been used by a number of authors such as Lee and Harvie (2010), Ajibefun and Daramola (2003), and Pitt and Lee (1981) to estimate the efficiency of firms.

The Stochastic Frontier Approach is preferred to other techniques in measuring efficiency because, first, it considers both factors beyond the control of the firm and firm-specific factors, and hence it is closer to the reality; and, second, the error term captures the effects of exogenous shocks or random variations of the frontier across firms, the effects of measurement error; and third, it incorporates technical inefficiency.

This study uses the Cobb-Douglas Production Frontier (Equation 1) which is a simplified and restricted form of the Translog Stochastic Frontier Analysis. The Translog Stochastic Production Function used in this study is expressed as:

$$\begin{aligned}\ln Y_i &= \beta_0 + \beta_1 L_i + \beta_2 K_i + \beta_3 ME_i \\ &\quad + \beta_4 (\ln L_i)^2 + \beta_5 (\ln K_i)^2 + \beta_6 (\ln ME_i)^2 \\ &\quad + \beta_7 \ln L_i \ln K_i + \beta_8 \ln L_i \ln ME_i + \ln K_i \ln ME_i + V_i + U_i \qquad (2)\end{aligned}$$

Where: Y_i is Output of firm *i*; L_i is labour input of firm *i*; K_i is capital investment of firm *i*; *ME* is material input and energy cost of firm *i*. Equation 2 on the second line represents the square terms of the factor inputs; while the third line represents the interactive terms of the factor inputs including Y_i which is the random error assumed to be $N(\mu_i, \sigma^2{}_v)$; and U_i represents technical inefficiency and is assumed to be $N(\mu_i, \sigma^2 u)$, while β's are the coefficients.

Identification of factors affecting efficiency

To identify the factors that affect the efficiency of SMEs we apply the Tobit Model developed by James Tobin and also used by a number of other authors to ascertain the factors that affect productivity and/or efficiency in a variety of firms. Some of these authors include Aikaeli (2008) and Sammy (2008). This model is appropriate because of its advantages in estimating equations whose dependent variable values are restricted within a specific range (Gujarati, 2003). The original Tobit Model is specified in terms of an indexed function denoted as:

$$y_i^* = x'\delta + \varepsilon_i, \qquad (3)$$

$y_i = 0$, if $y_i^* \leq 0$, and

$$y_i = 0, \text{ if } \; y_i^* > 0.$$

Where y_i is the transformed random variable, y^* is a column vector of independent variables which is a transpose of 1xK row of x, and δ is a vector of parameters to be estimated and ε_i represents a column vector of disturbances. For lower and upper truncations, this model will be adjusted in line with Maddala (1983). Maddala explained how to deal with a sample which does not include some information below or above specified thresholds. One can see from the defection that some SMEs are left out even if they were engaged in the same activities just because of their respective thresholds of output, employment, capital, etc. So the model has to be adjusted to capture only the specific values that are within the acceptable ranges. The two-limit specification of the doubly-truncated Tobit model has been used in this study to identify the determinants of inefficiency is written as:

$$y_i = x_i'\delta + \varepsilon_i \tag{4}$$

$$\begin{aligned} y_i^* &= L_{1i} \text{ if } y_i^* \le L_{1i} \\ &= y_i \text{ if } L_{1i} < y_i < L_{2i} \\ &= L_{2i} \text{ if } y_i \le L_{2i} \end{aligned}$$

Where y is the latent or unobserved variable whereas y^* is the observed dependent variable. L_{1i} is the lower limit while L_{2i} is the upper limit.

