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Determinants and Extent of Technical Efficiency of Micro and Small-Scale Enterprises in Ghimbi Town, West Wollega Zone, Ethiopia: Data Envelopment Approach

Segni Teshome Feneche[1] and Shumet Asefa Kibret[2]

Abstract
Over the years, the role of Micro and Small Enterprises (MSEs) in Ethiopian economic development has become apparent. In order to formulate appropriate policy for improvement of development of MSEs, it is important to examine sources and their level of technical efficiency. The objective of this study is to examine determinants and the extent of technical efficiency of MSEs in West Wollega Zone, Ghimbi town. A multistage sampling technique was employed to select sample MSEs at the study area. Among the total sample of 206, 152 MSEs (73.79 %) are Micro Enterprise and 54 MSEs (26.21 %) are Small Enterprise. The Finding of Data Envelopment Approach (DEA) revealed the mean level of technical efficiency is 65% for micro-enterprises, 70% for small enterprises and 48.2% for pooled MSEs. These findings revealed that MSEs have huge potential output gains through improving their resource use inefficiency at their exiting inputs and technology. The finding of the Tobit model reveled age of manager, family size, business plan, size of enterprise, managerial training, vocational training and investment in ICT were found to significantly and positively affect efficiency of MSEs while age of enterprise, location of enterprise and access to credit were found to significantly and negatively affect their efficiency. Enhancing investment in ICT, vocational training, training in preparation of business plan, share capital contribution, education and training of MSEs promoters in business development services are recommended to the concerned bodies to make MSEs operate at their full potential levels.
Keywords: DEA, MSEs, Technical Efficiency, Tobit Model, Wollega, Ethiopia
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1. Introduction

It is obvious that Micro and Small Enterprises (MSEs) are essential for socio-economic development of any country in the world. Many highly-industrialized countries like Japan, China, and Taiwan have based their industrial development on MSEs in which they are considered as a role model for less-developed countries on how to utilize their domestic resources, unemployed labor and domestic technologies (Gebremariam, 2017).

The major development goals of the government of Ethiopia are reducing poverty and unemployment, and hence economic transformation via Agriculture Development led to Industrialization (ADLI) policy. One of the strategies to achieve these goals is expanding MSEs since there is large potential of MSEs in the economy. But, the growth of performance of MSEs has been poor and hence the implementation of large manufacturing projects has been delayed. These are the major reasons for the slow growth in the overall manufacturing sector of Ethiopia over the first growth and transformation plan (GTP I) periods (FDRE, 2016).

The key challenges to the long-term survival and growth of MSEs in Ethiopia are lack of basic entrepreneurial and managerial skills, poor production efficiency, lack of access to finance, and information asymmetry between bankers and community. In an economy where resources are scarce and opportunities to use new technologies are limited, studies revealed the potential possibility to raise the productivity of MSEs by improving their efficiency without necessarily developing new technologies or increasing the resource base (Tekle et al., 2016).

Developing technical skill of labors and managers will lead to higher productivity levels among MSEs. One possible method which could be adopted by MSEs to overcome managers and labor inefficiency problems is to improve internal efficiency. Improving technical efficiency will be an important means for MSEs to grow and expand in a competitive environment (Altenburg, 2010).

According to the policy and strategies establishment of enterprises in the country, there are many problems that face the MSEs. One and the most problem is even if the MSEs were organized with different sectors, they were not progressed and their capital were not grown as planned. In order to formulate appropriate policy measures to improve the development of MSEs, it is important to examine their level of technical efficiency. Although many empirical studies conducted in this thematic research area, there is dearth of literatures in Ethiopia in general and in the study area in particular.

[1] MSc in Development Economics, Private Organizations' Employees Social Security Agency in Gimbi District, West Wollega Zone, Oromia Region, Ethiopia. Email: segni2004@gmail.com, phone:+251912029948
[2] PhD in Economics, Department of Economics, College of Business and Economics, Mekdela Amba University, South Wollo Zone, Amhara region, Ethiopia. Email: shumetasefa@gmail.com, phone: +251929488859

Therefore, this study is initiated to estimate and identify principal determinants and the extent of technical efficiencies of micro and small scale enterprises in Ghimbi Town, West Wollega Zone, Ethiopia using Data Envelopment Approach (DEA).

