Efficiency of Micro and Small Enterprises in Ethiopia: Evidence from Data Envelope Analysis Model

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Abstract

This study measures the technical and scale efficiency of Micro and Small Enterprises (MSEs) and input slacks using Data Envelop Analysis (DEA) model and identifies the determinants of efficiencies of MSEs by employing ordinary least square (OLS) econometrics model. A sample of 375 randomly selected MESs are included in the study. The study found that the average technical and scale efficiency of MSEs are relatively low; technical efficiency averaged at 30 percent and 38.4 percent under constant returns to scale (CRS) and variable returns to scale (VRS) assumptions, respectively. Besides, the overall average scale efficiency score of MSEs was estimated at 77.8 percent. The highest mean technical and scale efficiencies were registered in the construction (71.8 percent) and manufacturing (85.7 percent) sectors, respectively. Whereas, the lowest technical and scale efficiency goes to urban agriculture sector and service sector, with 38.9 percent and 67.2 percent, respectively. The level of inputs, enterprise age and sector, human capital, labor productivity variables significantly affect relative technical efficiency level of MSEs with different directions while variables such as start-up capital, gender of the enterprise manager and availability of support from the government identified statistically not significant in determining the MSEs' technical efficiency.

Key words: MSEs, Technical Efficiency, DMU

1. Introduction

Micro and Small Enterprises (MSEs) has been recognized as a key component of many nations' economy. Development of MSEs is believed to be the major source of economic diversification, employment creation and income generation, particularly for urban youths who are engaged in informal sector of the economy. More importantly, MSEs facilitate the economic transition of countries without demanding skilled labor, large capital and advanced technological breakthrough (Minh et al., 2007). In addition, MSEs can innovate, adopt new technology and know-how, broaden the tax base, and diversify risk (Brixiova, 2009). Furthermore, the development of MSE permits greater decentralization, reduce income inequality, and mobilize latent entrepreneurs (Young, 1994).

The current government of Ethiopia, recognizing the significant contribution of this sector to overall development, showed its dedication to accelerate the development of MSEs through the issuance of National Micro and Small Enterprises Development Strategy in 1997 and the Establishment of the Federal Micro and Small Enterprises Development Agency (Mulu G., 2007). Ethiopia's industrial development strategy issued in 2003 also singled out the promotion of MSE development as one of the important instruments to create productive and dynamic private sector (Ageba and Ameha, 2004; cited from Mulu G., 2007).Thus, measuring efficiency of the sector will be important to the government, policy makers, and MSEs.

Number of employees, capital investment and scale of operation can be used to define micro, small, medium and large scale enterprises. In the case of Ethiopia, there is lack of uniform definition at the national level to have a common understanding of the MSEs. While the definition by Ministry of Trade and Industry (MoTI, 1997) uses capital investment, the Central Statistical Authority (CSA, 2008) uses employment and favors capital intensive technologies as a yardstick (CLEP, 2006).

Despite their momentous contribution to economic development and poverty reduction, MSEs are also circled by various challenges, particularly in developing countries. The most often mentioned challenge is access to finance. There exists a general consensus among policy makers, scholar and business experts that MSEs faced with financial constraints (Akoten et al.,

2006; Ishengoma & Kappel, 2008; Beck & Demirguc-Kunt, 2006). Hussain et al. (2012) has also accredited the human resource and technological capabilities as major determinants of MSEs' growth. Moreover, Sarwoko & Frisdiantara (2016) identified personal, managerial and environmental factors as determinants of MSEs' growth. Technical inefficiency has been also mentioned as significant contributor to low productivity, poor performance and slower growth of MSEs while improving the production efficiency of these business entities has been considered as the way-out mechanism. Moreover, the current state of world economy coupled with dynamism in technological progress forced enterprise to be more efficient to remain competitive and profitable in the market.

Productivity growth is a precondition for increasing people's living standards and maintaining competitiveness in the economy. Low total factor productivity is the key reason for persistent poverty in developing countries. Moreover, firms need to be productive enough in their operation. Firm level productivity in turn guides their survival and growth rate. Productivity and firm growth, on the other hand, determined by many variables; some are firm specific, some industry or sector specific while some of the determinant factors are economy wide.

Some literature, (Gebreeyesus 2007; Page and Söderbom, 2012; Bigsten and Gebreeyesus 2007), indicate that MSEs grow faster than medium and large enterprises, though others found positive relationship between firm growth and size (Shiferaw 2012; Bewen et al. 2009). For instance, a study by Gebreeyesus (2007) based up on a survey of 972 MSEs in selected cities of Ethiopia found that firm's initial size and age are inversely related with growth providing evidence that smaller and younger firms grow faster than larger and older firms. Firm size in turn may relate with productivity. Bewen et al. (2009) has also found that three out five MSEs failed within the first few months of establishment, highlighted the positive and significant impact of age for firm growth.

