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Determinants of Output per Workers in Large and Medium Manufacture Enterprise in Mekelle City, Northern Ethiopia

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Abstract

This research is made to estimate productivity of labor in large and medium manufacturing firms in Mekelle city by using Logistic regression model. There are 90 large and medium manufacturing firms in Mekelle city. From the total 90 large and medium manufacturing firms data was collected only from 80 firms. Estimation result from the logit model indicate that from eight explanatory variable six of them have significant effect on the probability of producing high amount of output per unit of labor. Therefore, to increase productivity of manufacture, the federal and regional government should investing more in education and training, reduce the high inequality of salary in the manufacturing firms, and increase in firm size. As well as firms should develop the organizational and managerial experience and employ more experienced workers and financial institution to give long-term loan to the manufacturing firms.

Keywords: Logistic regression model, large and medium manufacturing firms data.

1. INTRODUCTION

Manufacture sector in developing countries is an engine in order to achieve long term economic growth and development. Ethiopia as one of the developing country gives much priority in this sector to achieve sustainable development.

The strategic pillars GTP II (growth and transformation plan) related to manufacturing include (1) developing light and small manufacture enterprise that are globally competent and leading in Africa (2) setting up an establishment for further development strategic heavy industry which ultimately enable Ethiopia to become an industrialized country by 2025 (GTP II). In the GTP II the government adopted policy focused on the development of manufacture sector by opening industrial park (industry zone) in different corner of the country to attract FDI and to support the small manufacture enterprise.

Mekelle is one of the selected industry zones by the government in GTP II. Labor productivity is an important indicator of different economic conditions within an economy. It is an indicator of dynamic economic growth and development, competitiveness, living standard and welfare. Labor productivity also important indicator of manufacture sector performance such as profit, competitiveness and growth performance. Study labor productivity in large and medium manufacture sector in Mekelle town (one of the industry zone in Ethiopia) is important to analysis the performance of manufacture industry in GTP II at the industry zone.

There are several empirical evidences on the manufacturing sector productivity

internationally. Kurre and Eiben (2013), look at why productivity varies so much, utilizing a select set of 5-digit manufacture industry in USA. to explore the clarification behind this variety, Examine the impact of education investment , physical capital, health capital, public capital, agglomeration economy it has shown capital is crucial to the productivity regardless of industry, while the other determinant are influence in certain industry but insignificant in others.

A far reaching study undertaken on firm productivity of Bangladesh manufacturing industry by Fernandes (2008) has found that the age of the firm has an inverse U-shape relationship with TFP whereas the firm size has a negative correlation on TFP. However, according to Margono and Sharma (2006) large firms were more efficient than small firms. Further, firms with educated and experienced management, firms with foreign ownership, firms which manufacture only to export and firms with quality standard certifications have higher TFP whereas firms which have power supply issues, firms with heavy bureaucracy and firms with corruption were shown to have an adverse effect on the TFP (Fernandes2008). Couture, Sydor and Jang (2015), study the relationship between firm off shoring and productivity in Canadian new manufacture industry. The finding demonstrate that, compare with non-off shoring manufacture firm, firm engaging in off shoring have higher productivity and the productivity increase with off shoring intensity.

However, in Ethiopia there are limited studies about productivity in the manufacturing sector. Same study show little evidences on this, Admit (1998) examined the technical progress of the manufacturing sector in Ethiopia for the period 1976–1995 utilizing a Cobb-Douglas, Constant Elasticity of Substitution (CES)and Trans log models. The outcome showed a zero or negative TFP growth. He additionally found a variation in the pattern of TFP growth across sectors. TFP increased in sectors such as tobacco, paper, plastic, and leather while it was stagnant or decreasing in other sectors. Mulu, 2008 using the annual CSA census of medium and large manufacturing industries found that the Ethiopian manufacturing sector exhibited an annual average productivity growth of about 9.3 percent between 1996 and 2003, with entry and exit of firms being the major source of productivity growth.

The important of productivity in general labor productivity in particular in economic growth, competitiveness, welfare, standard of living of one nation in one hand and the absence of sufficiently study on the manufacture sector productivity in Ethiopia imply the wide information gap in the area and the important of this study to fill the gap. This study therefore aim to adequately explain the determinant of productivity in large and medium manufacture industry in Mekelle town to fill the information and knowledge gap in the study area.