2. Research Methodology

West Wollega zone is one of 21 zones in Oromia region, Ethiopia. The capital of the zone, Ghimbi town, is situated at 441 km to the west of Addis Ababa city, the capital city of Ethiopia. Micro and Small Enterprises (MSEs) play an important role in creating income and employment opportunities resulting beneficial impact on poverty reduction in the Zone. MSEs are predominant sector of the economy next to agriculture in the Zone. West wollega Zone Employment opportunity and food security agency (WWZEOFS, 2017) report confirms 3037 MSEs were established which consists of 2141micro and 896 small enterprises. Similarly, the sector further classified in to different economic activities i.e. manufacture102 (3.36 per cent), construction 714(23.51 per cent), trade1210 (39.84 per cent), service929 (30.59 percent) and urban agriculture 82(2.7 per cent) and which created jobs for 9,738(56.62 percent) males and 7,462 (43.38 per cent) for females with total of 17200 people. There are large numbers of Micro and Small Scale Enterprises in the Zone.

2.1. Sampling Technique

The study used multi-stage random sampling strategies.

In the first stage: west wollega zone was purposively selected because of the existence of largest number of MSEs in the Zone. Besides, West Wollega zone has unexploited potential that could definitely serve as business area for MSEs. Further, West wollega zone is the catchment area for the research and development program of Wollega University, Ghimbi campus.

In the second stage: one administrative town, Ghimbi town, was selected purposively from the target zone because of the largest numbers of MSEs and members available there.

In the third stage: stratified random sampling technique was used to select the required sample from the study area. The use of stratified random sampling technique was justified on the ground that the population of interest is heterogeneous; hence, it is necessary to classify the population of interest into non overlapping elements or strata. The heterogeneous population of interest in each town is divided into two strata. These are micro and small enterprises that are the major components of MSEs in the study area.

In the fourth stage: the study used systematic random sampling technique so as to select the required sample enterprises from the two strata proportional to their size in each stratum.

2.2. Sample Size Determination

To determine appropriate sample size simplified formula which was developed by Yamane (1967) was employed. This is specified as:

$$n = \frac{N}{1+N(e^2)} \text{----------1}$$

Where, assume n=required sample size; e =degree of accuracy expressed as a proportion of (0.05); and & N= total population of MSEs in the division.

Yamane sample calculation is the most ideal method to use when the only thing you know about the underlying population you are sampling from its size. Statistical abstract of West Wollega zone Ghimbi Town Employment opportunity and Food Security Agency (WWZGEOFS, 2017) confirms 423 MSEs were established which consists of 314micros and 109 small enterprises. Similarly, the sector further classified in to different economic activities i.e. manufacture 7, construction 19, trade 276, service 121 and which created jobs for 3024 Males and 1597 Females with total of 4621 people. The required sample sizes are computed from the total population of 423 MSEs found in the study area, 206 MSEs were selected by using systematic random sampling technique.

2.3. Data Sources and Methods of Data Collection

The study was based on both primary and secondary sources of data which were gathered using questionnaires and personal interviews taken as primary while magazines, reports and other written documents were as a secondary sources of data. The relevant data was collected from 206 sampled enterprise managers. The survey focused on socio-economic, demographic and enterprise related, institutional and environmental related factors.

2.4. Model Specification

In empirical works on the efficiency of MSE has two approaches, i.e., parametric –Stochastic Frontier Approach (SFA) and non-parametric - Data Envelopment Analysis (DEA) have been overwhelmingly dominating (Coelli et al., 2005). Both approaches provide measures of technical efficiency as a radial distance from the best practice frontier. However, each approach obtains technical efficiency scores by utilizing different techniques. The DEA

involves the use of linear programming whereas stochastic frontiers involve the use of econometric methods (Coelli et al., 2005). As the SFA impose functional and distributional forms on the error term, the DEA does not require any functional form to be specified. Further, while the former distinguishes the component of inefficiency in to random and inefficiency effect, the later deems any deviation from the efficiency frontier to the result of inefficiency.

