



Determinants of Firms' Capacity Utilization in Ethiopia

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Abstract

Under-utilization of firms in Ethiopia is an overriding problem which requires empirical evidence pertinent to capacity utilization policy formulation and implementation. This paper investigates determinants of capacity utilization from 848 firms collected by the World Bank in 2018 in all regions of the country. Capacity utilization (%) and number of hours of operation per week were measured to capture the determinants of overall capacity utilization. A seemingly unrelated (SUR) model result of bivariate estimation of the two measures suggested that about 73.64% and 53.57% of the variation, respectively, in capacity utilization and number of hours operated per week were explained by SUR model. The determinant factors which are idiosyncratic to both measures were cost of input measured in monetary terms as a proxy variable for quantity of intermediate goods and raw material ($\ln inputcost$), the percentage share of domestic inputs for the establishment ($\ln domesticinput$), fuel cost ($\ln fuelcost$) and access to credit ($creditdummy$) were contributing positively and significantly. However, foreign exchange constraint ($EXCGdummy$) and foreign input ($FRGNINPT$) were attributed to affect significantly but have adverse effect for capacity utilization and number of hours of operation per week. Moreover, capacity utilization and number of hours of operation have positive interdependency. The major contribution of this paper is it employs econometric estimation of capacity utilization and number of hours of operation per week and measures their interaction as well as identifies its determinants at firm level.

Keywords: Bivariate Regression, Capacity Utilization, Hours of Operation Per Week, Regression (SUR), Seemingly Unrelated

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1. Introduction

Capacity utilization is a concept in economics which refers to the extent to which an enterprise or a nation actually uses its installed productive capacity. Different scholars define capacity utilization in different ways perhaps with similar theme. Satik (2017), define as capacity utilization is the extent that an enterprise or a country puts its installed production capacity to use. It also refers to the relationship between the actual output produced and the maximum potential output According to Okpaleye (1988), Capacity utilization in firms is described as “the level of utilization of a firm’s installed productive capacity”. Thus, it refers to the relationship between actual output produced and potential output that could be produced with installed equipment.”

On the other viewpoint, capacity utilization is defined from the perspective of cost principles where at each level of production, firm will choose its level of utilization based on the principle of cost minimization and then explores how such will determine its normal rate of utilization (Nikiforos, 2012). This concept is also substantiated by other scholars such as Afroz and Roy (1976), that cost-minimizing firm has a tendency to increase the utilization of its capital if the returns to scale decreases as its production increases. Moreover, the level of capacity utilization does not only determine how much additional output obtained by greater utilization of existing capital but also defines expansion of capacity of a firm for a targeted level of output (Afroz and Roy, 1976). Thus, an increase in capacity utilization means a reduction in the average cost of production (Afroz and Roy, 1976).

In general capacity utilization plays a crucial role in evaluating economic performance of different firms. It is an important factor to be considered when an increase in productivity and expansion of firm’s production become necessary. Therefore, in the realm of capacity utilization concept, the determinants of capacity utilization are the leading concept to be considered how factors and to what extent they affect the entire capacity utilization of firms. Hence, identifying the determinants of capacity utilization is paramount to explain investment behavior, productivity movements, cost-push inflation and inventory behavior, and are often used as indicators of the strength of aggregate demand.

As a vital economic indicator, capacity utilization has not received due attention from development economists especially in most developing countries, Ethiopia inclusive. Though not greatly dealt with, capacity utilization does not only explain the relationship between actual

output and maximum or potential output, but also imply the level of market demand. Over underutilization of plant capacity can reduce plant competitiveness by increasing operating costs (Seguin and Sweet land, 2014). When market demand grows, capacity utilization will rise. By contrast, if demand weakens, capacity utilization will slacken.

In theory, capacity utilization is measured in 100% efficiency level, however, in practical sense, capacity utilization may not exceed 90% maximum level especially in all types of economies due to some setbacks in the production process such as lack of proper labor monitoring and supervision, wastages in the process and machine breakdown (Afroz and Roy, 1976). Empirical evidences show that average capacity utilization of developed countries ranges from 85 to 104.1% where Japan is operating over capacity utilization (104.1%), middle income countries (BRICS) ranges from 64 to 85% and less developed countries is about 32 to 65.6% (Trading economics, 2017). Ethiopia's manufacturing firm's capacity utilization is only about 50% (Solomon, 2018). Thus, factors affecting capacity utilization remains an important concept, though often neglected, in the production process. Hence, the presence of idle resources that can be readily engaged in production process constitute a big problem in explaining fluctuations in firm output in Ethiopia where underutilization of some productive equipment has become rampant in almost all productive firms. Therefore, identifying the determinant factors of capacity utilization of firms makes the study magnificent.

1.2. Statement of the problem

In literature, the sources of productivity change are divided into four, namely: pure technical efficiency change, technical change, scale efficiency change and capacity utilization change (Coelli *et al.* 2005; Kumar & Basu 2008; Melfou *et al.* 2009). Capacity utilization change is important factor that affects productivity growth (Basu & Fernald, 2001; Gu & Wang, 2013), however, capacity utilization is less recognized problem predominantly in less developed countries in general and Ethiopia in particular. There are very few empirical evidences conducted in few selected firms about the capacity utilization of Ethiopian manufacturing firms. Despite its limited evidence about capacity utilization rate of manufacturing industries, to the best of my knowledge, there is no empirical evidence about the determinants of all types of firms in Ethiopia perhaps its study is deterministic. Accordingly, with the existence of limited literature focusing on the subject, determinants of capacity utilization of Ethiopian firms are not yet clearly defined for the concerned bodies to take action in solving the problem effectively.