The model specified to estimate factors that determine efficiency is given as:

$$Eff = f(L, K, M, AE, AE^2, AC, Exp, AF, I, E, C, MA) \tag{5}$$

Where *Eff* represents efficiency index estimated from the Translog stochastic frontier production function, *L* denotes labour and *K* represents capital. *M* denotes managerial competence which encompasses education level, training and experience of entrepreneur. AE denotes the age of the entrepreneur, AE^2 represents the age of entrepreneur square, *AC* denotes access to credit, and *Exp* denotes experience of entrepreneur. *I* denotes infrastructure while *AF* stands for the firm age. *E* represents electricity, *C* represents communication and *MA* stands for access to market. In this regard, the Tobit Model of efficiency function is expressed econometrically as:

$$\begin{aligned} (eff)_i = {} & \alpha_o + \alpha_1 L + \alpha_2 K + \alpha_3 M + \alpha_4 \pi + \alpha_5 AE + \alpha_6 AC + \alpha_7 Exp + \alpha_8 AF + \alpha_9 I + \alpha_{10} M \\ & + \alpha_{11} C + \alpha_{12} MA + AE^2 + \varepsilon_i \end{aligned}$$

if LHS > 0

$$(Eff)_i = 0, \text{ otherwise.} \tag{6}$$

The calculation of the Efficiency index is calculated for all firms shows that it lies between zero and one, whereby a value of one indicates that the firm is efficient; whereas a value of zero indicates that the firm is inefficient. A firm with an index value of less than 1 (say 0.9) is inefficient; however, such a firm is more efficient than another firm with an index value of any value less than 0.9.

The selection of variables used to estimate efficiency scores and determinants of efficiency in Liberia was guided by literature. The variables that have been usually hypothesised as relevant for efficient outcomes in the production theory, and those which have been empirically applied were considered for this case study. These are variables which are key to the performance of the SME businesses. Assuming that land as one of the factors of production may be available (or is not a big limiting factor), next are labour and capital costs that have to be incurred for production to take place. From these broad factors, then a few specific variables were selected as facilitative to the functioning of the conventional factors. The additional variables to capital and labour include those which are among the derivers of entrepreneurial outcomes; and then finance and market accesses are taken as requisites for success of any businesses.

Table 1: Variables, their measurements and Hypothesised sign

Variable	***Measurement***[iii]	***Hypothesized sign***[iv]
Labour	Average monthly wages	Negative
Material Input	Average monthly material input cost	Negative
Capital	As proxy by initial investment	Negative
Managerial Competence	Educational level of entrepreneur	Negative
	Training of entrepreneur	Negative
	Experience of entrepreneur	Negative
Age of Entrepreneur	Number of years lived	Negative
Age of Entrepreneur Square	Square of the number of years lived	Positive
Age of firm	Years of operation	Negative
Infrastructure	Electricity	Negative
	Communication	Negative
Access to credit	Dummy, "1" where credit is available and "0" otherwise	Negative
Access to market	Dummy, "1" a firm has customers and "0" otherwise	Negative
Level of investment	Initial investment	Negative

To measure technical efficiency, the study uses the natural logarithm of average monthly output, which is measured in monetary value (United States dollar) of the average monthly output produced as the dependent variable whereas the independent variables include the average cost of labour; average cost of material inputs (including energy)[v], and capital.

Empirical results

Descriptive statistics

Descriptive statistics of key variables of the sample are presented in Table 2. These statistics explain some characteristics of the SMEs operating in Monrovia, which serve as a snapshot of the situation of the interviewed organisations before we analyse the estimated results. The first seven variables in the table are in terms of period (years) whereas the rest eight variables are in dollar values.

Table 2: Descriptive statistics

Variable	Mean	Std.Deviation	Minimum Value	Maximum Value
Age of entrepreneur	3.350	0.796	1.0	5.0
Age of firm	5.960	3.275	0.0	15.0
Level of education	2.560	0.958	1.0	6.0
Experience of entrepreneur	2.320	0.737	1.0	3.0
Number of employees	2.040	0.197	2.0	3.0
Education level of employees	2.300	1.150	1.0	6.0
Initial investment	1.720	1.155	1.0	4.0
Average material input cost	1689.696	1493.987	172.1	7096.2
Average wages and salaries	293.373	284.086	27.7	2500.0
Average output	2034.099	2351.657	83.4	6093.8
Average sales	2356.713	1732.619	295.0	8416.0
Average total cost	1970.396	1630.600	333.8	8329.2
Average profit	374.324	380.620	-94.9	895.2
Proportion of profit to cost	30.060	37.645	-12.3	149.3
Value of average output	3445.684	2940.752	280.0	16692.0