The study specified four inputs and one output; Initial capital, labor force, land rent, and loan amount are specified as inputs whereas one output income (sale revenue) was specified as output. According to Amornkitvkel et al. (2014), it is necessary to select orientation from input oriented DEA model or output oriented DEA model according to which quantities the decision maker has more control over.

The estimation is obtained from the difference between technical efficiency values under the constant returns to scale (CRS) assumption where all decision making units operate at their optimal level. Under imperfect competition situation certain DMUs may not be able to operate at the optimal level; hence, the variable returns to scale (VRS) assumption is more realistic and flexible to allow the envelopment of more observed data than the case of CRS assumption. As a result, the variable returns to scale DEA model was applied for this study. Therefore, the outcomes of DEA of this study was considered as efficiency scores which represent performance indicators of MSEs as 1 = best performance and 0 = worst performance. The best efficient DMU lies on the frontier while the inefficient ones lies below the frontier. The efficient DMUs can be considered as benchmark of the inefficient DMUs. The inefficient DMUs can improve their performances to reach the efficient frontier by decreasing their current input levels (Cooper *et al*., 2006). The DEA method constructs a non-parametric production frontier over the data. Charnes et al. (1978) proposed input-orientated CRS DEA to simultaneously construct frontier with the aim of minimizing inputs with the given level of output. The TE (Θi) of i^{th} the DMU was obtained by solving the following DEA model (Coelli et al., 2005):

$$\max_{\theta,\lambda} \theta i \quad \text{---------- 2}$$

Subject to

$-yi + Y\lambda \geq 0$

$\theta xi - X\lambda \geq 0$

$\boldsymbol{\lambda} \geq 0$

Where,

Θi: it refers to a TE measure of the i^{th} DMU under CRS,

λ: it refers to an N x 1 vector of weights attached to each of the efficient DMUs,

yi: it refers to total value of MSEs output produced by i^{th} the DMU,

xi: it refers to the vector of inputs, x1, x2,…, x10, used by the i^{th} DMU

Y: it refers to the (1 x N) vector of outputs of all N DMUs in the sample, and

X: it refers to the (M x N) matrix of inputs of all N DMUs in the sample.

The individual DEA efficiency score varies between 0.00 and 1.00. This means the efficiency scores are double-truncated at 0 and 1. Though other types of regression model such as multiple linear and one sided Tobit regression models can be applied only if the efficiency scores do not assume both or either of the upper or lower limits. Therefore, in this study, the two-limit tobit regression model was applied to identify the sources of efficiency since the dependent variable in this case assumed 0 as lower limit and 1 as upper limit (Maddala, 1999).

The two-limit Tobit model is defined as

$$Y_i = \beta_0 + \sum_{k=1}^{m} \beta_k x_{ki} + Ui \quad \text{----------3}$$

Where

Y_i= latent variable representing the technical efficiency scores of firm i,

β = a vector of unknown parameters,

Xki = a vector of explanatory variables m (K = 1, 2... m) for firm i and

Ui = an error term that is independently and normally distributed with mean zero and variance σ^2 (Tekle leza et al., 2016).

The estimated values of technical efficiency scores of the i^{th} MSEs is double censored from both lower and upper sides. The Maximum Likelihood Estimation (MLE) was then used to obtain unbiased and consistent estimate of the unknown parameters of the Two-Limit Censored Tobit model. To identify the marginal effect yields, Belasco (2007) used the proportion of uncensored variables of mortality losses and average daily gain. Apart from the estimated coefficients, the marginal effects of the probability of technical efficiency of MSEs calculated by multiplying the estimated coefficients by predicted value of uncensored observation which was calculated from Tobit model. This study aimed to explore the determinants of technical efficiency of MSEs in West wollega Zone, Ghimbi town. Resource use efficiency of MSEs were supposed to be affected by several factors. These factors are, age of managers, size of the enterprises, education level of managers, managerial training, business plan of the enterprise, location of the enterprise, family size, social network, initial capital and

enterprises age. For the analysis of technical efficiency of MSEs, the Data Envelopment Analysis (DEA) was employed. Principal factors affecting the level of efficiency of MSEs were analyzed through two limit Tobit model. Therefore, technical efficiency index= f (Age of respondent, education, size of the enterprises, managerial Training, business plan, location of MSEs, family size, social network, Vocational Training, Investment on ICT, access to credit, initial capital and enterprises age).