Similarly, firm size explains MSEs' productivity and efficiency level. According to Page and Söderbom (2012), the average worker in a 160-worker firm produces as much value-added in 15 minutes as the average worker in a 5-worker enterprise does in an hour. The study also found the existence of strong positive relationship between value-added per employee and

firm size. Firms with 30 employees have, on average, twice as much value-added per worker as firms with 5 employees; hence the size-productivity differential is very pronounced, even amongst small firms.

Financial constraint is the other major determinants of SME growth. Theoretically, it is true that firms can finance their business activities both from internal and external sources. However, many firms in developing countries (micro and small businesses in particular) cannot resort to capital markets the firms are not in a position to access such markets (Gebrehiwot & Wolday, 2006; Eshetu & Mammo, 2009; Anthony & Thomas, 2012). Formal financial institutions excluded MSEs because either the enterprises couldn't fulfill the bank's lending requirements or the banking sector considers these business firms as risky (Gebeyehu, 2002). Sometimes it is visible that formal financial institutions favor large and medium enterprises though their policies do not explicitly stated in such a way (Tybout, 1999). Access to credit for MSEs is limited due to unclear property rights and lack of assets that can be used as collateral (Lutz et al., 2011). This is empirically supported by Page and Söderbom (2012) in which out of an estimated 365-445 million, formal and informal MSEs in the developing world, approximately 70 per cent report that they do not use any external financing, although they would do so if financing were available. Besides, Brown & Earle (2004) indicated the existence of strong evidence that access to external credit increases the growth of both employment and sales.

On the other hand, some study results indicate that access to credit is not a significant determinant of small firm growth; instead, other observable and unobservable characteristics of firms appear to cause growth (Bewen et al., 2009; Bari 2005; Beck 2007). Business experience, education, location of the business to traditional market places, possession business license and male headedness relate positively to the growth of MSEs (Gebreeyesus, 2007). Competition among themselves and from large firms, cheap imports, insecurity and debt collection also hinder growth of MSEs (Bowen et al., 2009). On the other hand, Anderson & Tell (2009) try to show the managerial effect of firm growth and found that managerial traits and characteristics, managerial intentions, and managerial behavior or roles highly correlated to enterprise growth.

Recognizing their manifold contribution in developed and developing countries economy, several empirical studied conducted so far indicates that MSEs are the point of policy discussion and a topic for research for practitioners and in the academia. Among the researchers, Chapelle & Plane (2015), Le & Harvie (2010), Alvarez & Crespi (2001), Heilbrunn et al. (2011), Ajibefun & Daramola (2003) tried to estimate the technical efficiency of MSEs in the developing country context.

A study by Le & Harvie (2010) examined the performance of manufacturing small and medium enterprises in Vietnam. Specifically, it evaluates firm level technical efficiency and identifies the determinants of technical efficiency using Stochastic Frontier Production (SFP) approach for 5,204 enterprises from three surveys. The results from the econometrics estimations reveal that manufacturing firm in Vietnam have relatively high average technical efficiency ranging from 84.2 percent to 92.5 percent. The study further examines the factors influencing efficiency and found that firm age, size, location, ownership, cooperation with a foreign partner, sub-contracting, product innovation, competition, and government assistance are significantly related to technical efficiency, with varying degrees and directions.

Another study by Alvarez & Crespi (2001) tried to identify the basic determinants of efficiency among Chilean small manufacturing enterprises using plant survey data and non-parametric deterministic frontier methodology. They found that efficiency is positively associated with the experience of workers, modernization of physical capital and innovation in products. In contrast, they also found that variables such as outward orientation, owner education and participation in some public programs had no statistically significant impact on efficiency of firms.

Using a Data Envelope Analysis model, Heilbrunn et al. (2011) has also identified firm level efficiency of MSEs and level of input slacks which intern lead to technical inefficiency. The result revealed that 89 out of 248 SMEs were found to be on the frontier. Besides, financial management variables were the main causes of inefficiency amongst MSEs in the study.

Leza et al. (2016), employing DEA model applied to 354 MSEs in Wolayita zone of Ethiopia, found a mean efficiency score of 0.61 which was disaggregated to 0.59 and .0.67 for micro and

small scale enterprises, respectively. Meanwhile, promoter's age, social networking, initial capital, vocational training and investment in ICT were identified as significant and positive determinants of technical efficiency.

Since the seminal work of Farrel (1957), comparing the productivity and efficiency level of Decision Making Units (DMUs) has been recognized as one area of research. Consequently, significant bodies of empirical studies were conducted on technical efficiency and determinants of efficiency. Even though MSEs efficiency has been studied by different researchers in some sectors of the economy, to the best of the researchers' knowledge, there are scant of scholarly researches undertaken so far on efficiency of MSEs in Ethiopia, of which were Leza et al. (2016) and Gemechu & Fitwi (2016).

