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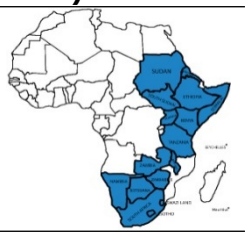

Analysis of Technical Efficiency and Profitability of Manufacturing Enterprises Operating in Informal Sector in Dar es Salaam Region

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KEYWORDS

Production, Technical efficiency, Profitability

ABSTRACT

Contribution of informal sector to the economy remains substantial in developed countries such as Tanzania. In order to promote sustainable industrialization through manufacturing enterprises in the informal sector, this study was conducted to analyze their technical efficiency and profitability. The study employed data from the 2019 Informal Sector Survey conducted in Dar es Salaam, Tanzania. Variables involved in this study were output, maximum possible output, technical efficiency level, value added, net income, return on assets, total asset value, capital investment in equipment and machinery, number of workers, labor costs, worker productivity, intermediate consumption, age of enterprise, and sex and education level of enterprise operators. The study employed multiple linear regression and stochastic frontier production function for analysis. Results from multiple linear regression showed that output increased significantly with labor costs ($p < 0.1$) and with intermediate consumption ($p < 0.01$). Also, results showed that technical efficiency ranged between 0.00 and 70.15, with an average of 17.77 percent. Additionally, profitability increased significantly with worker productivity ($p < 0.01$) and with sex of the enterprise operator being female compared to a male ($p < 0.05$). The study recommends enhancing resource optimization and strengthening workforce capacity to support profitable manufacturing practices.

1.0 Introduction

The informal economy, which comprises of half to three-quarters of all non-agricultural employment in developing countries has a noticeable contribution to the Gross Domestic Product (GDP) (Aikaeli and Mkenda, 2014; Gengzhi *et al*., 2022). In Tanzania, informal sector is the second sector having the largest share of total employment in the United Republic of Tanzania (NBS, 2022). More than half of the people who have been employed in the informal sector reside in Dar es Salaam region. Informal sector plans to engage more manpower in the future mostly through manufacturing activities, agricultural activities, and services industry (NBS, 2023; NBS, 2019).

Prospects of employment expansion through manufacturing activities, agricultural activities, and the services industry suggests that structure of the domestic economy is transformed from a heavy emphasis on agriculture to more industrially diverse manufacturing and service economy (Todaro and Smith, 2012; NBS, 2021;ILO, 2025). As Tanzania aims at transforming the economy from a predominantly agricultural one with low productivity to a diversified and semi-industrialized economy, it implies that manufacturing enterprises are expected to play a greater role of value addition, sustainable industrialization, employment generation, and GDP increase (FAO, 2024; UN-DESA, 2024).

Currently, manufacturing sector is among the top three industries which offer highest total employment in the informal sector (NBS, 2022). This implies that manufacturing enterprises tend to apply different economic concepts such as production, efficiency, cost, and firm theories (Mwiti and Kimunge 2019; Migosi, 2022; FAO, 2024), Furthermore, Mwiti and Kimunge (2019), and Ngoc *et al.* (2023) explained application of the production theory in the manufacturing sector by incorporating Cobb-Douglass production function. However, their studies did not explain technical efficiency and determinants of profitability among manufacturing enterprises operating in the informal sector as these enterprises need to device mechanisms for improving productivity (NBS,2020).

Analysis of technical efficiency is regarded as the most significant measure for productivity growth (Aljohani and Chidmi, 2024). Furthermore, analysis of technical efficiency seeks to reduce wasting of resources due to inefficient inputs use (Aljohani and Chidmi, 2024; Cechura and Kroupová, 2021). By reducing wasting of resources or using fewer resources to accomplish tasks, enterprises minimize production costs and improve profitability (Aljohani and Chidmi, 2024; Mziray *et al*., 2024). Hence the present study was designed to fulfil that gap by analysing technical efficiency levels and factors affecting profitability of manufacturing enterprises operating in informal sector in Dar es Salaam region so as to promote sustainable industrialization as per SDG 9.

2.0 Materials and Methods

2.1 Study Area

The study was conducted in Dar es Region. Dar es Salaam region is the region leading in informal sector employment compared to rural and other urban areas of mainland Tanzania (NBS, 2022). Also, Dar es Salaam is the region that has the highest population compared to others in Tanzania reflecting urbanization (URT *et al*., 2022; Ndoya and Dongmo, 2021; Masanja, 2014).