3. Results and Discussion

3.1. Results of Data Envelopment Analysis (DEA)

3.1.1. The level 0f Technical Efficiencies of MSEs

As Table 1 shows for pooled enterprises, micro and small enterprise the mean level of technical efficiency score equals to 48.2%, 65% and 70% which ranges from minimum of 2.9%, 8.6% and 25.1% and maximum of 100%, 100%, and100% respectively. According to Radam *et al., (*2008) and Grabowski *et al.,* (1990), a firm is considered technically inefficient even if the firm registered a technical efficiency index of 0.82. By this standard, the number of MSEs considered technically efficient was only index of 0.07 from the both MSE. Based on the distribution of the efficiency scores it was observed that the highest value was range of 0.31-0.50 for pooled enterprise, 0.51-0.70 for micro enterprise and 0.91-1.00 for small enterprise, while the lowest value was in the interval 0.71-0.90 for pooled enterprise, 0.31-0.50 for micro enterprise and 0.00-0.30 for small enterprise. The MSEs analyzed in this study comprised of micro and small enterprises. In the general economic sense, by virtue of firm size, resource allocations, lower per unit cost and technology adoption, the small enterprises are supposed to attain the highest efficiency level. A higher standard deviation for small enterprises shows generally low performance even though the maximum efficiency index is 0.70. The results indicate that there might be some resource misallocation in the small and micro enterprise industries. This requires further investigations as to what are the causes of the low efficiency.

Table 1: Frequency Distribution of Technical Efficiency Estimates under DEA.

Technical	**Frequency**			**% of Total**		
Efficiency Range	**Pooled Enterprise**	**Micro**	**Small**	**Pooled Enterprise**	**Micro**	**Small**
0.00 – 0.30	59	22	2	28.64%	14.47%	3.7%
0.31 – 0.50	71	15	15	34.47%	9.87%	27.78%
0.51 – 0.70	31	52	11	15.05%	34.21%	20.37%
0.71 – 0.90	17	29	6	8.25%	19.08%	11.11%
0.91 – 1.00	28	34	20	13.59%	22.37%	37.04%
Total	206	152	54	100%	100%	100%
Mean	.482	0.650	0.700			
Std. Deviation	.2708157	.2631827	.2657791			
Maximum	1	1	1			
Minimum	.029	.086	.251			

Source: Primary Survey Data of 2019

3.1.2. Technical Efficiency Scores of DMUs

As table 2 shows the mean Technical Efficiency (TE) score of the MSEs Decision Making Units (DMUs) was found to be 48 percent for pooled enterprise which shows that MSEs DMUs were 52 percent Technical inefficient, the mean TE score of the micro enterprise is 65percent were 35percentTechnical inefficient and the mean TE score of the small enterprise is 70percent were 30percentTechnical inefficient. Regarding to the nature of returns to scale, 23 (11.17 percent), 2(1.32percent), 31(57.41percent) for pooled enterprise, micro and small enterprises respectively DMUs had Increasing Returns to Scale (IRS), 168 (81.55 percent), 135(88.82percent), 12(22.22percent) for pooled enterprise, micro and small enterprises respectively DMUs had decreasing returns to scale (DRS), and the remaining 15 (7.28percent), 15(9.86percent), 11(20.37percent) for pooled enterprise, micro and small enterprises respectively DMUs had constant return to scale (CRS), so this shows that the production technology of majority of the pooled enterprise and micro enterprise DMUs were characterized by DRS consistent and small enterprise is characterized by IRS which were revealed by the result of DEA technique.