MSEs Efficiency, however, is a relative concept which needs area specific study. Therefore, this research aimed at measuring the efficiency and the determinants of efficiency among MSEs in East Gojjam zone, Ethiopia and emphasizing on firm specific determinants of efficiency. The efficiency of MSEs examined using DEA model and the determinants of efficiency by Ordinary Least Square (OLS) estimation. The model estimation results revealed that most MSEs in East Gojjam zone were found to be relatively inefficient, operated below the production frontier and exhibited huge potential of productivity through increasing their efficiency. Moreover, labor productivity, form of ownership, enterprise age and sector effects were found to be significant determinants of MSEs' technical efficiency, whereas, the effect of location is asymmetric.

The rest of this paper is organized as follows: Section II presents the data and research methodology adopted in the study. Section three of the paper deals with results and discussion. Finally, the conclusion and policy implication part is presented in Section four.

2. Data and Methodology

The study was based on primary survey data collected from MSEs in East Gojjan Zone. Structured questionnaires were distributed to owners/manager of MSEs by the researchers

themselves and data enumerators. Secondary data were also obtained from Office of Trade and Industry and MSE Offices of the Zonal and Woreda[1] administrations.

The actual sample size of any study depends up on the total population, the level of precision to be achieved, the degree of homogeneity, the research budget and the available time to accomplish the study. Hence, using the formula set by Yamane (1967), the total sample size for this study is determined as follows.

$$n = \frac{N}{1 + N(\alpha)^2}$$

$n =$ the actual sample size

$N =$ the total population

$\alpha =$ degree of accuracy usually set at 0.05

Thus, from the total population of 10,081 MSEs in the six selected towns of East Gojjam Zone, 385 MSEs were considered for the study.

The study employed three stage sampling technique. At the first stage, sample towns were selected from East Gojjam Zone purposively, namely; Debre Markos, Amanual, Debre Elais, Bichena, Dejen and Mota, based on their MSE size. In the second stage, using business types as strata, sample MSEs were selected proportionately from each town and sector. Finally, Sample MSEs were selected with in 10th intervals as per the firm list obtained from the MSE development offices. MSEs which were operational for at least one year period and still being in operation at the time of the survey were considered. Enumerators were also selected from respective sampled town's MSE development offices and training was given regarding the questionnaire.

The Empirical Models

The DEA Model

To estimate the efficiency level of DMUs the study employed a DEA model as developed by Charnes et al. (1978). This model is an input-oriented with constant returns to scale

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[1] Woreda is the second lowest administrative level in Ethiopia. The lowest administrative level is Kebele.

assumption, implying that all DMUs are deemed to operate at their optimal scale. Imperfect completion, financial constraints and others, however, forced business firms to operate sub-optimally. The Banker et al. (1984) model on the other hand is an extension of the CRS-DEA model which accounts the VRS assumptions. This assumption of the DEA model enables us to isolate pure TE form the scale efficiency component (Coelli, 1996).

This method is a multi-factor, productivity analysis for measuring the relative efficiencies of DMUs (Ayaz and Alptekin, 2012). It is a non-parametric method of estimating production frontiers. DEA measures the efficiency of DMUs by making comparison with the best producer in the sample to derive relative efficiency scores. Based on the DEA model, technical and scale efficiency scores are measured relative to the production frontier; MSE is said to be efficient if it operating on the production frontier. Meanwhile MSEs are inefficient if it fails to achieve the maximum output from a given level of input(s) or operating below the production frontier. Therefore, DMUs are ranked based on their distances from the efficient DMU(s) or the production frontier. The production frontier of the most efficient firm, however, is not known in practice, rather estimated on a sample DMUs (Coelli, 1996).

The input-oriented DEA model for multiple outputs and inputs case is expressed as:

$$Efficiency = \frac{weighted\,sum\,of\,outputs}{weighted\,sum\,of\,inputs} , \quad .... (1)$$

For **s** DMUs, each with **m** inputs and **n** outputs, the relative efficiency score for DMU**i** is obtained by solving the following linear programming model as proposed by Banker et al. (1984):

$$\max \frac{\sum_{k=1}^{n} v_k y_{kj}}{\sum_{j=1}^{m} u_j x_{ji}}, \qquad \text{Subject to} \qquad \frac{\sum_{k=1}^{n} v_k y_{kj}}{\sum_{j=1}^{m} u_j x_{ji}} \leq 1 .... (2)$$

Where: $v_k u_j \geq 1$ k, j ; k= 1,…, n; j= 1, …, m and i= 1, …, s

y_{ki} = the amount of output k produced by DMU_i

x_{ji} = the amount of input j used by DMU_i

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v_k and u_j $=$ weights given to output k and input j, respectively.

For DEA model, the following output and input variables were used to measure relative efficiency of MSEs.

Output (Y): Yearly values (in Birr) of total sales or revenue generated by MSEs were used as a proxy to measure the output of that particular enterprise.

Fixed Capital (X_1): Fixed capital represents assets of the establishments with a productive life of one year or more. It shows the net book-value of fixed assets at the beginning of the survey period; evaluated by combining data relating to initial equipment and the value of registered investments minus the value of sold and disposed machineries, equipment and depreciation during survey period. Straight line deprecation method was employed to make adjustments of depreciation.