2. Literature Review

There are limited studies on the manufacture sector productivity in Ethiopia. Admit (1998) analyzed the technical progress of the manufacturing sector in Ethiopia for the period 1976–1995 using a Cobb-Douglas, Constant Elasticity of Substitution (CES) and Trans log models. The results showed a zero or negative TFP growth. He also found a variation in the trend of TFP growth across sectors. TFP increased in sectors such as tobacco, paper, plastic, and leather while it was stagnant or decreasing in other sectors. Mulu, 2008 using the annual CSA census of medium and large manufacturing industries found that the Ethiopian manufacturing sector exhibited an annual average productivity growth of about 9.3 percent between 1996 and 2003, with entry and exit of firms being the major source of productivity growth. In Ethiopia manufacture sector is still small and stagnant value added share of the GDP. In order to ensure dynamic growth in Ethiopia the manufacture sector should be increase its share of the GDP, employment creation, and foreign currency. Tesfahun, 2015 in Ethiopia wages and salary in manufacture sector is very low which is not adequate to finance daily subsistence even if the basic needs of the workers. Because of this most of the skilled and hard worker workers

forced to migrate from the manufacture sector to other sector like service sector.

For example Bole-lemi the only operating industrial park in Ethiopia faced this problem. Since the growth of service sector in Addis Ababa is much higher than manufacturing sector they pay labor higher than manufacture sector. These mobilize of workers from the manufacture sector to the service sector to get higher payment. This negatively affected the manufacture sector to low productivity and competitive trap. In addition to that, due to low amount of wage and salary the productivity and profitability of the enterprise is low which again yielding to low wage of workers. This is lead to a vicious circle problem.

3. Methodology of the Study

3.1 Sampling design, sampling frame and sampling size

The sampling frame is the list from which the sample is selected. Our sampling frame is all large and medium manufacturing firms in Mekelle town. According to Tigray bureau of industry data there are 90 large and medium manufacturing firms in Mekelle town that are categorized in to five sub-sectors, chemical and construction, metal and metallic engineering, cotton and textile, milk and beef, food and beverage.

To achieve the objective of this study two stage purposive sampling method also known as judgmental, selective or subjective sampling method was employed. Purposive sampling is a sampling technique in which researcher relies on his/her own judgment when choosing member of population to participate in the study.

At the first stage, the study area Mekelle town was purposively selected from the other town of Tigray regional state because its accessibility and among the several town in Tigray region where higher amount of large and medium manufacturing firms are found. At the second stage, the total populations of the study are all the 90 large and medium manufacturing firm in Mekelle town. However, data was collected from the 80 large and medium manufacturing firms. Five manufacturing firm are not willing to give their data and company profile for security purpose and the rest five firms are not start production until now. From the 80 manufacturing firms 35(44%) of them are medium manufacturing firm where as the remaining 45(56%) are large manufacturing firm. The total populations are limited in number; taking sample from those limited number of population undermines the reliability of the data. Therefore, for the purpose of reliability of the data the study was take all the 80 large and medium manufacturing firm to conduct the research. In this case sample size equal to total population.

3.2 Sample size

According to the Tigray bureau of industry data on large and medium manufacture firms, there are 412 large and medium manufacture firms in the Tigray regional state of which 90 of them are found in Mekelle town. Since, the sample size equal to the total population the sample size determination procedure is irrelevant in this case.

3.3 Methods of Data collection

Methods of data collection are the tools which are employed so as to gather data. Out of the 90 large and medium manufacturing firms data was collected from the 80 large and medium manufacturing firms. The paper was utilized both primary and secondary data. Primary data was collected by distributing one questionnaire for each of the 80 large and medium manufacturing firms. The questionnaires contain both open end and cloth ended questions. Mainly data for empirical analysis is primary data that was collected on the relevant variables (determinants of labor productivity in large and medium manufacturing firm) and Secondary data was collected from journals, annually, quarterly reports of Tigray industry bureau. The secondary data was used to analysis the challenges and problems faced by the manufacturing firm in the town. In addition

to that, interviewing with some of the managers and observation was also considered to enrich the data finding.

3.4 Data analysis technique

To analysis the data that was collected from the 80 large and medium manufacturing firm's discrete choice model specifically logit model (Binary logit model) was utilized in this study. Where labor productivity is the dependent variable follow probability distribution i.e. 1 if it high (above the mean), 0 if it is low (below the mean) put on the left hand of the equation and the independent variable that determinant labor productivity in the manufacture enterprises put in the right hand side of the equation.

The study was take eight explanatory variables that determined labor productivity those are capital accumulation, salary, education, gender, and access to external source of finance, amount of budget for R&D, year of work experience, gender and firm size.

The collected data has been analyzed and processed using various statistical tools in state version 13. Test the results to check the significance of variables, interpretation and discussion of the logit regression results, interpreting the marginal effect of each variables, various diagnostic test and statistical descriptive like mean, median, maximum, minimum and quartile of the variables was also analyzed.