Table 2. Efficiency of MSEs based on the scale of production

Production scale	Frequency			Percentage		
	Both Enterprise	Micro	Small	Both Enterprise	Micro	Small
Increase Return to Scale	23	2	31	11.17	1.32	57.41
Constant return to scale	15	15	11	7.28	9.86	20.37
Decrease Return to Scale	168	135	12	81.55	88.82	22.22
Total	206	152	54	100	100	100

Source: Primary Survey Data of 2019

3.2. Econometrics Analysis

3.2.1. Determinants of Efficiencies among MSEs

Table 3. Empirical Estimate of Two Limit Tobit Model

Variables	Pooled Enterprise		Micro Enterprise		Small Enterprise	
	Coef.	P>t	Coef.	P>t	Coef.	P>t
INICAP	-1.89e-07	0.496	-2.00e-06	0.130	7.02e-08	0.766
EDU	.001037	0.906	-.0069442	0.543	.0169179	0.138
MATRA	.0163216	0.233	-.0154965	0.677	.0359219	0.014**
INVICT	1.75e-06	0.004**	5.89e-08	0.982	2.95e-06	0.000: ***
AGMA	.0017996	0.588	.007657	0.070*	.0007291	0.873
FAMSHH	.3321616	0.051*	.3207431	0.065*	-.1819174	0.259
SIZENT	2.11e-07	0.302	2.41e-06	0.032**	2.96e-07	0.104
SONET	.0303172	0.659	.0827541	0.279	-.0943626	0.524
VOTRA	-.1818627	0.094*	-.2036614	0.065*	-.0996011	0.479
AGEN	-.3374363	0.046**	-.3055587	0.075*	.1857473	0.269
BUSPL	.3636799	0.001: ***	.2866709	0.016**	.5547571	0.001: ***
LOCEN	-.000184	0.182	-.0001451	0.376	-.0004173	0.068*
ACCRE	-.0084482	0.832	-.083253	0.079*	.1132818	0.092*
N = 206			N = 54		N = 152	
LR chi2(13) = 46.78			LR chi2(13) = 50.70		LR chi2(13) =22.43	
Prob > chi2 = 0.0000			Prob > chi2 = 0.0000		Prob > chi2 =0.0491	
Log likelihood = -42.37			Log likelihood = 5.137		Log likelihood = -30.269	
Pseudo R2 = 0.3557			Pseudo R2 = 1.2542		Pseudo R2 = 0.2703	

Note: ***, ** and * indicate that statistically significant at less than 1%, 5% and 10% significant level, respectively.

Model Results:

For the sake of estimating determinants of technical efficiency of MSEs using the Tobit Model, the study used data envelopment analysis to obtain technical efficiency scores which were then used as a dependent variable in the Tobit Model. The results through the application of two-limit censored Tobit model in Table 3 showed that the TE effects of MSEs incorporated in the model are jointly significant as the p-value (0.000) of the log-likelihood ratio of chi-square test (χ2Cal =LR =46.78) is significant at one percent level. This shows that not only the variables incorporated in the model were jointly responsible for the variation of technical efficiency among the MSEs, but also the existence of considerable technical inefficiency in the study area. Variables that were found to have significant effect on TE are explained as follow:

Business Plan (BUSPL): This variable positively and significantly affects level of technical efficiency at less than 5 per cent and1 percent significant level in micro, small and both enterprises. The Tobit model indicated that a change in this dummy variable represents having of the formal planning done by MSEs would increase the probability of micro, small and both MSEs together to fall under efficient category by about 28.6%, 55.4% and 36% respectively while assuming all other factors remain constant. This implies that in the study area the business plans and record keeping practice less likely enable MSEs owners to calculate risk associated with production, marketing, and purchasing decisions by clearly determining expenditures and sales/ income.

Family size (FASIZE): Family size of the MSE operators was positively and significantly affected by technical efficiency at less than 5 per cent and 10 percent significance level in both enterprises and micro enterprise category. The result of Tobit model indicated that as the family size increased by one member would increase the probability of pooled enterprises and micro enterprise to be technically efficient by 33 per cent and 32percent while other variables remaining constant. This implies that increase in family size was found to have higher social and economic growth of MSEs.