Labor (X_2): The Birr value of wages and salaries paid to workers was used to estimate the labor input. This variable includes all payment made to workers during the full year of the survey period.

Cost of Raw Materials (X3): This input variable includes all costs related to the purchase of raw materials, payments made for utilities and other miscellaneous expenses measured in terms of Birr.

DEA has some advantages over the SFP efficiency estimation model. First, it is not necessary to assume a specific functional form for the production function. Second, it makes no priori distinction between the relative importance of outputs and inputs considered as relevant in firm decision-making process. Third, DEA is relatively insensitive to model specification because the efficiency measurement is similar, regardless of input oriented or output-oriented measurements (Minh, 2007).

The Econometric Model

Determinates of MSE's efficiency was estimated using OLS econometric model. As the value of the dependent variable, MSE's technical efficiency score, is continues, OLS estimation provide BLUE estimate of parameters amid the fulfillment of all the classical linear regression

assumptions. Following Greene (2002) and Macdala (1983) as the OLS model can be specified as:

$$Y_i = \alpha + \beta X_i + \varepsilon_i$$

Where $Y_i = $ efficiency of DMU_i

$X_i = $ Vector of Indipendent Variables obsrved over DMU_i

$\varepsilon_i = $ the usual error term

α and β are parametrs to be estimated

The expanded OLS model is;

$$(\textbf{Technical Efficiency})_i$$
$$= (\ln(\textbf{fixed capital}))_i + (\ln(\textbf{labor}))_i + (\ln(\textbf{variable input})_i$$
$$+ \ln(\textbf{startup capital})_i + \ln(\textbf{human capital}) \quad + (\ln(\textbf{labor producitvi})_i$$
$$+ (\textbf{sector})_i + (\textbf{town})_i + (\textbf{form of ownership})_i + (\textbf{age of enterprise})_i$$
$$+ (\textbf{enterprise age square})_i + (\textbf{educational level of the manager})_i$$
$$+ (\textbf{sex of the manager})_i + (\textbf{support from government})_i + \varepsilon_i$$

For the OLS model estimation, the estimated efficiency scores of DMUs in the DEA model were used as a dependent variable along with a set of explanatory variables. Literatures identified different variables as determinant factors for MSE efficiency.

Regarding to the explanatory variables used in this study, the first three variables are the same as the input variables of the DEA model. The only adjustment we made from the DEA model is transforming the variables to their logarithmic form to deal with outliers and ensure the normality assumptions of the OLS model. The independent variables of the OLS model are explained below.

Table 1: Description of Explanatory Variables

Variable	Description and Measurement	Expected sign
lnfcap	Log of monetary values of current fixed assets (in Birr)	-
lnlab	Log of salaries and benefits of employees (in Birr)	-
lnviput	Log of intermediate input value (in Birr)	-
ln_scapital	Log of start-up capital (in Birr)	+

ln_hcapital	Log of average school year of employees	+
lnlabor_productivity	Log of total sales/revenue per number of employees	+
ln_age	Log of enterprise age in years	+
ownerd_partnership	Ownership dummy (1 for partnership, 0 otherwise)	+
gender	Gender dummy (1 for Male, 0 otherwise)	+
Bichena Dummy	Bichena dummy (1 for Bichena, 0 otherwise)	+/
Amanual Dummy	Amanual dummy (1 for Amanual, 0 otherwise)	+/
Debre Markos Dummy	Debre Markos dummy (1 for Debre Markos, 0 otherwise)	+/
Debre Elias Dummy	Debre Elias dummy (1 for Debre Elias, 0 otherwise)	+/
Dejen Dummy	Dejen dummy (1 for Dejen, 0 otherwise)	+/
Mota Dummy	Mota dummy (1 for Mora, 0 otherwise)	+/
Trade Dunny	Trade dummy (1 for enterprises in the trade sector, 0 otherwise)	+/
Construction Dummy	Construction dummy (1 for enterprises in the construction sector, 0 otherwise)	+/
Manufacturing Dummy	Manufacturing dummy (1 for enterprises in the manufacturing sector, 0 otherwise)	+/
Urban Agriculture Dummy	Urban agriculture dummy (1 for enterprises in the urban agriculture sector, 0 otherwise)	+/
Service Dummy	Service dummy (1 for enterprises in the service sector, 0 otherwise)	+/-

3. Results and Discussions

3.1. Descriptive Statistics

Description of enterprise in terms of their initial and current capital, age, and number of employees is indicated in the table below. It shows mean and standard devotion of the aforementioned variables across sectors and towns.