Many Ethiopian firms have performing under-capacity production volume (below 50%) with respect to their installed production capacity (Solomon. M, 2018). This under-capacity utilization is a problem not only for the firms themselves, but also a big challenge against the national economic growth convoy process at large. The complexity of under-capacity utilization problem of firms has multitudes of potential determinant factors among which no one was easily put into their order of significance. Therefore, there is gap of knowledge about the determinants of capacity utilization of firms and their order of importance. In line with this, the responsible stakeholders such as the government, the firm owners, and the supportive institutes can't easily determine their specific role to resolve the anticipated problems before which the cause is fundamentally affecting capacity utilization at most, and how that affects the firm' overall operation.

1.3. Objective of the paper

The objective of the research was to analyze the major possible determinants for capacity utilization of Ethiopian firms comprising major problems attributable to under-utilization against its potential capacity and further it strived

- To identify major causes of under-capacity utilization of firms,
- To identify factors affecting firms' length of working hour which ultimately determines capacity utilization of firms
- To identify the correlation between capacity utilization of firms and number of working hours of operation per week.

2. Methodology

2.1. Data set and analytical technique

2.1.1. Descriptive analysis

To analyze determinants of capacity utilization, descriptive analysis was applied. The data was taken from the Ethiopian enterprise survey collected by World Bank 2018 from 848 firms in all regions of the country. In this analysis data on variables such as: quantity of domestic input, input cost, fuel cost, number of permanent workers, number of competitive firms, frequency of water shortage, credit access(dummy), foreign exchange constraint(dummy), foreign input (dummy), electric power outage(dummy), collateral size was analyzed. Standard deviation and mean values are used for continuous explanatory variables and frequency and percentage for dummy variables in analyzing explanatory variables that determines capacity utilization. The results are discussed using tabulations so as to summarize and interpret the data. Moreover, descriptive analysis tools such as minimum, maximum, percentage and chi-square statistics are

used to analyze the relationship among variables. This analysis is also applied to describe the status of explanatory variables with an intention to obtain results that can strengthen the econometric model which is seemingly unrelated regression (SUR) model of the regression analysis.

2.1.2. Empirical model specification

The major endogenous variables considered in the analysis include capacity utilization of firms in percent and the number of hours of operation per week. Capacity utilization and number of hours of operation per week of Ethiopian firms were generally hypothesized to be determined by supply and demand factors. As such, the expected determinants of capacity utilization of firms and the number of hours of operation per week are electricity outage(dummy), quantity of raw materials and intermediate goods used in production, demand for products (domestic demand), annual total cost of fuel, access to credit (dummy), number of permanent workers, colateral size, number of competitive firms, foreign exchange constraint (EXCGdummy), frequency of water shortage, foreigninput (Rukhsana, 1998; P.A. Adeyemi and O.B. Olufemi, 2016; Okunade, 2018; Guo-liang, Y. et al. 2019).

The primary reason of simultaneous estimation of determinants of capacity utilization and number of hours of operation per week was designed to identify the relationship between capacity utilization and number of hours of operation per week with its covariates. To account for this bivariate correlation, the two equations were estimated by seemingly unrelated regression (SUR) model (Zellner,1962; Greene, 2012):

$$CU = x_1\beta_1 + e \quad (1)$$

$$NHOPWEEK = x_2\beta_2 + e \quad (2)$$

where *CU* and *NHOPWEEK* are capacity utilization and number of hours operated per week of the firm *i*, respectively; the *x*'s are the respective vectors of covariates determining the endogenous variables; and the *β*'s are their vectors of parameter coefficients. The assumption of disturbances to be strictly exogenous, homoscedastic, non-zero correlation among equation but zero correlation among observation was also considered.

The model of prediction that signifies factors that determine capacity utilization and number of hours of operation per week of firms attempts to estimate using bivariate seemingly unrelated regression (SUR) model collected cross sectional data from 848 firms collected by world bank in 2018. The main question under consideration is what factors determine capacity utilization of Ethiopian firms not fully utilizing with the existing stock of capital. The model

to test the various hypotheses concerning factors affecting capacity utilization is specified in the following form;

$$CU = \alpha_1 + \beta_1 \text{OUTPMdummy} + \beta_2 \text{domesticinput} + \beta_3 \text{competition} + \beta_4 \text{domesticsale} \\ + \beta_5 \text{creditdummy} + \beta_6 \text{colateral} + \beta_7 \text{FRGNINPT} + \beta_8 \text{lninputcost} + \beta_9 \text{lnfuelcost} \\ + \beta_{10} \text{EXCGdummy} + e \quad (3)$$

$$\text{NHOPWEEK} = \alpha_1 + \beta_1 \text{OUTPMdummy} + \beta_2 \text{domesticinput} + \beta_3 \text{lnwater} + \beta_4 \text{domesticsale} \\ + \beta_5 \text{creditdummy} + \beta_6 \text{permworker} + \beta_7 \text{FRGNINPT} + \beta_8 \text{lninputcost} + \beta_9 \text{lnfuelcost} \\ + \beta_{10} \text{EXCGdummy} + e \quad (4)$$