Source: Authors' computations

Among the variables one would be keen to talk about is the level of education of those engaged in SMEs in Monrovia, which seem to be skewed to the lower levels with regard to the standard deviation of 1.15 from the mean level of 2.3 for the given range of six levels/categories form the lowest to the highest. Similarly, initial investment for the start-up of SMEs seems to have been low since the mean is 1.7 and the standard deviation is 1.155 for the range of four censored values from 1 the lowest level to 4 the highest level. These are among the binding constraints for SMEs' performance because they are generally on the down side. The other issue of concern from the outset is the fact that there are some SMEs that are incurring losses as the profit question reveals. This provides a quick picture of the inefficiency of some of the cases. Other variables such as the level of output, sales and costs incurred by the Monrovia SMEs show that a diversity of SMEs took part in the study.

Estimates of stochastic frontier model

The estimates of the Stochastic Frontier Model reveal that SMEs are technically inefficient. The functional form of the model was selected based on the log likelihood results of the two most common functional forms of the Stochastic Frontier Model[vi].

To ensure that correlated independent variables are not included in the same model, we tested for correlation among the independent variables. The results reveal that the variables are not correlated. Then, the study estimates the Stochastic Frontier Model as Table 3 illustrates:

Table 3: Estimates of stochastic frontier model of technical efficiency

Stoc. frontier normal/half-normal model Number of obs = 100
Wald chi2(9) = 448.58 Log likelihood = -31.60283 Prob > chi2 = 0.0000

Log of value of average output	*Coefficien*	*Standard*	*Z*	*P>|z|*	*[95% Conf. interval]*	
Log of average wages & salaries	1.851985	0.5835854	3.17	0.002	0.7081783	2.995791
Log of average material input cost	-1.096257	0.7020493	-1.56	0.118	-2.472249	0.2797339
Log of initial investment	0.8609949	0.7573887	1.14	0.256	-0.6234597	2.345449
Log of average wages & salaries square	-0.01152	0.0683077	-0.17	0.866	-0.1454007	0.1223606
Log of average material input cost square	0.2024522	0.0510583	3.97	0	0.1023799	0.3025246
Log of initial investment square	0.3766783	0.2583585	1.46	0.145	-0.129695	0.8830516
Log of average wages & salaries*log of average material input cost	-0.2012	0.1013335	-1.99	0.047	-0.39981	-0.0025899
Log of average wages & salaries*log of initial investment	0.037929	0.1377013	0.28	0.783	-0.2319607	0.3078187
Log of average material input	-0.1888206	0.1045607	-1.81	0.071	-0.3937558	0.0161146

Likelihood-ratio test of sigma^2_u = 0: chibar2 (01) = 1.56 Prob > = chibar2 = 0.106
Source: Authors' estimations

Table 3 shows that Sigma squared is 1% statistically significant, indicating that the SMEs in Monrovia are not technically efficient. Both sigma *u* squared (*for inefficiency*) and *v* squared (*for the statistical noise*) are significant at 1%. If Sigma *u* is significant in stochastic frontier estimation as it has happened in this case it indicates that variations from the production frontier are caused by technical inefficiency. In some other two cases of previous studies—Ajibefun and Daramola (2003) on the Nigeria's microenterprises efficiency and the Omer *et. al.* (2001) on efficiency of wood-products microenterprises in Ghana—sigma *u* squared is similarly significant, hence showing that there were inefficiencies in their operations. The summary of efficiency scores is provided in Table 4 below.