Table 1: Descriptive Statistics on Enterprise Characteristics

Sector/Town	Startup Capital	Current Capital	Enterprise Age	Number of Employees
Manufacturing	12,616.67 (14,726.78)	214,540.3 (467,434.9)	4.18 (3.20)	3.89 (3.41)
Service	9,875.23 (21,143.4)	73,871.82 (133,220.7)	3.75 (3.01)	2.59 (2.47)

Urban-Agriculture	10,042.04	50,600.51	4.91	3.12
	(22,659.39)	(50,216.49)	(5.68)	(2.13)
Construction	51,000.00	399,490.9	2.54	5.36
	(74,690.03)	(485,420)	(1.29)	(3.69)
Trade	10,885.71	54,559.53	3.83	1.25
	(16,125.87)	(69,873.61)	(3.49)	(0.57)
Dejen	22,114.81	111,023.9	4.03	1.89
	(34,456.97)	(179,633.5)	(2.58)	(1.15)
Debre Markos	9,060.571	869,85.13	3.22	2.36
	(22,963.08)	(272,088.4)	(2.82)	(2.42)
Amanual	8,225.00	759,87.04	3.69	1.39
	(15,379.63)	(149,016.3)	(2.22)	(1.56)
Mota	18,103.81	720,33.93	5.02	1.83
	(26,013.83)	(91,201.06)	(5.78)	(1.45)
Bichena	10,546.74	93,569.57	4.40	2.24
	(13,375.63)	(221,903.9)	(3.82)	(2.22)
Debre Elias	8,324.111	63,597.78	3.76	2.18
	(12,860.77)	(80,399.65)	(2.48)	(2.45)
Overall Average	**11,999.77**	**81,784.33**	**3.96**	**2.03**
	(22,271.91)	**(193,474.3)**	**(3.75)**	**(2.04)**

Source: Survey data, 2019
Note: Standard devotions are in parenthesis

The average start-up capital required to establish and run a new MSE in the study area was about Birr 12,000. The construction sector was found to be the most capital intensive sector while people engaged in service sector needed relatively low start-up capital. Standard deviation figures have also revealed important information; the capital requirement to start a small business varied significantly across sectors and administrative towns.

Moreover, MSEs' capital base has been exhibited dramatic increment during the average four years of their operation, jammed on average by 400% to about Birr 82, 000. Among economic sectors, the construction and manufacturing sectors showed remarkable growth in capital. Likewise, the standard deviation figures of the current capital indicated gigantic variations among business types and towns. Moreover, the median age of MSEs was about 4 years. Sector wise, urban agriculture and manufacturing type of business incorporated older firms while firms in the construction sector have relatively young firms. One of the economic importance of MSEs is that they can create employment opportunities, particularly for marginalized and less privileged part of the society. In this regard, the mean employment status of MSEs was 2

people; the construction and manufacturing sectors create more job opportunities compared to other line of businesses. MSEs engaged in trading activities, however, need less workers and mostly run by the owner and/or family members.

3.2.   Model Estimation Results

Technical Efficiency of DMUs

One measure of efficiency of DMUs is their technical efficiency, which can be measured as the ratio of weighted outputs to inputs. Those enterprises which operate on the production frontier are considered as the best performers in terms of technical efficiency and have technical efficiency score of 100 percent (Coelli, 1996). Table 2 below presents a summary of technical efficiency results of the input oriented[2] DEA model for both CRS and VRS assumptions over different business types or economic sectors.

As indicated in the above table, majority of MSEs was found to be relatively technically inefficient; about 96 percent and 92.5 percent MSEs operated below the production frontier under CRS and VRS assumptions, respectively.
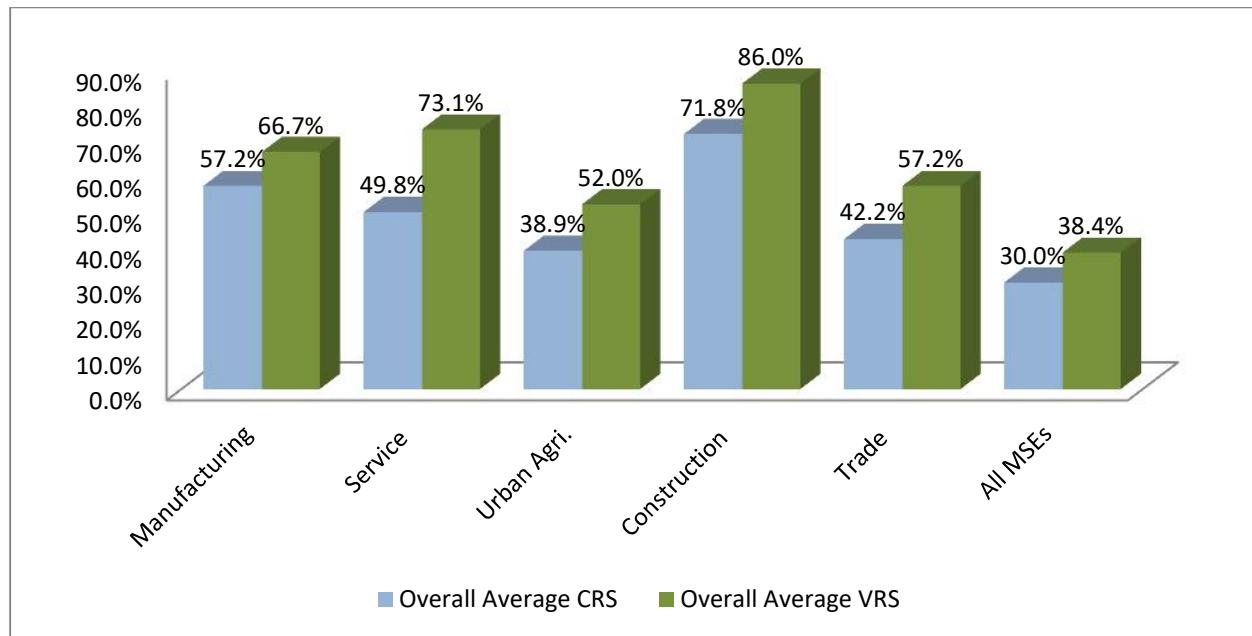
Table 2: Technical Efficiency Scores