Where: CU is capacity utilization of firms

NHOPWEEK: Number of hours of operation per week

OUTPMdummy: Electricity outage per month

Domesticinput: Quantity of raw materials and intermediate domestic goods used in production in percent

Competition: number of competitive firms

Domesticsale: national sale (domestic demand) for firms' product

Creditdummy: access to credit

Colateral: size of the colateral required by credit institutions

FRGNINPT: foreign input

Lninputcost: percentage use of domestic input (log transformed)

Lnfuelcost: Total annual cost of fuel (log transformed)

EXCGdummy: foreign exchange constraint (dummy)

lnwater: water availability (dummy)

2.2. Working hypotheses and variables definition

2.2.1. Dependent variables

Capacity utilization (CU): - This variable is dependent variable measured in percentage. It is entered in the model to measure what was the capacity utilization of the establishment.

Number of hours per week (NHOPWEEK): - This is also another continuous dependent variable to measure number of hours per week operated by the establishment in last fiscal year.

2.2.2. Explanatory variables of the study

Using past literatures and empirical evidences on factors determining capacity utilization of firms, the following covariates are presumed and hypothesized to explain the dependent variables.

Electricity outage per month (OUTPMdummy): it is dummy variable that (firms who faced no obstacles = 1; and 0; otherwise). An important factor affecting capacity utilization in Ethiopia's firms may be the irregular power supply. It is hypothesized that power outage may be an important factor hindering capacity utilization and introducing more shifts into the system. Owing to the increased demand for electricity, the government has used a load-shedding program since the year 2000. Firms may be reluctant to increase total working hours in view of the possibility of power shut down at different periods of time. So that frequency power outage per month and number of hours per week operation has expected to have negative relationship. The problem of electricity consumption resulted for load shedding on the basis of the assumption that there is a functional relationship between output and electricity consumption lies on one hand and capacity utilization and electricity consumption on the other. The presumption is that output is a function of electricity consumption but if there exists frequent power outage, it affects the capacity utilization. Hence, we can postulate that the relationship between power outage and capacity utilization has been negative. Hence those firms who faced frequent power outage per month has negative contribution to their capacity utilization compared to their counterparts.

Quantity of raw materials and intermediate domestic goods used in production (Ininputcost)

The total cost of inputs is taken as a proxy variable for the quantity of raw and intermediate domestic goods used in production process reflecting firm's dependence on inputs. Up on this premises, expected output is the resultant of an increased demand for these inputs which is manifested by an increase in the cost of the firm indicating that positive relationship is expected to prevail between capacity utilization and quantity of input. Cost of input for firms may be increased either increased quantity demand for input or increased unit cost inputs but if the increment is due to increase in per unit cost, it could be manifested by its market demand for product to decrease because of price of product so as to affect negatively. Hence, in this assumption increased cost is due to the increase in quantity of inputs demanded for production. It also hypothesized to have positive relationship with the number of hours operated per week because the more input the firm used, the longer time it will operate.

Total annual cost of fuel (Infuelcost)

It is the total amount of expenditure incurred for purchasing fuel. The variable is entered as log transformed. Because of the co-existence of electricity power outage and load-shedding, firms do have two alternatives either interjecting of production and waiting for power or using

generator to extend production without interruption. Firms preferring the latter option has greater output and larger cost of fuel where as those firms that don't use generators would have lesser output and lesser cost of fuel. Hence, greater output indicates greater capacity utilization of firms. So that it is hypothesized that it has positive relation to capacity utilization when larger use of fuel for generator maintains greater production perhaps increase cost of the firm for fuel. Besides this, if the firm uses more fuel for generator, more production and longer working hour per week could be in effect. So that it is hypothesized that total annual cost of fuel incurred and number of working hours per week have positive relationship.

Credit access (creditdummy)

This variable is entered in the model as dummy variable (firms having credit access = 1; 0 otherwise). If firm have access to credit with no obstacle, they are hypothesized as they can increase their capacity utilization. Although there exist various schemes, policies and institutions designed to provide financial support, it is expected that all firms would not have equal access to finance and they face much obstacles. This is because of extended and tedious beaurocratic system are manifestations of most credit supplier institutions. Besides, high interest rates on loans and demanding high colateral discourage borrowing firms, thus affecting production levels and hindering full utilization to the level of its potential capacity. Hence, it is hypothesized that firms that have access for credit has positive relationship to both capacity utilization as well as the number of hours per week of operation.

Foreign Exchange

It is dummy variable. Firms that face obstacles to get foreign exchange = 1; 0 = otherwise. Firms using foreign goods as their input for their production could have get access to foreign exchange availability. If they get sufficient foreign exchange, they can produce more output; if not the vice versa holds true. So, it is hypothesized that firms having obstacles to earn foreign exchange has negative relationship to capacity utilization as well as to the number of hours of operation per week compared to their counterparts.