3.5 Econometric analysis

Approach to developing a probability model for binary response variable

A categorical variable here refers to a variable that is binary, ordinal, or nominal. Event count data are discrete (categorical) but often treated as continuous variables. When a dependent variable is categorical, the ordinary least squares (OLS) method can no longer produce the best linear unbiased estimator (BLUE); that is, OLS is biased and inefficient. Consequently, researchers have developed various regression models for categorical dependent variables. The nonlinearity of categorical dependent variable models makes it difficult to fit the models and interpret their results. Since our dependent variable (labor productivity) binary variable applying OLS regression model to analysis the data is difficult to fit the model and interpret the result. So that, the paper was employed one of the binary response variable that is logit model to best fit the model.

Binary response variable is one of the categorical variables. There are three approaches to develop binary response variables; those are linear probability regression model, logistic regression model, probit regression model Gujarati, 2004. Though there are different approaches to develop binary response variables the paper employ logit model because this model is an advantage over the other approaches.

Linear probability model have an advantage over the logit model interims of interpretation of the result. However, linear probability model have so many limitation such as non-normality of error term and heteroscedastic variance of the disturbances and questionable value of R2 as measure of goodness of fit as well as the possibility of the estimated probability laying outside the 0-1 bounds. Linear probability models less fit our model than logit model because of this limitation (Gujarati, 2004).

Using logit or probit model is up to the researcher preference. Even if probit model give almost similar result with logit model, probit model is highly complicated and difficult to interpret the result. So that, logit model is more preferable than probit for interpretation purpose.

Logistic regression model: logistic regression model is one approach to develop binary response variable that use the cumulative logistic function. Unlike LPM, logistic model assume that the natural log odds p/1-p is a linear function of the regression. , the log of odds ratio, is not only linear in x, but also linear in parameter. Li is called the logit model, Li is linear in x the probability itself not. The impact of predictor variables is usually explained in terms of odds ratio. The logistic regression calculates changes in log odds of the dependent, not changes in the dependent itself.

After transforming the dependent variable into logit, maximum likelihood, estimation was employed to determine the coefficients of the variables. The log odd of the outcome is modeled as a linear combination of the predictor variable. Logistic regression has better interpretation than probit regression Gujarati, N.D (2004).

Logistic slope coefficient can be interpreted as the effect of a unit of change in the X variable on the predicted logit with other variable in the model held constant. Thai is, how one unit change in X affects the log of the odds when other variable in the model held constant.

The rule of thumb said that, if the probability that you're modeling are extreme- close to 0 or 1 –then you probably have to use logistic regression. But if the probability are more moderate -say between 0.20 and 0.80 a little beyond-then the linear and logistic model fit about equally well, and the linear model should be favored for its ease of interpretation Hellevik, O. (2007).

Logit model specification

According to Gujarati, 2004 logit model can be specified as below:

$$[Pi = E(y = 1|Xi = \frac{1}{1 + e - (\beta o + \beta 1x1 + \beta 3x3 + \beta 4x4 + \cdots \beta nxn)}$$

Where, βi=coefficient of each explanatory variables

Xi = explanatory variables

This can be write as,

$$pi = 1/1 + e^{zi = \frac{e^z}{1+e^{zi}}}$$

Where, Zi = $\beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \beta 4x4 \ldots \beta nxn$

The above equation represents the cumulative logistic distribution function.

Pi =the probability of producing higher output per unit of labor by the manufacturing firms, then (1-Pi) is the probability of producing high which is $pi = 1/1 + e^{-zi}$

So that, this can be written as,

$$\frac{Pi}{1 - Pi} = 1 + \frac{e^{zi}}{1 + e^{-zi}}$$

Where $e^{zi} = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \beta 4x4 \ldots \beta nxn$

As indicted in the above, pi / (1-pi) is the odd ratio of producing higher output per unit of labor or the ratio of probability of producing higher output per unit of labor verses probability of producing lower output per unit of labor.

If we take the natural logarithm of the above, we obtain what the interesting logit model.

$$\ln (\frac{Pi}{1 - Pi}) = \frac{1 + e^{zi}}{1 + e^{-zi}}$$

Therefore the general logit model that used for estimation purpose is that

$$Z_i = \beta 0 + \beta 1x1 + \beta 2x2 + \beta 3x3 + \beta 4x4 \ldots \beta nxn$$

Finlay, the logit model where, labor productivity as dependent variable (measured by output per unit of labor (YL)) as indicated below:

$$n\,(YL) = \beta 1 + \beta 2(X1) + \beta 3(X2) - \beta 4(X3) - \beta 5(X4) + \beta 6(X5) + \beta 7(X6) - \beta 8(X7) + \beta 9(X8) + \epsilon i$$

Where,

YL.....output per unit of labor

β1 ……..constant term

β2…… β9 are the coefficient of independent variable

X1, year of experience

X2, firm size

X3, amount of capital accumulation

X4, access to external source of finance

X5, salary of payed to workers

X6, number of educated workers

X7, budget for research and development

X8, gender of the manager

εi error term.