Sectors	Return to Scale	No. of Efficient MSEs	No. of Inefficient MSEs	% of Inefficient MSEs	Min. Efficiency Score	Max. Efficiency Score	Overall Average
Manufacturing	CRS	22	353	94.1	0.062	1	**0.572**
	VRS	51	324	86.3	0.065	1	**0.667**
Service	CRS	6	38	86.4	0.012	1	**0.498**
	VRS	14	30	68.2	0.058	1	**0.731**
Urban Agriculture	CRS	5	44	89.8	0.015	1	**0.389**
	VRS	8	41	83.7	0.090	1	**0.52**
Construction	CRS	5	6	45.5	0.050	1	**0.718**
	VRS	7	4	63.6	0.052	1	**0.860**
Trade	CRS	12	223	94.9	0.010	1	**0.422**
	VRS	30	345	92.0	0.012	1	**0.572**
All MSEs	**CRS**	**15**	**360**	**96.0**	**0.007**	**1**	**0.300**
	VRS	**28**	**347**	**92.5**	**0.017**	**1**	**0.384**

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[2] The input orientation seeks to minimize the usage of inputs given a fixed level of output while the output orientation maximizes the level of output for a given level of inputs.

Source: Survey data, 2019

The overall average technical efficiency scores of MSEs were estimated at 30 percent and 38.4 percent under CRS and VRS respectively while remaining percentages represents technical inefficiency of MSEs. This is by far lower than 61 percent average efficiency score of the study result by Leza et al. (2016) in Wolaita zone. Significant variations were also observed on average technical efficiency scores amongst MSE sectors. Enterprises engaged in the construction sector have relatively higher average technical efficiency scores; 71.8 percent and 86 percent under CRS and VRS, respectively. Conversely, considering the CRS assumption, the lowest mean technical efficiency is observed in the urban agriculture sector (38.9 percent), implying that on average enterprises in this sector could use 61.1 percent fewer factors to be on the efficiency frontier. Similarly, in the construction sector, 29.8 percent of inputs were underutilized.

Figure 1: Mean Technical Efficiency of MSEs

Source: Survey data, 2019

Overall, estimation results confirm that there is huge potential for MSEs to increase productivity through enhancing their technical efficiency. Besides, the technical efficiency scores are expressed in relative terms, indicating MSEs have mammoth potential to be relatively efficient as the better performers, those MSEs operated close to the production frontier, before even struggling for absolute efficiency.

Scale Efficiency

On the other hand, researchers estimate scale efficiency of DMUs to label them as efficient and inefficient in their production process. According to Coelli (1996), measuring scale efficiency is vital when we assume that MSEs were constrained by many factors (such as finance or policy) and unable to operate at their full capacity. Once we obtained technical efficiency using constant returns and variable returns assumptions, it is an easy task to drive scale efficiency of enterprises. Technically speaking, scale efficiency is the ratio of technical efficiency under CRS to technical efficiency under VRS.

Table 3 below shows the estimation result of scale efficiency of MSEs. As indicated in the table, out of the total sampled 375 MSEs, only 17 MSEs were scale efficient, enterprises which have relative scale efficiency scores of 100 percent, while the remaining 95.5 percent enterprises

were identified as relatively scale inefficient. Comparisons among MSE sectors showed that the construction sector has relatively lowest proportion (54.5 percent) of inefficient enterprises while this proportion is relatively high for trade and manufacturing sectors, 94.5 percent in each. Moreover, the mean scale efficiency level of MSE estimated at 77.8 percent; the highest score registered in the manufacturing sector (85.7 percent) and the lowest in the trade sector.