Number of competitive firms (competition): The number of units in the industry is taken as a proxy for the extent of competition or market structure within the industry. It is hypothesized that they are positively related to capacity utilization. The assumption is that the more the number of firms, the greater will be the degree of competition and hence, more inducement to utilize the stock of capital.

Number of permanent worker (permworker): This is assumed to have workers who have permanently employed are getting better experience and contribute to increase output. Besides this they are loyal to the company in decreasing wastage and protecting machineries from breaking that ultimately increase output compared to temporary employees are doing. A positive relationship is assumed to prevail between permanent number of workers and capacity utilization.

Water availability (lnwater): - it is log transformed and it is the average frequency of water interruption (affecting length of production hour) can create the firm to have longer working hour per week in order to maintain its production. So, it is hypothesized that the variable has positive relation with length of working hour.

National sale (domesticsale): A positive relationship is hypothesized between domestic sale and length of working hours as well as capacity utilization. It is generally expected that higher demand for the product will lead to increase domestic sale of products would enable a firm to utilize more of its production capacity and to work longer hours of operation per week and vice versa.

Domestic input (domesticinput): -This is the percentage of material inputs and supplies of domestic origin applied in the production process. The presumption behind this variable is that firms that use the maximum proportion of their material and supplies input of domestic origin has greater capacity utilization compared to those firms using lesser domestic inputs. The logic behind is that firms that use greater portion of foreign inputs face different challenges such as foreign exchange problem, customs problem, and others to decrease production. Hence, largest proportion of application of domestic input has positive relationship with capacity utilization.

Foreign input (FRGNINPT): - this variable is dummy variable entered to the model and firms that use foreign inputs have value of 1 and 0; otherwise. Therefore, firms that use foreign inputs are more likely to produce lesser output compared to their counter parts. It is hypothesized that firms that used foreign input has negative relationship with capacity utilization. Besides, firms that use material inputs and supplies of foreign origin have lesser use of working hours and expected to have negative relationship.

Colateral: - It is the value of collateral required for the most recent credit/loan in order to protect default. It is hypothesized that larger colateral request by credit delivery institutions made the firms discouraged and retreat to access the loan. This ultimately decreases the

production capacity of firms. Therefore, the hypothesis is that colateral and capacity utilization have negative relationship.

2.2.3. Diagnosis and model specification tests

Prior to running the SUR regression, both continuous and dummy explanatory variables were checked for the existence of multi-collinearity problem. This is because when there is an existence of linear relationship among some or all explanatory variables there can be occurrence of large variances and covariances, making precise estimation difficult. In this case the confidence intervals tend to be much wider, leading to the acceptance of the “null hypothesis” more readily and the t -ratio of one or more coefficients tends to be statistically insignificant (Gujarati, 2004).

There are two measures often suggested to test the presence of multi-collinearity. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. The technique of variance inflation factor (VIF) was employed to detect the problem of multi-collinearity among the continuous variables. According to Gujarati (2004), VIF can be defined as:

$$\text{VIF } (\beta_i) = \frac{1}{(1-R_i^2)}$$

Where, R_i^2 is the square of multiple correlation coefficients that results when one explanatory variable (X_i) is regressed against all other explanatory variables. β_i is the coefficient of the explanatory variable (X_i) larger the value of VIF which exceeds 5 by a rule of thumb, indicates the presence of a multi-collinearity problem. Annex 1, table 1 shows that there is no problem of multi-collinearity (2.25) for CU and for NHOPWEEK (2.31) of table 2, annex 1. Similarly, contingency coefficients are computed to check the existence of multi-collinearity problem among the dummy explanatory variables using pair wise correlation test method (annex 2, table 2.5).

Heteroscedasticity problem is an increase or decrease variance of the error term with dependent and independent variable faced under a certain situation. This also will lead to an invalid test of significance. Breusch-Pagan-Godfrey test is the most powerful sample test of this problem. The squared residuals are standardized by dividing by the mean squared residual (regression sum of squares (RSS) divided by N), giving the generalized residuals. The generalized residuals are then regressed on all independent variables (m variables) suspected of causing heteroscedasticity. The error sum of squares (ESS) divided by 2, for this regression, follows a chi-square distribution with ($m - 1$) degrees of freedom. If the finding is significance then the

null hypothesis is rejected and heteroscedasticity can be assumed (Garson, 2012). Breusch-Pagan-Godfrey test result for this analysis revealed that $p = 0.1001$ for CU and $p = 0.0510$ for NOHPWEEK which indicates there is no heteroscedasticity problem.

Finally, whether the model has omitted variable or no I tried to test for omitted variable test for the independent regression. Based on the Ramsey RESET test of regression result, the values for capacity utilization and number of hours operated per week were 0.6962 and 0.0519 respectively where both p-values are insignificant indicating that there is no problem of omitted variable.