2.2 Population of the Study

Population for the study involved manufacturing enterprises in Dar es Salaam region aligning to the 15th International Conference of Labour Statisticians (ICLS). The 15th ICLS explains that manufacturing enterprises operating in the informal sector economy are private unincorporated enterprises owned by individuals or households that are not constituted as separate legal entities independent of the households or household members who own them, and for which no complete set of accounts (including balance sheets of assets and liabilities) are available that would permit a financial separation of the production of the enterprise from the other activities of its owner(s); all or at least some of the goods produced are meant for sale or barter; they are not registered under specific forms of national legislation; their size in terms of employment is below 5 employees (NBS, 2022).

2.3 Sampling Method

The study used information from the Informal Sector Survey (ISS) which applied multi-stage sampling strategy to gather information from informal sector in Dar es Salaam region in 2019 (NBS, 2020). In large-scale survey research, the data collection is usually organized in a multistage sampling design whereby PSUs are selected at the first stage and a sample of households at the second stage in case of a two-stage sampling (Hox and Maas, 2005; NBS, 2020; NBS 2022; Yansaneh, 2024).

2.4 Data Collection Methods

The study used secondary data for analysis. Data was obtained from the Informal Sector Survey conducted in 2019 in Dar es Salaam region by the National Bureau of Statistics (NBS, 2020).

2.5 Data and Variable Description

Table 1: Variables description and their measurement units and scales

Table 1 presents variables used in the study together with their measurement units and scales.

Variable	Description	Measurement unit	Scale
OUT	Output	Tanzanian shillings (TZS)	Ratio
MXO	Maximum Possible Output	Tanzanian shillings (TZS)	Ratio
VAA	Value Added	Tanzanian shillings (TZS)	Ratio
NEI	Net Income	Tanzanian shillings (TZS)	Ratio
VTA	Value of Total Assets	Tanzanian shillings (TZS)	Ratio
CAP	Capital Invested in Equipment and Machinery	Tanzanian shillings (TZS)	Ratio
WKR	Workers	Number of workers in the manufacturing enterprise	Ratio
LAC	Labour Costs	Tanzanian shillings (TZS)	Ratio
INC	Intermediate Consumption	Tanzanian shillings (TZS)	Ratio
T.E	Technical Efficiency	Ratio between Output and Maximum Possible Output	Ratio
ROA	Return on Asset	Ratio between Net Income and Value of Total Assets	Ratio

AGE	Age of Enterprise	Number of years which a manufacturing enterprise has been operating	Ratio
WKP	Worker Productivity	Ratio between Value Added and Number of Workers	Ratio
EDL	Education Level of the Informal Sector Operator	1= If informal sector operator has secondary education or vocational education (VETA) and above, 0= Otherwise	Ordinal
SEX	Sex of the Informal Sector Operator	1=Male, 0= Female	Nominal

Source: Authors' compilation (2025).

2.6 Data Analysis Techniques

2.6.1 Descriptive statistics

The study applied descriptive analysis to present measures of central tendency and dispersion. Descriptive statistics was applied in the study to compute ratios, means, percentages, and standard deviations.

2.6.2 Regression analysis

Multiple linear regression was applied to model the relationship between inputs and output, and as determinants of profitability of manufacturing enterprises operating in the informal sector. Based on Cobb-Douglas production function, effect of inputs on output follows the function $Y=AK^{\alpha}L^{\beta}M^{\gamma}$ whereby Y is output, K is capital, L is labour; and M is materials or intermediate consumption (Balk, 2024; Keen *et al*., 2019; Skare *et al.*, 2024). Furthermore, multiple linear regression was applied to model determinants of profitability for manufacturing enterprises operating in the informal sector using predictors such as age of firm, worker's productivity, and sex of the informal sector operator (Agiomirgianakis *et al*., 2006; Kant,2018; Pérez-Gómez *et al*., 2018; Dahmash *et al*., 2021; Agegnew and Gujral, 2022).