Estimates of Tobit model of determinants of inefficiency

To identify the determinants of inefficiency using the Tobit Model, the study undertook a post-estimation analysis of the Stochastic Frontier to obtain the inefficiency scores which were then used as a dependent variable in the Tobit Model. See Appendix Table A.1 for the inefficiency scores. The inefficiency of SMEs in Monrovia ranges from 0.07 or 7% to 0.62 or 62% whereas the average inefficiency is 0.21 or 21% (see Table 4). This implies that the average efficiency of SMEs in Monrovia is 79%. A similar study by Ajibefun and Daramola (2003) for Nigeria shows that inefficiency of microenterprises in Nigeria ranges from 0.3 or 30% to 0.59 or 59%. A study that was carried out in Ghana by Omer *et al* (2001) shows that efficiency of microenterprises in Ghana (a case of those which deal with wood-products) on average stood at 62%. This tells us that Liberia's case is not an exception as there are other areas in sub-Saharan Africa with similar underutilisation of resources in production for the growing businesses.

Table 4: Summary statistics of inefficiency scores

Variable	*Mean*	*Std. Deviation.*	*Minimum*	*Maximum*
Inefficiency scores	.2109783	.0813162	.0724525	.6229115

Source: Authors' computation from 2011 SMEs Survey in Monrovia

Since the Stochastic Frontier estimation has confirmed that SMEs in Monrovia are technically inefficient, and inefficiency scores have been obtained, this leads to the identification of factors that affect the efficiency of SMEs. Inefficiency scores were regressed against 12 explanatory variables, including average monthly wages and salaries, average monthly material input cost, initial investment, and education of entrepreneur. Other explanatory variables were the experience of entrepreneur, training of entrepreneur, electricity and communication as proxies for infrastructure, access to market, access to credit, age of the entrepreneur, age of entrepreneur square, and age of the firm. The study also tests for correlation between the independent variables and the results reveal that average monthly material input cost highly correlated with the average monthly wages and salaries, and so average monthly material input cost was dropped from the model. This correlation happened because the material inputs data had a bias of wages and salaries. Most of the SMEs records of their inputs cost in Monrovia had taken account of salaries and wages as part of it. The age of the entrepreneur was also found to correlate with the experience of the entrepreneur.

Table 5: Estimates of Tobit Model of the Determinants of Inefficiency

Inefficiency Scores	Coefficient	Std. Err	t	P>|t|	[95% Conf.	interval]
Age of entrepreneur	-0.0100238	0.056551	-0.18	0.86	-0. 1224075	0.1023599
Age of entrepreneur square	0.002056	0.008208	0.25	0.803	-0.0142564	0.0183685
Age of firm	-0.0022703	0.00253	-0.9	0.372	-0.0072985	0.0027579
Average wages & salaries	0.0000409	2.97E-05	1.38	0.171	-0.000018	0.0000999
Initial investment	0.0006959	0.007288	0.1	0.924	-0.013788	0.0151798
Education level of entrepreneur	-0.0038435	0.009506	-0.4	0.687	-0.0227337	0.0150467
Experience of Entrepreneur	-0.0354447	0.011453	-3.09	0.003	-0.0582051	-0.012684
Training of entrepreneur	-0.0078653	0.016482	-0.48	0.634	-0.0406189	0.0248882
Electricity	-0.0308203	0.01588	-1.94	0.055	-0.0623783	0.0007377
Communication	-0.0369181	0.030447	-1.21	0.229	-0.0974243	0.0235881
Market Availability	-0.0181441	0.024235	-0.75	0.456	-0.0663055	0.0300172
Access to credit	-0.0409719	0.015376	-2.66	0.009	-0.071528	-0.010416
Constant	0.3935074	0.10855	3.63	0	0.1777868	0.6092281
/Sigma	0.0716748	0.005159			0.0614232	0.0819264

Obs. summary: 1 left-censored observation at inefficiency<=.07245255
98 uncensored observations
1 right-censored observation at inefficiency>=.62291145

Source: Authors estimations

Table 5 demonstrates that the experience of the entrepreneur is significant at 1% with a negative coefficient. This result conforms to the entrepreneur learning theory on the view that SMEs' strategic development and change result from the combination of knowledge and experience rather than through plan development (Deakins and Freel, 1998) and it is consistent with Hussain *et al*. (2010) and Ajibefun and Daramola (2003) who also found that entrepreneur education encompassing both experience and training positively influences the efficiency of firms in Nigeria.