3. Results and discussion

3.1. Descriptive result analysis

In this sub-chapter, by employing some statistical tools such as mean, percentage, standard deviation, frequency distribution and chi-square test, the results of the descriptive analysis made on the data and their interpretation are discussed as follows:

Table 1. descriptive table of dependent variables

Variable	Obs	Mean	Std. Dev.	Min	Max
CU	848	26.54009	32.31462	1	100
NOHPWEEK	848	36.85142	33.37716	15	168

Source: Author's computation, 2021

The overall performance of firms' capacity utilization is on average at 26.54% despite the fact that there are significant differences among themselves ranging from 1% to 100% in its potential capacity and the standard deviation is 32.31 while in the case of number of hours of operation per week (NOHPWEEK), the average number of working hours of operation is about 36.58 hours. The maximum number of hours of operation per week is 168 hours and the minimum is 15 hours indicating wider range of performance with standard deviation of 33.38 (Table 1).

Table 2. descriptive table of continuous explanatory variable of the model

Variable	Obs	Mean	Std. Dev.	Min	Max
Domesticsale (%)	848	93.07547	22.80525	0	100
Competition	848	2.883255	9.62873	0	200
Permworker	848	92.64151	371.6163	1	7600
Fuelcost	848	2,277,522	20,700,000	0	364,000,000
Inputcost	848	14,000,000	60,200,000	5,000	717,000,000
colateral	848	45,900,000	1,030,000,000	0	30,000,000,000
Domesticinput (%)	848	33.67807	43.24444	1	100

Source: Author's computation, 2021

The variable percentage sale of domestic firms indicates that the total sale products of a particular product from its total output in a given time implies the demand for the product of the firm. The market demand for the product ranges from minimum sale of zero percent to 100 percent domestically with mean of about 93% and the standard deviation 22.8%. The implication is that there is larger domestic demand of the products. Regarding the number of competitive firms for similar product ranges from zero competitors to a maximum of 200 competitive firms producing similar output. The mean competitive firms of the sample are around 3 (2.88) with a standard deviation of 9.6. The sample firms undertaken in the study has permanent with full-time employed workers have maximum number of 7600 and minimum number of 1 worker with mean of about 93 and standard deviation about 372 workers.

The percentage share of domestic inputs for firms ranges from 1 percent to 100 percent and the average domestic input application by the firms is about 33.7% with standard deviation of 43.2%. Input cost is the quantity of raw and intermediate goods used in the production process in monetary terms. The maximum amount of cost of input is 717,000,000 and the minimum is 5,000 with mean 14,000,000 and standard deviation 60,200,000. The amount of fuel cost allocated for generator in order to maintain the production of the firms' output is the maximum cost of 364,000,000 birr and minimum cost of zero with average mean for samples is 2,277,522 birr with standard deviation of 20,700,000. The implication is that because of the existence of load-shedding effect and electric power outage, firms are using much fuel for the generator. Collateral is the amount of asset required by financial institutions for the loan they deliver to firms. The price of assets required by lenders for the sample firms has minimum of zero and maximum value of 30,000,000,000 with average mean of 45,900,000 and standard deviation of 1,030,000,000 birr.

Table 3. electric power outage (dummy)

OUTPMdummy	Freq.	Percent	Cum.
No obstacle	700	82.55	82.55
Obstacle	148	17.45	100
total	848	100.00	

$Pr = 0.227$ $Pearson\ chi2(45) = 54.3027$ $Pr = 0.161$ (CU)

$Pearson\ chi2(42) = 48.5194$ (NOHPWEEK)

Source: Author's computation, 2021

This variable is whether the firm experienced obstacles in relation to power outages or not for enhancing its capacity utilization. It is included as dummy variable. Based on the descriptive statistics 700 (82.5%) observations don't experience power outage whereas 148 (17.45%) faced obstacles in relation to power outage. From its chi square test, the variable is insignificant

for both dependent variables of capacity utilization ($pr = 0.161$) and for number of hours operated per week ($pr = 0.227$). The implication is there is no capacity utilization differences between firms facing power outage obstacles and firms that don't face the obstacles.

Table 4. credit access by firms

creditdummy	Freq.	Percent	Cum.
Yes	362	42.69	42.69
No	486	57.31	100
Total	848	100	

Pearson chi2(42) = 36.3159 *Pr = 0.718* (*for CU*)

Pearson chi2(45) = 45.3598 *Pr = 0.457* (*for NOHPWEEK*)

Source: Author's computation, 2021

Access to credit is the easiness for firms to get access to credit which is captured by the variable making dummy that is expressed as those firms having access to credit with no obstacle amounts 362 (42.69%) of the total proportion while firms that have obstacles to get credit are 486 (57.3%) for their capacity utilization. This chi square test shows that access to credit is not significant at 5% level indicating that credit access doesn't have significant difference between those who have obstacle and who don't have obstacles for their capacity utilization ($pr = 0.718$) as well as the variable is also insignificant for the number of hours operated per week ($pr = 0.457$).

Table 5. Exchange rate obstacle (is there any obstacle to get foreign exchange?)