Age of Manager: The level of technical efficiency of MSEs was positively and significantly affected by the age of the promoters at less than 10 per cent significant level in micro enterprises category. The result of the study indicated that one-year increase in promoters' age would increase the probability of micro enterprises category to be technically efficient by 0.7 per cent while keeping all others variables remains constant. This implied that, Older and experienced promoters were found to use technical and human skilled manpower leading to higher efficiency.

Investment on Information, Communication and Technology (INVICT): Investment on ICT of MSEs was positively and significantly affects the technical efficiency of both MSE and small enterprises at less than 5 per cent and 1 percent significant level. The Tobit model result implies that a one Birr increase investment in acquisition of ICT would increase the probability of both MSEs and small enterprises to be technical efficient by 1.75 percentages and 55.4percent increment while assuming all other variables remain constant. This implies that

investment in information technology (ICT) would have enabled enterprises to overcome the production constraints.

Size of the enterprises (SIZENT): Size of the enterprise was positively and significantly affected to technical efficiency at less than 5 per cent significance level in micro enterprise category. The tobit model result indicted that a one percent change in enterprises size would increase the probability of technically efficiency of micro enterprises category by 24per cent while keeping all other variables remain constant.

Age of the enterprises: Age of enterprise of the pooled enterprise and micro enterprise was negatively and significantly affecting technical efficiency at less than 5% and 10 per cent significance level. The result of tobit indicated that as the age of enterprise increased by one year would decrease the probability of pooled enterprise and micro enterprises to be technically efficient by 33.74% and30.55 per cent would decrease respectively while other variables remaining constant. This implies that increase in age of enterprise was not providing knowledge of organizational routines and necessary skills enabling the promoters to apply them to the current business.

Managerial training (MATRA): Managerial training was positively and significantly affected to the level of technical efficiency at less than 5 per cent significant level in small enterprise category. The tobit model result indicted that a unit change in managerial training would increase the probability of small enterprise category to be technically efficient by 3.5 per cent while assuming all other factors remain constant. This implies that MSEs managers/promoters had acquired one more additional unit of managerial training lead to towards narrowing technical inefficiency gap.

Vocational training: Vocational training was positively and significantly affect the level of technical efficiency at less than 1 per cent significant level in small enterprise category. The tobit model indicted that a unit change in acquisition of vocational training would increase the probability of small enterprises category to be technically efficient by 11 per cent respectively while assuming all other factors remain constant. This implies that MSEs owners had acquired one more additional unit of vocational training lead to towards narrowing technical inefficiency gap.

4. Policy Implications

The findings of the study deem for appropriate supportive interventions to improve technical efficiency of micro and small enterprises in West Wollega zone. Hence, the primary focus should be given to enhance the growth and productivity of MSEs through targeted government support. Specific interventions shall focus on the following issues:

- ✓ Given the resource constraints facing MSEs, there is no choice but to improve internal resource use efficiency significantly in order to become competitive in the local, regional as well as national market.
- ✓ Several firm-specific characteristics such as managerial skill, adoption of ICTs and size of enterprise as well as improvement of business plan of firms may have significant implications on the firm-level technical efficiency.
- ✓ Hence, efficiency gains could come from the improvement in the managerial skill such as giving managerial and technical training to the labor force and undertaking investment in ICTs. It is imperative that the government should provide support with respect to timely and adequate supply of quality inputs and training, affordable and timely credit facilities to micro and small-scale enterprises.
- ✓ Several firm-specific characteristics such as managerial skill, adoption of ICTs and size of Enterprise as well as improvement of business plan of firms may have significant implications on the firm-level technical efficiency.
- ✓ Hence, efficiency gains could come from the improvement in the managerial skill in technical training of the labour force and management, and investment in ICTs. It is imperative that the government should provide support with respect to timely and adequate supply of quality inputs and training, affordable and timely credit facilities.

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