The dependent and independent variable of the model and their explanation are puts as blow:

Table 1: *List of dependent and independent variable of the model*

Dependent variable	
Labor productivity	1, if output per unit of labor is high (if it is above the average output per unit of labor) 0, otherwise
Independent variable	
Capital accumulation (CA)	Continuous variable
Education(Edu)	Continuous variable
Salary(Sala)	Continuous variable
Amount of Budget for research and development (R&D)	Continuous variable
Gender (Gn)	1, male 0, female
Access to external source of finance (AEFin)	1, if there is 0,otherwise
Year of experience (Wexp)	Continuous variable
Firm size (Fsize)	Continuous variable

Definition of the variables

Labor productivity (dependent variable) of the manufacturing firm was measured by dividing the total amount of output that each manufacturing firm produced in 2016 by the total amount of labor input used in that year. By calculating output per unit of labor for each of the 80 manufacturing firm, the study was take average or mean of output per unit of labor (1305) by dividing the total output per unit of labor of all firms to the number of firms. That is,

Average (mean) output per unit of labor = $\frac{\sum_{n=1}^{80} output\ per\ unit\ of\ labor\ of\ the\ firms\ in\ 2008\ e.c}{number\ of\ firm(80)}$

= 1305

If the output per unit of labor of a given firm is above the mean (1305) it means high (give value of 1) and if it is below the mean (1305) it means low (give value of 0).

From the eight explanatory variables five of them (capital accumulation, salary payed to workers, number of educated workers, and amount of budget for R&D and year of work experience) are continuous variable and the rest three are dummy variable.

1. Capital accumulation (CA): Is continuous variable that measure in terms of the total amount of investment stoke that each firms accumulate from its establishment up to 2016. It is expected that manufacturing firms with high investment stock are rewards with high productivity of labor.

2. Salary (Sala): is continuous variable. Measured by the amount of average salary that each firms pay to their workers in 2016. Since salary of the workers is differ with in a firm the study was take average salary of workers for each of the 80 large and medium manufacturing firms. So that, this average salary was used as measurement of the amount of salary payed by each firms to their workers.

3. Educated (Edu): also continuous variable measured by the number of educated workers that a given manufacturing firm has in 2016. It is expected that the productivity of labor in manufacturing firms increase as more of its workers are educated.

4. Firm size (Fsize): firm size is dummy variable. This shows how productivity of labor vary between large and medium manufacturing firms. Give the value of 1 if it is large and 0 if it is medium. It is expected that labor productivity of large manufacturing firm is greater than medium manufacturing firm because of the existence of economic of scale at firm level.

5. Amount of budget for research (R&D): investment in research and development is vital for manufacture firms to increase their productivity of labor. It is continuous variable that measured in terms of the proportion of budget for research and development from the total budget in 2008 E.C. It is manufacturing firms invested more budget for research and development rewarded with high labor productivity and the less invested reward less productivity of labor

6. Year of experience (Wexp): year of work experience is continuous variable measured in terms of the number of year of work experience that the manufacture firm has from its establishment up to 2016. Labor productivity of manufacturing firm increase with year of experience.

7. Gender (Gn): is dummy variables. Give the value of (1) for male (0) for female. It expected that female-managed manufacturing firm produce less output per worker than male managed manufacturing firms.

8. Access to external source of finance (AEFin): is binary variable give the value of (1) if the manufacturing firm have access to external source of finance (0) if the manufacturing firm have no access to external source of finance

4. Result and Discussion

4.1 Statistical Descriptive Analysis

As indicated in the below Table 4.2 most of the manufacturing firms are managed by male manager. From the total 80 large and medium manufacture firms 63(79%) of them are managed by male managers and the rest 17(21%) are managed by female manager. This indicated that there is gender bias (male dominance) in the managerial position of the manufacturing firm. Even if the productivity of the manufacturing firms positively related to female manager in our result more than half of the manufacturing firm are managed by male manager.

One –way tabulation for access to external source of finance show that from the total 80 large and medium manufacturing firms 30(38%) of theme have no enough access external source of finance. Most of the manufacturing firms related this financial problem to collateral problem, high interest rate on the loan and time-consuming to get the loan and the rest 50(42%) have enough access to external source of finance from bank and micro finance institutions.

The mean value of output per unit of labor for all the 80 manufacturing firm is 1305. When we see the amount of capital accumulation of the manufacturing firms, most of the manufacturing firms accumulated capital between150 million up to 160 million. 6 percent of the manufacturing firm have accumulated capital between 150 million and 160 million.