EXCGdummy	Freq.	Percent	Cum.
No	341	40.21	40.21
Yes	507	59.79	100.00
Total	848	100.00	

Pearson chi2(42) = 52.9359 *Pr = 0.120* (*CU*)

Pearson chi2(45) = 75.8698 *Pr = 0.003* (*NOHPWEEK*)

Source: Author's computation, 2021

This is the challenges that firms are facing in relation to foreign exchange. It is a dummy variable that firms earning foreign exchange without any obstacle are 341(40%) whereas firms that faced obstacles are 507(60%) indicating that larger proportion of firms are facing obstacles to get foreign exchange. The chi square test substantiated the fact that firms getting foreign exchange with no obstacle are significantly different at less than 5% level for capacity utilization ($pr = 0.03$). The implication is that firms that are dominantly dependent on foreign inputs are likely to be affected in their production.

Table 6. Percentage share of foreign input (dummy) in the production process

FRGNINPT	Freq.	Percent	Cum.
No	651	76.77	76.77
Yes	197	23.23	100.00
Total	848	100.00	

Pearson chi2(42) = 358.8799 Pr = 0.000

Source: Author's computation, 2021

The variable foreign input is the dummy that whether the firm is used foreign input as factor of production or not. Number of firms that used foreign inputs as factor of production are 197 (23.23%) while those who don't use foreign inputs were 651 (76.77%). The chi square test of the variable is significant at 1% level ($pr = 0.000$). The implication is that firms that use foreign inputs have significance difference with their counterparts.

3.2. Econometric analysis

The SUR model result demonstrated that the determinants enhancing capacity utilization were quantity of raw and intermediate goods(lninputcost), credit access (creditdummy), percentage share of domestic input(domesticinput), and cost of fuel for generator usage (lnfuelcost) all of which were in line with the expected signs. Factors adversely affecting households' capacity utilization were foreign input (FRGNINPT) and foreign exchange constraint (EXCGdummy). The negative effect of foreign input application and foreign exchange constraint in the production process of firms reflects the problem of Ethiopian context in connection with the balance of payment constrictions to get sufficient foreign currency due to the fact that the country is known for its balance of payment deficit and in dearth of delivering surplus foreign currency for firms as per their request/demand. The result of predicted value also depicts that the index captured by capacity utilization is 26.54% (Table 6) to affect the overall determinant factors of firms' capacity utilization in Ethiopia.

3.2.1. Independent regression of determinants of capacity utilization (CU)

According to the model output the variable input cost(lninputcost), it is proxy variable for the amount of intermediate goods and raw material used in the establishment in monetary terms. It is significant at 1% to affect capacity utilization of firms signifying that a 1% increase of input cost will result in the increase in capacity utilization by 0.011%, keeping other things constant and the sign of the coefficient is as of expected in the hypothesis. This result is in line with the findings of (Okunade, 2018). Whereas, the variable foreign input (FRGNINPT) is a dummy variable that is significant at 5% level of significance. The likelihood of firms that used foreign inputs as factor of production, their capacity utilization is decreased by 6.79%

compared to their counterparts. The sign of the variable is as expected of the hypothesis and; the justification is that Ethiopia as a country is known for its foreign currency deficit and firms that used foreign inputs requires foreign currency but they face challenges which creates obstruction in the production process that ultimately affects firms output and capacity utilization. The result is in conformity with (Kemal and Allauddin, 1974). Concerning the variable foreign exchange constraint (EXCGdummy), the likelihood of firms that face obstacles to get foreign exchange, the capacity utilization of firms is decreased by 3.389% compared to their counter parts and it is significant at 5% level of significance. In contrast, firms that used larger portion of inputs of domestic origin (domesticinput) is highly significant at 1% level and the implication is a 1% increase in the share of inputs of domestic origin makes the capacity utilization of firms to increase by 9.46%, *citrus paribus*.

Regarding the cost of fuel, it is the total expenditure incurred for purchasing of fuel for the generator where there is greater electricity outage and load-shedding. The result (Infuelcost) is significant at 5% level and it infers that a 1% increase in consumption of fuel for generators increases the capacity utilization of firms by 0.0069% keeping other things constant. The finding is in line with the findings of Adenikiju (1998) in Nigeria.

Table 7. linear regression of capacity utilization

Variable	Coefficient	Marginal effect (dy/dx)
Electric poweroutage (OUTPMdummy)	0.0871174	0.087117
Domestic input (domesticinput)	9.469113***	9.469113
Competition	0.0154871	0.015487
Domestic sale (domesticsale)	0.0012157	0.001215
Credit access (creditdummy)	3.589898*	3.589898
Colateral (LNCOL)	0.0814481	0.081448
Foreign input (FRGNINPT)	-6.792232**	-6.792232
Input cost (Ininputcost)	1.142358***	1.142358
Fuel cost (Infuelcost)	0.691392**	0.6913922
Foreign exchange (EXCGdummy)	-3.389454**	-3.389454
Constant	1.67786	
Fitted values (predict)		26.54
Adjusted R ²	73.33	

***, **, * are significant at 1%, 5% and 10% respectively.

Source: Author's computation, 2021

3.2.2. Independent regression of determinants of number of hours of operation per week

On the other hand, factors enhancing number of hours operated per week were quantity of raw and intermediate goods(Ininputcost), Water availability (lnwater), percentage share of domestic input (domesticinput), and cost of fuel for generator usage (Infuelcost). Factors

adversely affecting number of hours operated per week were foreign input (FRGNINPT), foreign exchange constraint (EXCGdummy) other factors captured by the constant. The result of predicted value also depicts that the index captured by number of hours of operation per week is 37% (Table 8) to affect the overall determinant factors of firms' capacity utilization in Ethiopia.