The proxy for infrastructure, electricity, is significant at 10% and has a negative coefficient. The implication is that improvement in the supply of electricity reduces the inefficiency of SMEs and, conversely, deterioration in supply of electricity increases inefficiency. The availability of stable supply of electricity enhances efficiency of SMEs and, at the same time, reduces the production cost. This result is in consonance with Kaliba *et al*. (2010) who also found that infrastructure positively influences the macro-business environment and, hence, positively impacting efficiency.

Access to credit is significant at one percent (1%) and has a negative coefficient. The implication is that, as credit increases, inefficiency in SMEs declines. The availability of credit enables entrepreneurs to acquire the requisite inputs for production. Furthermore, availability of capital reduces the cost of acquiring capital and the difference can be used to produce additional output. Efficiency of SMEs results to increases in productivity, market demand, as well as income (United Nations Conference on Trade and Development, 2005). This finding conforms to Hussain *et al*. (2010), and Kaliba *et al*. (2010) who found that access to credit positively influence the macro-business environment, thereby enhancing a firm's efficiency.

This study also estimates the marginal effects of the Tobit regression result of inefficiency of SMEs to ascertain how the probabilities of the dependent variable change with respect to changes in the regressors. However, as the coefficients of both estimations are the same, the study only reports the Tobit Regression estimates.

Conclusion and implications

The results of the Stochastic Frontier Model show that SMEs in Monrovia are generally inefficient. The mean inefficiency of SMEs in Monrovia is 21%. About 11% of the SMEs surveyed have inefficiency level of more than 30%. In other words, despite the meagre financial resources at the disposal of SMEs in Liberia, there is a need to address such underutilisation. The estimates of Tobit regression reveal that entrepreneur experience, infrastructure, and access to credit are factors that influence the efficiency of SMEs in Monrovia. Therefore, they are critical to the performance of SMEs.

These results have important policy implication for the post-conflict Liberia with around 68% of its total employment in the informal sector. To achieve shared economic growth, there is a need for the Liberia government to focus on enhancing the efficiency of the vast SME sector. Enhancing efficiency of the SMEs requires that the government prioritises the formulation and implementation of the requisite policies to build and strengthen SMEs entrepreneur capacity. Such policies can encourage knowledge diffusion for inexperienced entrepreneurs to acquire experience from veterans. Furthermore, improvements in basic infrastructure and the availability of broader access to credit can enhance the SMEs' efficiency which may augment their contribution to employment, economic growth as well as poverty reduction.

On the theoretical front, it is deduced that material inputs and labour cost (wages and salaries) are distinct variables that can be put together in estimation models of efficiency and their determinants thereafter. Our study, however, has brought forth an important caveat that SMEs accounting in developing countries such as Liberia is too aggregative to make such a simple breakdown. What is referred to as input costs may include labour cost. In selecting the variables for efficiency test, therefore, some of the variables that have been applied in advanced and emerging economies might need to be either dropped owing to high correlations or the use of proxies may be necessary where possible.

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Appendix 1

Table A.1: Inefficiency Scores in Ascending Order

Inefficiency Scores	Inefficiency Scores*100	Frequency	Percent	Cumulative
.0724525	7.25	1	1	1
.0897108	8.97	1	1	2
.0926564	9.27	1	1	3
.0999893	10.00	1	1	4
.1089005	10.89	1	1	5
.1125746	11.26	1	1	6
.1176186	11.76	1	1	7
.1182195	11.82	1	1	8
.1214197	12.14	1	1	9
.1218007	12.18	1	1	10
.122838	12.28	1	1	11
.1235576	12.36	1	1	12
.1269219	12.69	1	1	13
.1279635	12.80	1	1	14
.130241	13.02	1	1	15
.1322894	13.23	1	1	16
.1377333	13.77	1	1	17
.1383814	13.84	1	1	18
.1433901	14.34	1	1	19
.1473677	14.74	1	1	20
.1478516	14.79	1	1	21
.1489583	14.90	1	1	22
.1499923	15.00	1	1	23
.1503506	15.04	1	1	24
.1535811	15.36	1	1	25
.1549547	15.50	1	1	26
.1577237	15.77	1	1	27
.1588614	15.89	1	1	28
.1627955	16.28	1	1	29
.1653685	16.54	1	1	30
.1657127	16.57	1	1	31
.1681737	16.82	1	1	32
.1712569	17.13	1	1	33
.1727544	17.28	1	1	34
.1743109	17.43	1	1	35
.175808	17.58	1	1	36
.1760607	17.61	1	1	37
.1767119	17.67	1	1	38