On average most of the manufacturing firms pay 2000 birr per month to their workers and spend 100000 birr for research and development that is around 15 percent of the manufacturing firms spent 100000 birr up to 150000 birr for research and development. Market opportunity finding and raw material finding researched and development are most of the research and development conducted by the manufacturing firms. The one- way tabulation for size of the firm, accessibly to external source of finance and gender of the manager are summarized as below:

Table 2: *One- way tabulation of dummy variables*

Variables		Frequency	Percent	Cum.
Firm size	Medium	34	43.75	43.75
	Large	44	55	100.00
Access to external source of finance	0	30	38	21.25
	1	50	42	100.00
Gender of the manager	0	17	21	37.50
	1	63	79	100.00
Total		80	100	

Source: own primary data, 2017

4.2 Econometrics Results and Discussion

The logit model is estimated by considering the manufacturing firms probability of producing high output per unit of labor verses producing lower output per unit of labor as dependent variable. By calculating output per unit of labor for each of the 80 manufacturing firms in 2008 E.C, the study take mean output per unit of labor (1305) by dividing the output per unit of labor of all firms in 2008 E.C to the number of firms in that year. if the output per unit of labor for a given manufacturing firm is above 1305 it means labor productivity of that manufacturing firm is high (give the value of 1) and if it is below 1305 it means labor productivity of that manufacturing firm is low (give the value of 0).

To see the overall significant of the model and to test the significance of the individual variables at each level of significance (1%, 5%, 10%) the maximum likelihood estimate for logit model is done. In addition to that, maximum likelihood estimate is done to estimate the marginal effect of each independent variables on the probability of producing higher output per unit of labor or not. The main concern of the logit model is to estimating factors that determine (influencing) the probability of producing higher output per unit of labor for the 80 large and medium manufacturing firms.

From the result logit model is as it is indicated below:

$$Ln\,(YL) = -3.675 + 0.17(Wexp) + 1.403(Fsize) - 8.11(CA) - 2.94(AEFin) + 0.0068(Sala) + 0.122(Edu) + 1.58(RD) - 1.0447(Gn)$$

Table 3: *Summary of the logit model regression result*

Explanatory variable	**Coefficient**	**z**	**P>|z|**	**Odds ratio**	**Marginal effect**
Wexp	0.1651252	1.83	0.067	1.179	0.068
Fsize	1.403678	2.28	0.023	4.070	0.116
CA	-8.11e-09	-2.29	0.022	1	-6.72
AEFin	-2.940018	-2.47	0.013	0.052	0.243
Sala	0.000675	3.43	0.001	1.00067	0.000056
Edu	0.122056	2.40	0.016	1.1289	0.019
RD	1.57e-06	0.58	0.563	1.00002	1.3
Gn	-1.044696	-1.03	0.303	0.351	-0.86
Number of obs = 80, Prob > chi2 = 0.0000		LR chi2 (8) = 67.46 Pseudo R2 = 0.6127		Log likelihood = -21.320158	

Source: Own logistic regression result

As indicated in the above Table 4.8 regression result the number of observation being analysis are 80 large and medium manufacture firms. LR Chi2 (8) is the likelihood ratio chi square with 8 degree of freedom. One degree of freedom is used for each predictor variable in the logistic regression model. The LR chi2 can be defend as 2(L1-L0), where L0 represent log likelihood for the constant only model, L1 is the log likelihood for the full model with constant and predictor. The likelihood ratio chi-square of the model can be calculated as below:

In this case, L0 =-55.051105 and L1=-21.320158

So that the likelihood ratio chi-square = 2*(-21.320258-(-55.051105) = 67.46

Prob>chi2 is the p-value of the model it indicates the reliability of explanatory variable to predict the dependent variable. Since the value of Prob > chi2 is lower than 0.05, we can say that there is spastically significant relationship between the explanatory variables and explained variable.

-21.320158 is Log likelihood for the whole model with constant and predictor. Pseudo R2 indicate the predictive strength of the logistic regression model or it show how the model fit the data. Since the value of Pseudo R2 in our model is 0.6127 which is approximate to one we can conclude that the model best fit the data.

As indicated in the above logistic regression Table 4.8, six variables including the intercept term are statically significant at 5% significant level, one variable is significant at 10% significant level and the other two variables are statically insignificant in all level of significant(1%, 5%, 10%). Variables including firm size, capital accumulation, access to external source of finance, salary, education and the intercept term are statically significant at 5% significance level, capital accumulation is significant at 10% significant level the other two research and development and gender are insignificant even if at 10% significance level.

Since firm size, capital accumulation, access to external source of finance, salary, education are statically significant we can say that, firm size,

capital accumulation, access to external source of finance, salary, education are significant variables that determined the probability of producing high amount of output per labor for the large and medium manufacturing firms. That means changing in those variable lead to a significant change in the odds of producing high amount of output per labor. The marginal effect tells you by how many unit the probability of producing higher output per labor changes if the explanatory variable changed by one unit.