Out of the ten variables proposed to explain the dependent variable, six variables were significant at 1% and 5% level of significance. The result depicts that percentage share of domestic input (domesticinput) was significant at 1% level implying that an increase in the proportion of domestic input by 1% will increase the number of hours of operation of the establishment by 0.078 hour of operation, *ceteris paribus*. The sign is as of the prior expectation. By the same token, the amount of domestic sale (domesticsale) which is an important implication of the demand side factor which affects over all capacity utilization of firms, an increase in domestic demand for the product by 1% will enhance the firm to increase its number of working hours of operation per week by 0.058 hours keeping other factors constant. Hence domestic demand and number of working hours have direct relation and the sign is also as expected in the hypothesis.

The other variable which affects number of hours of operation per week is average length of water shortage (lnwater) to affect production. This is the condition in which firms are striving either to increase production or at least to maintain the existing production level similar with the time of sufficient water is available in order to hold their production capacity stable. But if there is water shortage, the firm is expected to take more hours of operation in order to maintain the existing output level. Hence, water scarcity and NHOPWEEK are directly related and the model result shows when water scarcity problem is increased by 1%, the number of hours of operation of the firm will increase by 0.025hours per week, keeping other things constant. The implication is that as the water availability is a problem for firms, they are obliged to increase more hours of operation which ultimately increase the firms cost of production.

In connection with the input cost(lninputcost), the result shows that if the amount of intermediate goods and raw material of the firm's input is increased by 1%, the number of working hours of operation per week of a firm would increase by 0.0054 hours per week, *ceteris paribus*. It is also significant at 5% level. Moreover, the cost of fuel (lnfuelcost) is also significant at 1% level implying that increasing the total cost incurred for purchasing of fuel would increase the number of working hours of operation per week by 0.01 hour keeping other

factors constant. The intuitive behind is that firms facing electric power outage and load-shedding. Therefore, they are using generators to maintain their production unless they become idle for long which ultimately increase their per unit cost of the product since their fixed cost is larger.

In contrast, the likelihood of firms which are highly dependent on foreign inputs for their production, the number of hours of operation per week is lesser by 7.59 hours. This variable is significant at 1% level of significance. The sign is also as of the prior expectation.

Foreign exchange constraint is another significant factor affecting number of hours of operation per week. It is a dummy variable and highly significant at 1% to affect number of hours of operation per week adversely. The likelihood of firms facing obstacle to get foreign exchange from the national bank come across to decrease the number of hours of operation per week by 7.59 hours compared to their counter parts.

Table 8. linear regression of number of hours of operation per week

Variable	coefficient	Marginal effect (dy/dx)
electric poweroutage (OUTPMdummy)	-0.5903259	-0.5903259
Domestic input (domesticinput)	7.876246***	7.876246
Water availability (Inwater)	2.509071***	2.509071
Domestic sale (domesticsale)	0.0589963*	0.0589963
Credit access (creditdummy)	1.947483	1.947483
Number of permanent workers(permworker)	1.947495	1.947495
Foreign input (FRGNINPT)	-7.595137***	-7.595137
Input cost (Ininputcost)	0.5378795**	0.5378795
Fuel cost (Infuelcost)	1.029685***	1.029685
Foreign exchange (EXCGdummy)	-4.850135***	-4.850135
Constant	11.8611***	
Fitted values (predict)		36.85
Adjusted R ²	0.5302	

***, **, * are significant at 1%, 5% and 10% respectively.

Source: author's computation, 2021

3.2.3. Linear interaction of capacity utilization and number of hours of operation per week

Assuming that capacity utilization is correlated with number of working hours operated per week, underlying joint explanatory variables of firms' capacity utilization and number of hours of operation per week were identified by estimation of the bivariate model of seemingly unrelated regression (SUR) model of the two equations.

The cross-equation correlation of residuals was strongly significant at 1% level and the null that the two equations are independent was rejected, suggesting that their simultaneous

estimation was appropriate (Table 9). About 73.64% and 53.57% of the variation, respectively, in capacity utilization and number of hours operated per week were explained by SUR model. According to seemingly unrelated regression (SUR) model output reported below, the common causal factors determining capacity utilization and number of hours of operation per week are percentage of domestic input (domesticinput), credit access(creditdummy), foreign input (FRGNINPT), quantity of raw and intermediate goods expressed in monetary terms (lninputcost), cost of fuel used when there is electricity outage (lnfuelcost) and exchange rate obstacle (EXCGdummy). The alternative hypothesis that the two equations are interdependent is accepted. The result suggests that capacity utilization of firms and the number of hours operated per week are interdependent by 19.04% where their interdependency is positively correlated to affect overall capacity utilization of firms (table 5, annex 2).