.1785942	17.86	1	1	39
.180244	18.02	1	1	40
.182554	18.26	1	1	41
.1829987	18.30	1	1	42
.1849322	18.49	1	1	43
.1851022	18.51	1	1	44
.1860141	18.60	1	1	45
.1890453	18.90	1	1	46
.1904286	19.04	1	1	47
.1918193	19.18	1	1	48
.1952184	19.52	1	1	49
.1953661	19.54	1	1	50
.1986949	19.87	1	1	51
.2055489	20.55	1	1	52
.2083699	20.84	1	1	53
.2089803	20.90	1	1	54
.2102234	21.02	1	1	55
.2166639	21.67	1	1	56
.2170452	21.70	1	1	57
.2173125	21.73	1	1	58
.2178639	21.79	1	1	59
.2195984	21.96	1	1	60
.2203034	22.02	1	1	61
.2204519	22.05	1	1	62
.2207429	22.07	1	1	63
.2217876	22.18	1	1	64
.2245203	22.45	1	1	65
.2284763	22.85	1	1	66
.2329289	23.29	1	1	67
.2365336	23.65	1	1	68
.239472	23.95	1	1	69
.2402952	24.03	1	1	70
.2403062	24.03	1	1	71
.2445907	24.46	1	1	72
.2475893	24.76	1	1	73
.2507375	25.07	1	1	74
.2510984	25.11	1	1	75
.2559776	25.60	1	1	76
.2569242	25.69	1	1	77
.2614679	26.15	1	1	78
.2634723	26.35	1	1	79
.2668506	26.69	1	1	80
.2686971	26.87	1	1	81
.2691686	26.92	1	1	82

.2792204	27.92	1	1	83
.2801964	28.02	1	1	84
.2828335	28.28	1	1	85
.2864326	28.64	1	1	86
.2895902	28.96	1	1	87
.2927864	29.28	1	1	88
.294282	29.42	1	1	89
.3004126	30.04	1	1	90
.3013185	30.13	1	1	91
.3099123	30.99	1	1	92
.3167429	31.67	1	1	93
.3229675	32.30	1	1	94
.3314752	33.15	1	1	95
.3468171	34.68	1	1	96
.3880715	38.81	1	1	97
.4039231	40.39	1	1	98
.4056702	40.57	1	1	99
.6229115	62.29	1	1	100
Total		**100**	**100**	

Source: Authors' estimations

[ii] An obsession with equitable distribution and the desire for centrally organised large-scale production led to the nationalisation and proliferation of inefficient parastatal companies in some African countries. There was a drive towards public capital injection into large national companies in several countries. Good examples is Tanzania during the late 1960s to the mid-1980s abound owing to the socialist reforms in the aftermath of the 1967 Arusha declaration. Other countries that had such practices include Mozambique and Ethiopia, to mention a few.

[ii] Normally shortened as *Translog*.

[iii] All variables that have to do with cost are measured in United States dollars

[iv] A priori expectations are given in relation to inefficiency

[v] Information on wages and salaries, cost of material input, output, and sales were collected for the preceding five months before the survey, and the average for each variable was computed.

[vi] These functional forms are the Cobb-Douglas production function and the Transcendental-logarithm (Translog) Production Function. The results revealed that the Translog specification is most appropriate for this study because it had the lower log likelihood in terms of absolute value.