Table 3: Scale Efficiency of MSEs

Sectors	No. of Efficient MSEs	No. of Inefficient MSEs	% of Inefficient MSEs	Min Efficiency	Max Efficiency	Average Efficiency
Manufacturing	2	34	94.4	0.461	1	0.857
Service	6	38	86.4	0.028	1	0.672
Urban Agriculture	5	44	89.8	0.155	1	0.740
Construction	5	6	54.5	0.291	1	0.818
Trade	13	222	94.5	0.031	1	0.737
All MSEs	**17**	**358**	**95.5**	**0.116**	**1**	**0.778**

Source: Survey data, 2019

Input Slacks

Input slacks are important estimation results in DEA efficiency analysis. It tells us the level of input that the firm can reduce to be 100 percent efficient in production. In other words, if MSEs reduce their respective input slacks they can produce at the efficiency frontier. The DEA estimation result for our sampled data produces the slack amounts for the three inputs used in the model; fixed capital, labor and variable inputs, all measured in monetary values. Based on the estimation result of the model, MSEs were more efficiently using their variable inputs in relative terms. Conversely, gaps were observed on the efficient employment of fixed capital and labor inputs.

Fixed capital were efficiently utilized in relative terms, on average, in the construction sector while less efficiently utilized in the service sector, with input slack value of Birr 148.5 and Birr 2761, respectively. Considering labor, it is less efficiently utilized in the manufacturing sector and more efficiently utilized in the trade sector. An input slack of Birr 148.5 in the construction sector implies firms in this sector can be at their efficiency frontier if they reduce their fixed

capital by Birr 148.5 along with other slack inputs used in the model (reduce labor by Birr 939.281 and variable costs by Birr 2271.761). The table below shows us the mean slack amount of three inputs across different sectors and the total data. Sector wise, fixed capital was the causes of inefficiency in the urban agriculture sector. This is true most agricultural activities are performed by labor, supported by less input slack of the variable. In the manufacturing sector, fixed capital is relatively wisely used while variable input is the highest contributor of firm inefficiency. Similarly, MSEs in the construction sector and trade sectors have relatively higher variable input slacks.

Table 4: Average Input Slacks (in Birr)

Sectors	Fixed Capital	Labor	Variable Input
Urban Agriculture	2,142.48	280.26	922.68
Manufacturing	687.81	3,549.80	8,139.09
Construction	148.55	939.28	2,271.76
Trade	1,161.75	420.39	705.76
Service	2,761.03	678.62	3,256.23
Total	**2,365.08**	**134.16**	**24.62**

Source: Survey data, 2019

3.3. Econometric Estimation Results

Before conducting the econometric estimation of determinants of efficiency among MSEs, cleaning of data to make it ready for estimation purpose was done. The data were checked for outliers and some corrections (log transformation) were made on some continues explanatory variables. For this study we took the technical and scale efficiency scores of DMUs, as obtained from the DEA model. Technical efficiency score of MSEs is a continues variable which allow us to use Ordinary Least Square (OLS) to identify the determinants of relative technical efficiency of MSEs, amid all the traditional assumptions of OLS model holds true.

Three independent OLS regressions were conducted to estimate the determinants of technical and scale efficiency. The first and second regression models present the determinants of

technical efficiency of the CCR and BCC model estimates of technical efficiency respectively. The third model, on the other hand, measures the determinants of scale efficiency among MSEs.

The OLS estimation results revealed that there is significant and negative effect of the three input levels (capital, labor and variable inputs) on the efficiency of MSEs ($p<0.001$). This is obviously true since the study is based on input-oriented models. The regression coefficients for these input variables as determinants of scale efficiency were, however, statistically insignificant. Moreover, labor productivity and age has statistically significant positive effect on firm level efficiency under both the CCR and BCC models while the impact of human capital is significantly negative. This implies that the stock of knowledge in each firm contribute less to the efficiency achievement of business enterprises in the study area. The start-up capital variable is found to be statistically insignificant.

The town dummies were non-systematic; MSEs located in Debre Elias and Dejen were less efficient than those SMEs found in the reference town (Bichena). MSEs in the rest of the towns have no statistically significant effect on their mean efficiency scores compared to firms in Bichena. Symmetrical effect of individual location dummies is also corroborated by the overall location effect test statistics to uncover the mean difference in terms of technical and scale efficiency of MSEs across towns in the study area. As indicated below, the study failed to reject the null hypothesis which says no mean difference in efficiency of MSEs over different towns.

F(5, 344)	**= 0.71**
Prob> F	**= 0.6179**

The study has also tested the hypothesis that there is overall sectoral difference in mean efficiency. The estimate result for mean independence in technical efficiency and economic sectors in which MSEs are engaged revealed that there is indeed significant sector effect on mean efficiency of MSEs. Thus, we reject the null hypothesis, Ho: No difference in technical efficiency among sectors at 1% level of significance.

F(4, 344)	= 3.92
Prob> F	= 0.0040

Based on the estimation result showed in table below, the study found that, although we control for firm characteristics such as firm age, size, government support, there is a sector effect which is statistically significant. Similar result was obtained by Roberto and Cerspi (2001) in their analysis of the determinants of technical efficiency for Chilean Small firms. MSE in the construction, manufacturing, urban agriculture and services sectors were significantly high efficient compared to the sector in the reference category, MSEs engaged in the trade sector. For instance, the average technical efficiency of MSEs in the construction, manufacturing, urban agriculture and service sectors is on average higher by 27.4%, 9.5%, 15.6%, and 11.3%, respectively, from the mean efficiency of MSEs in the trade sector, using the CCR model.