Interpreting the logit coefficients, odds ratio and marginal effects for each variables

Logistic slope coefficients can be interpreted as the effect of a unit of change in the X variable on the predicted logits with the other variables in the model held constant. That is, how a one unit change in X effects the log of the odds when the other variables in the model held constant. Detail explanation of each variable is as indicated below:

Firm size (Fsize): The sign of the coefficient is positive, this in line with hypothesized relationship with the dependent variable. It is statically significant at 5 percent level of significant this indicates size of the manufacture firm (i.e. being large or medium manufacturing firm) is significantly affects the odds of producing high amount of output per unit of labor verses (lower output per unit of labor) or the odds of labor productivity.

This insures that large manufacturing firms are higher odds of producing high amount of output per unit of labor than medium manufacturing firms and the odds of producing higher amount of output per unit of labor is positively and significantly increase in line with the size of the firm. To interpret the coefficient 1.4036, as the firm size change from medium to large the log odds of producing high amount of output per unit of labor verses lower output per unit of labor increased by 1.4036 other variables in the model held constant.

Exp(coefficient) gives the odds ratio of the variable that is 4.07, this implies as the firm size change from medium to large the odds ratio of labor productivity increase 4.07 times no matter what values the other independent variables take on. This means the odds of labor productivity are about 4.07 times greater for large manufacturing firms than medium manufacturing firms this is due to the fact of large economic of scale at the firm level. Large firm are larger value of raw material (including energy) per workers, large intermediate input per workers and monopoly power. This result is also similar with result done by Leung et al,2008b and Biesebroeck,2005, firm size matters for productivity. Firm size has a significant role on the difference of productivity. That is large manufacturing firms are 27 percent more productive than medium and small manufacturing firms.

The marginal effect of the variable is 0.116. This implies, the probability of producing high amount of output per unit of labor is increase by 11 percent as the firm size change from medium to large. How the probability of producing higher output per unit of labor vary as the firm size vary at 95% confidence interval is as it indicated below:

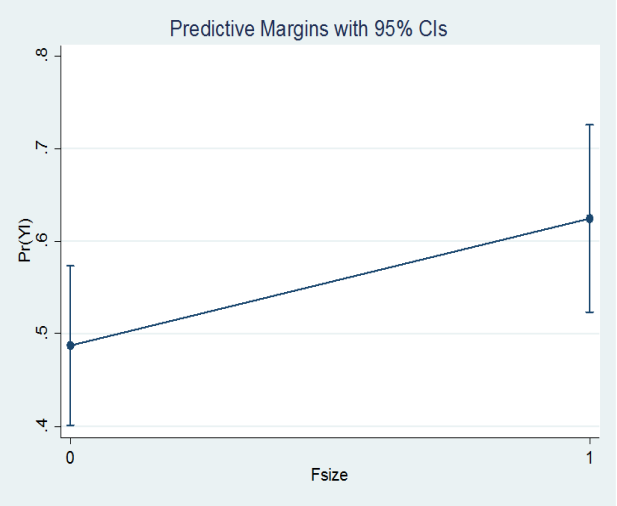

Figure 1: *Firm size and probability of producing higher output per unit of labor.*

Source: Own logistic regression result

Education (Edu): It has a coefficient with positive sign and the variable is statically significant at 5% level of significant. It show that as the number of educated workers in the manufacturing firms are positively and significantly affect the odds of producing high

amount of output per unit of labor verses (lower output per unit of labor). Its coefficient 0.122 implies, for a one percent increase in number of educated workers the odds of producing high output per unit of labor versus (producing low output per unit of labor) of the manufacturing firms increase by 0.122. The marginal effect 0.019 shows, as the number of educated workers increase by one unit the probability of producing higher output per unit of labor increase by 1.9 percent.

The odds ratio of education 1.1289 also can be interpreted as the number of educated workers increase by one unit the odds ratio of labor productivity increased by 12 percent no matter what values the other independent variables take on or we can say that the odds ratio of labor productivity is 1.129 times higher for manufacturing firms with high number of educated workers than lower number of educated workers. This result is also similar with result done by Afrooz et al, 2010 educated workers have significant effect on labor productivity. That is as the ratio of educated workers increase by one percent labor productivity increase by 0.14 percent.

Year of experience (Wexp): The sign of the coefficient is positive as already expected this implies manufacturing firms with higher year of experience tend to increase its log odds of labor productivity. The variable is statically insignificant at 5% level of significant but it is significant at 10% level of significant this implies year of experience of the manufacturing firm is significantly affect the log odds of labor productivity. To interpreted the coefficient of year of experience (0.166), as year of work experience of the manufacturing firm increase by one year the odds of producing high amount of labor productivity versus low amount of labor productivity is increased by 0.17 other variable in the model held constant or the odds of labor productivity increased by 0.17.