2.6.3 Stochastic frontier production function

The study applied stochastic frontier production function for analysis. According to Msuya and Ashimogo (2005), the stochastic frontier production function is expressed as

$Y_i = f(X_i ; \beta) \exp(V_i - U_i)$ ……... (i)

Whereby

Y_i = output produced by the i^{th} manufacturing enterprise

X_i=inputs (capital, labour, materials) used by the i^{th} manufacturing enterprise

V_i =a random errors which are assumed to be independent and identically distributed having zero means and unknown variance $N(0, \sigma_{v^2})$

U_i=a random variable that accounts for technical inefficiency in production

Furthermore, Náglová and Rudinskaya (2021) pointed out that an index for technical efficiency, T.E, which lies in the interval [0,1], can be defined as the ratio between the observed output (Y) and the maximum realisable output (Y*) as shown in (ii);

$$T.E = \left(\frac{Yi = f(Xi ; \beta) \exp(Vi-Ui)}{Y^{*}i = f(Xi ; \beta) \exp(Vi)}\right) = \exp(-Ui) \quad \text{……..….. (ii)}$$

3.0 Results and Discussion

3.1 Descriptive statistics

This section presents summary statistics for the key variables analyzed in the study. The data set comprises 149 observations from manufacturing enterprises operating in the informal sector in Dar es Salaam region.

Table 2: Summary of descriptive statistics for Continuous variables

Variable	Obs	Mean	Std. Dev
Output	149	1,051,871.82	2,424,313.63
Value Added	149	629,383.81	2,626,786.28
Net Income	149	1,050,705.44	2,424,354.91
Value of Total Assets	149	139,996.70	60,745.40
Capital Invested in Equipment and Machinery	149	13,987.74	60,698.25
Number of Workers	149	1.83	1.80
Labour Costs	149	83,618.21	175,721.87
Intermediate Consumption	149	422,488.01	979,536.63
Return on Asset	149	602.14	6,955.40
Age of Enterprise	149	9.84	10.01
Worker Productivity	149	433,266.83	1,583,371.59

Source: Authors' compilation (2025).

Table 2 presents the central tendencies and dispersion of key economic and performance indicators for informal manufacturing enterprises in Dar es Salaam:

On average, enterprises reported an **output** value of TZS 1,051,871.82, though the high standard deviation of TZS 2,424,313.63 indicates a wide variability in output among these enterprises. The mean **value added** was TZS 629,383.81, accompanied by a standard deviation of TZS 2,626,786.28 highlighting a notable variation in the enterprise's contribution to economy. **Net income** averaged TZS 1,050,705.44, a figure close to the average output, possibly reflecting relatively low-cost structures common in informal sector operations; however, the large standard deviation of TZS 2,424,354.91 reinforces the presence of notable disparities in financial performance across firms.

The average **value of total assets** held by enterprises was TZS 139,996.70, indicating that most businesses are generally asset-light, although the standard deviation of TZS 60,745.40 reveals considerable variability. **Capital investment in equipment and machinery** was modest on average at TZS 13,987.74, but the high standard deviation of TZS 60,698.25 suggests that while many firms lack substantial investment in modern tools, a few have invested significantly. The **average number of workers** per enterprise was 1.83, underscoring the small scale of these firms. However, with a standard deviation of 1.80, some businesses appear to employ a slightly larger workforce.

Labor costs averaged TZS 83,618.21, and the considerable standard deviation of TZS 175,721.87 reflects differences in workforce size, wage structures, or skill levels among firms. **Intermediate consumption** averaged TZS 422,488.01, and the high variability (SD = TZS 979,536.63) indicates wide differences in input expenses. Despite an average **return on assets** of TZS 602.14, the standard deviation of TZS 6,955.40 suggests uneven performance across firms, possibly influenced by extreme outliers. The average **age of the enterprises** stood at

9.84 years, indicating a moderate level of maturity, although the standard deviation of 10.01 implies a mix of newly established and long-standing firms. Finally, **worker productivity** averaged TZS 433,266.83 per worker, but the high standard deviation of TZS 1,583,371.59 suggests that while some firms are highly productive, others lag far behind.

Table 3: Summary of descriptive statistics for Categorical variables

Variable	Frequency	Percentage
Sex of the Informal Sector Operator		
Male	88	59.10
Female	61	40.90
Total	**149**	**100**
Education Level of Informal Sector Operator		
With secondary education or vocational education (VETA) and above	14	9.40
Without secondary education or vocational education (VETA)	135	90.60
Total	**149**	**100**

Source: Authors' compilation (2025).

Table 3 presents socio-demographic profile of informal sector operators. In terms of gender distribution, **59.10%** of the informal sector operators are **male** (88 operators), while **40.90%** are **female** (61 operators), showing a gender gap in participation.

When examining education levels, the vast majority of operators (**90.60%**) have **not attained secondary or vocational education** (135 individuals), while only **9.40%** (14 individuals) have attained secondary or vocational training **(VETA)**. This highlights the generally low educational attainment in the informal manufacturing sector, which may affect the uptake of modern technologies and management practices in these enterprises which may lower productivity and efficiency.