Most important economic interpretation can be made by observing the estimation coefficients of enterprise age. The coefficient of age variable is positive and significant at 5% level of significance, indicated that older firms have relatively higher level of technical and scale efficiency than young enterprises. The critical economic explanation for this result is that learn by doing and economics of scale advantages. Human capital and form of ownership were also found to be significant determinants of efficiency, whereas gender of enterprise and availability of support from the government have no any statistical significant effect.

Table 5: Determinants of Technical Efficiency

Variables	Model 1 OLS (TE-CRS)		Model 2 OLS (TE-VRS)		Model 3 OLS(Scale Effi.)	
	Coef.	Se.	Coef.	Se.	Coef.	Se.
Lnfcap	-0.042***	0.009	-0.053***	0.010	0.003	0.006
Lnlab	-0.097***	0.010	-0.099***	0.012	-0.016	0.010
Lnviput	-0.041***	0.008	-0.063***	0.009	0.013	0.011
ln_scapital	0.010	0.010	0.012	0.013	0.017*	0.010
ln_hcapital	-0.055**	0.022	-0.036	0.025	-0.035	0.026
lnlabor_productivity	0.177***	0.012	0.191***	0.013	0.074***	0.016
ln_age	0.026**	0.010	0.005	0.013	0.030**	0.013
ownerd_partnership	0.102***	0.027	0.127***	0.035	0.035	0.034
gender(male)	0.018	0.016	0.018	0.020	0.012	0.020

Bichena Dummy	(dropped)		(dropped)		(dropped)
Amanual Dummy	-0.017	0.038	-0.040	0.044	-0.012	0.043
Debre Markos Dummy	-0.032	0.029	-0.013	0.038	-0.021	0.037
Debre Elias Dummy	-0.072**	0.031	-0.107***	0.036	-0.003	0.046
Dejen Dummy	-0.079**	0.036	-0.112**	0.045	-0.030	0.050
Mota Dummy	-0.029	0.028	-0.045	0.035	0.028	0.037
Trade Dunny	(dropped)		(dropped)		(dropped)
Construction Dummy	0.274***	0.085	0.387***	0.073	0.029	0.079
Manufacturing Dummy	0.095***	0.034	0.121***	0.044	0.056	0.038
Urban Agriculture Dummy	0.156***	0.035	0.177***	0.043	0.099**	0.040
Service Dummy	0.113***	0.027	0.096***	0.032	0.114***	0.031
Constant	-0.050	0.124	0.171	0.158	-0.238	0.166
R2	0.651		0.600		0.325	
Log-Likelihood	178.85		112.77		123.17	
AIC	-319.708		-187.538		-208.339	
Number of observations	363		363		363	

note: *** p<0.01, ** p<0.05, * p<0.1

4. Conclusion

In most economies, particularly in developing countries, MSEs are recognized as important contributors to income generation and diversification, employment and poverty reduction. Thus, most policy makers and scholars in the academia emphasized on the development of the sector for the overall betterment of the society. Among other, policies shall be supportive for flourishment of MSEs. Besides, productivity and efficiency issues of MSEs are at the center of research and policy debates.

The study, therefore, using a sample of 375 enterprises taken from ix cities in East Gojjam zone of Ethiopia, estimated the efficiency level and determinants of productive efficiency of MSEs employing the DEA and OLS models respectively. The study found that MSEs in the study area were relatively inefficient, both technically and in scale efficiency measures. For instance, about 96 percent (under CRS) and 92.5 percent (under VRS) of sample MSEs were found to be technically inefficient. The mean efficiencies of MSEs were also estimated at 30 percent and 38.4 percent under CRS and VRS respectively. Moreover, sectoral variations were observed in efficiency implied business firms in the construction sector were relatively efficient and the lowest mean efficiency is registered in the urban agriculture sector. Regarding the

determinants, the level of inputs has negative and significant effect on efficiency level of MSEs. Besides, the regression resulted confirmed that the sectoral effect on efficiency was significant while the study found non-systematic impact of location on MSEs' efficiency.

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Conflicts of Interest

Authors of this research article declare that there is no conflicts of interests

Authors Contribution

Data curation, Zemenu Amare Ayalew; Formal analysis, Abebe Birhanu Ayele and Zemenu Amare Ayalew; Investigation, Abebe Birhanu Ayele and Zemenu Amare Ayalew; Methodology, Abebe Birhanu Ayele and Zemenu Amare Ayalew; Software, Zemenu Amare Ayalew; Writing – original draft, Abebe Birhanu Ayele and Zemenu Amare Ayalew; Writing – review & editing, Abebe Birhanu Ayele.

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