In terms of magnitude, the most important determinants were percentage share of domestic inputs(domesticinput) followed by credit access (creditdummy) and the quantity of raw and intermediate goods(lninputcost) and then cost of fuel for generator usage (lnfuelcost). In contrast, the highest explanatory variable that hinders capacity utilization and number of hours of operation per week of firms is application of foreign input (FRGNINPT) followed by foreign exchange constraint (EXCGdummy). Significant variables of capacity utilization and number of hours operated per week were generally in line with the empirical evidences by Adeyemi, P.A. & Olufemi, O.B. (2016), Okunade and Solomon Oluwaseun (2018), Solomon, M. (2018) except their magnitude difference.

The interpretation of the common significant variables is interpreted in a similar fashion with that of their interpretation regressed independently. Although the interpretation is similar, the interaction effect generates the magnitude of variables to be changed without changing the signs while one variable became significant that was not significant when independently regressed. The only variable that becomes significant due to the interaction effect is credit access.

Table 9. Bivariate regression of SUR model estimation

Variable	Coefficient		marginal effect (dy/dx)	Standard error
	CU	NHOPWEEK		
Poweroutage (OUTPMdummy)	0.087269	-0.5836682	0.0872	1.5403
Domestic input (domesticinput)	9.461763	7.861426	9.4617	0.5773***
Competition	0.0071723		0.0071	0.0601
Domestic sale(domesticsale)	0.0007689	0.0607738	0.0007	0.0255
Credit access(creditdummy)	4.094003	1.981806	4.0940	1.9744**
Colateral (LNCOL)	0.12303		0.1230	0.1269
Foreign input dummy (FRGNINPT)	-6.732879	-4.852776	-6.7328	2.2247***
Input cost (lninputcost)	1.146574	0.5314326	1.1465	0.1696***
Fuel cost (lnfuelcost)	0.6073561	1.028083	0.6073	0.1962***
Foreign exchange (EXCGdummy)	-3.392771	-7.403271	-3.3922	1.2967***
Water availability (lnwater)		2.440345	0	0
Permanent worker (permworker)		0.0131103	0	0
Constant	1.67786	11.8611		
Fitted values (predict)			26.54	
Adjusted R ²	0.7364	0.5357		

***, **, * are significant at 1%, 5% and 10% respectively.

Source: author's computation, 2021

The likelihood of firms that have access to credit can increase the capacity utilization of firms by 7.5% and makes these firms to have greater number of working hours of operation by 7.5 hours per week compared to their counter parts. This is for obvious reason that, firms having credit access are better to be pertinent for purchasing of inputs such as labor, raw material and equipment. So, firms require financial source to increase their capacity utilization as well as increase number of working hours of operation per week. The finding is in conformity with Okunade, Solomon Oluwaseun, (2018).

4. Conclusion

The major conclusion of this study is that there is significant under-utilization of firms' capacity in Ethiopian which is the descriptive result shows about 36%. This is the major problem which is exacerbated in the overall economy of the country. The problem is not restricted at firm level only, but also depicted in the economic system of the country which contributed greater role for slower economic growth. There are different factors which are accountable for under-utilization of firms' capacity to the maximum potential but there are not sufficient studies implying the major determinants of capacity utilization of firms in Ethiopia where the concerned stakeholders can take remedial measures. This study can be taken as a profound study to identify the determinants of capacity utilization.

The univariate regression result suggests that percentage share of domestic input, foreign input, quantity of intermediate and raw material input, fuel cost and foreign exchange constraint are significant determinants for capacity utilization. In spite of this, factors that affect the number of hours of operation per week are percentage share of domestic input, water availability, foreign input, quantity of intermediate and raw material input, fuel cost and foreign exchange constraint where univariate regression is conducted.

The seemingly unrelated regression model was employed to analyze idiosyncratic factors for capacity utilization and number of hours of operation per week. The SUR model result of simultaneous regression suggests that the two regressands are positively interdependent. The explanatory variables which attributed positive and significant contribution were cost of input, fuel cost, share of domestic input, credit access while factors hindering capacity utilization were foreign exchange constraint and foreign input usage. The interdependency between the two models were highly significant.

5. Recommendation

It may be conditional that the current state of the economy in Ethiopia in terms of the country's political stability, government expenditure, external influences such as foreign exchange constraint and foreign input price shocks influence the trend of capacity utilization of firms. Therefore, government should focus on building the bounciness of the economy to global shocks and design mechanisms to provide incentives to support firms' activities to enhance capacity utilization in the economy. Underutilization of the potential capacities of firms is emanated either from the demand side (domestic demand, competition of firms) or supply side (electric power supply, domestic and foreign input, credit supply, water supply, labor supply, etc) problems. But in this study, demand side factors are not sufficiently affecting the capacity utilization of firms rather the supply-side factors are essentially required intervention of the concerned stakeholders.

Optimum firms' capacity utilization should be the objective of every sector in Ethiopian economy and should be a policy focus by the government. Therefore, devising ways to facilitate optimal productive capacity of installed machinery and other resources in every sector would ensure full resource utilization and reduce wastage in the system. 2. Without loss of generality, the government should also be aware that the average capacity utilization of Ethiopian firms is only 36% (from the descriptive result) beyond which one of the lowest performance in the less developed countries. Therefore, more incentives should be introduced

especially for high capital-intensive industries to increase their output levels and reduce their cost of operations by providing tolerable foreign exchange, adequate infrastructures (such as electric power and water supply) and funding facilities.

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Conflict of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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