3.2 Factors affecting production of manufacturing enterprises

Table 4 shows that the model includes three independent variables namely **LN_INC** (logarithm of intermediate consumption) **LN_CAP** (logarithm of capital invested in equipment and machinery) and **LN_LAC** (logarithm of labor costs) and one dependent variable which is **LN_OUT** (logarithm of output). It shows that the regression model is statistically significant (**F = 37.41, p < 0.01**), indicating that at least one of the predictors significantly explain the variation in output.

Table 4: Model Summary

Model	Variables Entered	R	R Square	F-statistic and p-value
1	LN_INC LN_CAP LN_LAC a. Dependent Variable: LN_OUT b. All requested variables entered.	0.67	0.44	F = 37.41, p < 0.00

Source: Authors' compilation (2025).

The **Correlation coefficient (R** = 0.67) indicates that there is a moderate positive relationship between the predictors and the dependent variable (output). The coefficient of determination

(**R Square** = 0.44) indicates that about 44.00% of the variability in output (LN_OUTPUT) is explained by the model.

Table 5: Coefficients

Model	Standardized β	Std. Error	t	Sig.
1 (Constant)	4.41	0.89	4.95	0.00***
LN_CAP	0.01	0.07	0.17	0.87
LN_LAC	0.12	0.08	1.90	0.06*
LN_INC	0.62	0.06	9.72	0.00***

Note: Significance levels of 1%, 5%, and 10% are indicated by ***, **, and * respectively.
Source: Authors' compilation (2025).

From Table 5 it is shown that when predictors are zero the estimated value of **LN_OUT** is 4.41 units and this is significant ($p<0.01$). Furthermore, results show that **LN_LAC** is significant with ($p < 0.1$) which suggests that for every one percent increase in labour costs holding all other independent variables constant, there was increase in output (**LN_OUT**) by 0.12% units. These findings concur to Dinh *et al.* (2020) who found that output increased with increase in labour costs. Also, results show that **LN_INC** is significant with ($p < 0.01$) which suggests that for every one percent increase in intermediate consumption holding all other independent variables constant, there was increase in output (**LN_OUT**) by 0.62% units. These findings are similar to Girma *et al*. (2019) who found that use of intermediate inputs such as raw materials had positive effect on output of small-scale manufacturing enterprises. On the other hand, output-elasticity parameters 0.01, 0.12, and 0.62 sum to 0.75 which is less than 1 reflecting decreasing returns to scale. This implies that output of manufacturing enterprises operating in informal sector in Dar es Salaam may be less than double when all inputs double (Pindicky and Rubinfeld, 2013).

3.3 Technical efficiency levels of manufacturing enterprises

Results presented by Table 6 from the stochastic frontier production function show that the estimated maximum likelihood coefficient for labour costs showed a positive value of 0.13 and is significant ($p<0.05$) implying that increment of the labour costs by one percent increase output by 0.13 percent.

Table 6: Maximum likelihood estimates for the parameters of the Cobb-Douglas stochastic frontier production function

Variable	Parameter	Coefficient	S.E	p-value
Constant	β_0	12.07	1.29	0.00***
LN_CAP	β_1	-0.01	0.06	0.93
LN_LAC	β_2	0.13	0.06	0.03**
LN_INC	β_3	0.18	0.09	0.05*
δ^2		24.11	4.01	
λ		3.61	0.72	
Prob>chi2				0.00
Log likelihood				-369.78
LR test				8.13

Note: Significance levels of 1%, 5%, and 10% are indicated by ***, **, and * respectively.

Source: Authors' compilation (2025).

These findings agree to Sayavong. (2022) and Migosi (2022) that manufacturing sector tends to be more dependent on labour. Similarly, estimated maximum likelihood coefficient for cost

of intermediate inputs showed a positive value of 0.18 and is significant (p<0.1). This implies that increment of intermediate inputs by one percent will increase output by 0.18 percent. These findings agree to Cechura and Kroupová (2021) that output increases with material inputs used.

Furthermore, Table 7 presents technical efficiencies of firms as per Stochastic Production Frontier analysis. Results presented by Table 7 show that the minimum estimated technical efficiency of manufacturing firms in the informal sector is 0.00 percent while the maximum is 70.15 percent. Also, the mean level of technical efficiency is 17.77 percent implying that the output of manufacturing enterprises in the informal sector could be increased (using existing resources and technology) by 82.23 percent. The findings are similar to Tingum and Ofeh (2017) that small-scale manufacturing firms were less technically efficient compared to large scale manufacturing firms in Cameroon. Similarly, Girma *et al*. (2019) found that micro and small-scale manufacturing enterprises in Ethiopia were not technically efficient and could increase output by about 45 percent.

Based on findings presented by Dinh *et al*. (2020), small-scaled manufacturing enterprises in Vietnam operated at a moderate level of technical efficiency. This implies that manufacturing enterprises in the informal sector in Tanzania operate at a least level of technical efficiency as indicated in Table 7. Hence, strategies for reverting this situation will improve efficient utilization of resources and increase contribution of these enterprises in the economy.

Table 7: Firm specific Technical Efficiencies in the Stochastic Production Frontier

Percent	**Frequency**	**Percent**
0.00-10.00	54	36.24
10.00-20.00	45	30.20
20.00-30.00	21	14.09
30.00-40.00	15	10.07
40.00-50.00	8	5.37
50.00-60.00	2	1.34
60.00-70.00	2	0.67
70.00-80.00	2	1.34
80.00-90.00	0	0.67
90.00-100.00	0	0.00
Total	149	100
Minimum		0.00
Maximum		70.15
Mean		17.77

Source: Authors' compilation (2025).

3.4 Determinants of profitability of manufacturing enterprises

Table 8 shows that the model includes three independent variables namely AGE **(age of the enterprise),** WKP **(worker productivity)** and **SEX (sex of the informal sector operator)** and one dependent variable which is ROA **(return on assets)**
It shows that the regression model is statistically significant (**F = 32.05, p < 0.01**), indicating that at least one of the predictors significantly explain the variation in profitability (ROA).

Table 8: Model Summary

Model	Variables Entered	R	R Square	F-statistic and p-value
1	SEX WKP AGE	0.63	0.40	F = 32.05, p < 0.00
	a. Dependent Variable: ROA b. All requested variables entered			

Source: Authors' compilation (2025).

The **Correlation coefficient (R** = 0.63) indicates that there is a moderate positive relationship between the predictors and profitability (ROA). The coefficient of determination (**R Square** = 0.40) indicates that about 40.00% of the variability in profitability (ROA) is explained by the model.

Table 9: Coefficients

Model	Variable	Standardized Coefficients	Std. Error	t	Sig.
1	(Constant)	1.55	0.58	2.68	0.01**
	AGE	-0.03	0.00	-0.51	0.61
	WKP	0.61	0.00	9.43	0.00***
	SEX	0.17	0.87	2.64	0.01**

Note: Significance levels of 1%, 5%, and 10% are indicated by ***, **, and * respectively.
Source: Authors' compilation (2025).

From Table 9 it is shown that when predictors are zero, the estimated value of ROA is 1.55 units and this is significant (p<0.05)**.** Furthermore, results show that **WKP** is significant with (p < 0.01) which suggests that for every unit increase in worker productivity holding all other independent variables constant, there was increase in profitability (ROA) by 0.61 units. These findings concur to Kant (2018) who found that labour productivity of a firm positively influenced profitability. Similarly, Pérez-Gómez *et al*. (2018) found that the profit inefficiency of SMEs decreases as labour productivity improves. Also, results showed that **SEX** is significant with (p <0.05) which suggests that for every unit increase in sex of the enterprise owner being female compared to male, there was an increase in profitability (ROA) by 0.17 units. This concurs to Batista *et al*. (2021) who found that improved financial management practices (bookkeeping), an increase in accessible savings, and reduced transfers to friends and relatives made female-headed micro-enterprises to achieve higher baseline level of profits compared to male-headed micro-enterprises.

4 Conclusions and Policy Implications

This study analyzed technical efficiency and profitability of manufacturing enterprises operating in informal sector in Dar es Salaam region. The study used secondary data from the informal sector survey conducted in 2019 in Dar es Salaam region by the National Bureau of Statistics. The study employed descriptive statistics, regression analysis, and stochastic frontier production function for data analysis. Results from both Cobb-Douglas and stochastic frontier production functions. Furthermore, results showed that the mean level of technical efficiency is 17.77 percent implying that informal manufacturing enterprises operate at a least level of technical efficiency and hence they need to improve technology used for production so as to utilize efficiently existing inputs. Also, results showed that profitability of informal manufacturing enterprises increases with labour productivity and sex of the enterprise owner

being female compared to being male, implying that offering on job-training and capital management skills ought to improve financial performance of informal manufacturing enterprises. Therefore, study recommends the need to assess short-run costs incurred by informal manufacturing enterprises and develop strategies of minimization to foster output expansion and profit maximization.

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