The odds ratio of year of experience is exponentials of the coefficient, that is exp (0.166) equal to 1.179. This implies increasing in year of experience of manufacturing firm by one year lead to increase its odds ratio of labor productivity by 17 percent no matter what values the other independent variables take on. we can say that probability of producing high labor productivity is 1.179 times higher for manufacture firm with higher year of experience than lower year of experience.

Marginal effect of year of experience also interpreted as, the probability of producing high amount of output per labor is increase by 6 percent as the year of experience of the manufacturing firm increase by one year. This shows the new entrant firms with less year of experience are less productive than the old experienced firm because the old experienced firms have more experienced workers and more experienced in organizational and managerial skill. This is similar to investigation by Maranto and Rodgers (1984), significant and positive effect of work experience on productivity of firm.

Graphically the relationship between the probability of producing higher output per unit of labor and the year of experience of the manufacture firm at 95% confidence interval as it is indicated as below:

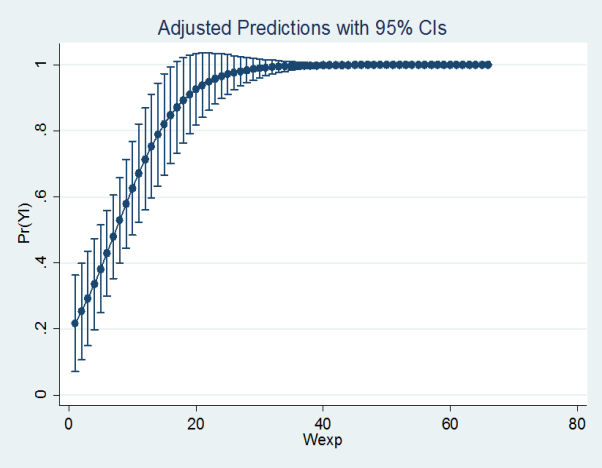

Figure 2. *Work experience of the firm and probability of producing higher amount of output per unit of labor.*

Source: own logistic regression result

Salary (Sala): The coefficient has positive sign as expected and at the same time the variable is significant at 1% level of significance. This indicate that salary payment to the workers by manufacturing firms positively and

significantly affect the odds of producing high amount of output per unit of labor verses (lower output per unit of labor). The coefficient of salary 0.0068 can be interpreted as, for a one percent increase in salary of the workers the odds of producing high output per unit of labor (versus producing low output per unit of labor) of the manufacturing firms increase by 0.0068 other variable in the model held constant.

The log odds ratio of salary 0.007, show that labor productivity is higher 0.007 times for manufacturing firms that pay higher salary than for manufacturing firms that pay lower salary or we can say that one percent increase in the salary of the workers lead to increase the odds ratio of labor productivity by 0.007 and its marginal effect 0.000056 shows, as the salary of the workers increase by one unit the probability of producing higher output per unit of labor is increased by 0.0056 percent. This is similar with result done by Ernesto et al., 2013, that paying higher salaries to workers attract higher IQ workers and motivated worker to work hard and to produce more output. Firms pay higher salary is more likely to attract and retain more productive workers.

Wolfers and Jan, 2015 higher salary payment to workers motivates workers to work hard, reduce shrinking, lower turnover and attract more capable and productive workers. In general, high salary payment to workers increases productivity. In addition to that, Kinyondo and Nganga, 2015 wage has significant Impact on the output per labor (labor productivity) of manufacturing sector.

Amount of Budget for Research and development (R&D): The coefficient of this variable is positive and this is in line with the hypothesized relationship with the dependent variable but it is statically insignificant even if at 10 percent level of significant. This shows although the coefficient is positive, the amounts of budget spent on research and development by the manufacturing firms have no significant effect on the odds of labor productivity (producing high output per unit of labor versus producing low output per unit of labor). The variable is insignificant in our case because most of the manufacturing firms have no budget (zero budget) for research and development.

Gender of the manager (Gn): The sign of the coefficient is negative, this not in line with the hypothesized relationship with the dependent variable and it is statically insignificant even if at 10 percent significant level. This implies being male manager or female manage is not significantly affect the odds of producing high amount of output per unit of labor verses (lower output per unit of labor). The negative relationship between the probability of producing high amount of output per unit of labor verses (lower output per unit of labor) and the sex of manager is as indicated in the below:

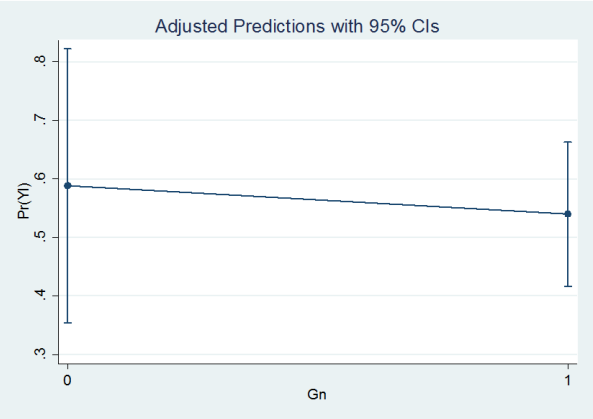

Figure 3: *gender of the manager and probability of producing higher amount of output per unit of labor.*

Source: own logistic regression result

Access to external source of finance (AEFin): surprisingly the sign of the coefficient is negative and not in line with hypothesized relation with the dependent variable but it is statically significant at the 5% level of significance. The coefficient - 2.94, indicated that, the odds of labor productivity are decrease by 2.94 as a firm has access to external source of finance.

This negative relationship between access to external finance and labor productivity of the firms is because of the type of debt that the firm gets from external source of financial institution. Since, financial institutions in the

town have liquidity constraint they can't give long-term loans. They only give short-term loan to the manufacturing firms. This short-term debt financing by the manufacturing firm negatively affect the productivity of the firms.

As Jaramillo and Schiantarelli, 1996 stated that nature of debt is an important determinant of productivity of a firm. Access to long- term debt financing allows firms to improve productivity. If a firm access has access to long-term debt financing it can invest in new capital and equipment which help to increase productivity. However, inability to access long-term finance can force firms to use short-term debt to finance long-term projects. This will create mismatches of assets and liabilities and depletes working capital. Depletion of working capital will negatively affect firm productivity and operations.

Amount of capital accumulation (CA): The sign of the coefficient is negative, not in line with hypothesized relation with the dependent variable but it is statically significant at 5 percent significant level. This implies capital accumulation of the manufacturing firm is negatively affected the odds of labor productivity.

The marginal effect of capital accumulation implies as the accumulation of capital increase by one unit the probability of producing higher amount of output per labor is decrease by 72 percent. There is no empirical finding that supports this result. However, theoretical it is similar to the Marxist theory of over accumulation of capita. This theory indicated over accumulation of capital by a given firm negatively affects its labor productivity. High amount of capital accumulation (high capital input to labor input ratio) depresses the salary bill, leading to stagnant salary and high rate of unemployment from the work class. Finally, this lead to lower productivity of labor and other problems.

5. Conclusion and Recommendation

5.1 Conclusion

Increasing productivity in general and labor productivity in particular is one of the most essential development and economic growth issues of one nation. Especially for developing countries like Ethiopia which have has a large endowment of labor relative to other productive factor such as capital, enhancing of labor productivity can make growth faster and more pro-poor. In addition to that, the government of Ethiopia adopted policy focused on developing of manufacturing sector in the GTP II, so that, increasing productivity of labor in the manufacturing sector is one of the periodic and essential issues at this time. This research is made to estimate productivity of labor in large and medium manufacturing firms in Mekelle town. The research may have its own important for the local government and town administration as well as for the manufacturing firm to utilize it as a clue to know the determinant of labor productivity and to take action to increase the productivity of labor in manufacturing sector. In addition to that, the research is important to the regional and local government to take action against the challenges faced by the manufacturing firm to increase their labor productivity.

There are 90 large and medium manufacturing firms in Mekelle town. Form the total 90 large and medium manufacturing firms data was collected only from 80 firms. Five firms are not willing to give their data and to fill the questioner for security purpose and the rest five are not started production. Of the 80 large and medium manufacturing firms 35(44%) of them are medium manufacturing firms whereas the remaining 45(56%) are large manufacturing firms. From the total 80 large and medium manufacture firms 63(79%) of the manufacturing firms are managed by male managers and the rest 17(21%) are managed by female manager. This indicated that there is gender bias (male dominance) in the managerial position of the manufacturing firms.

When we see the financial accessibility of the firms, from the total 80 large and medium

manufacturing firms 30(38%) of theme have no access to external source of finance from banks and other financial institutions. high interest rate, high amount of collateral, time consuming to get the loan (bureaucratic problem) liquidity constraint are some of the problem faced by the firms to get adequate financial access.

Education or human capital development is considered as the basic instrument in increasing productivity of the labor force. Increase both the quality and quantity of educated workers in one nation is expected to bring positive and significant effect on the productivity of labor force and economic growth. In this research educated workers included in data are workers that are TVET trained, diploma graduate and degree graduate. The numbers of educated worker are positively and significantly affect the labor productivity of the manufacturing firms in our result.

The number of educated workers of the manufacture firm is vary from manufacturing firms with no educated workers up to manufacturing firms with number of educated workers 8012. This shows the existence of higher variation in number of educated workers in the manufacturing firms. The mean value of educated works is 130 this can be interpreted as on average the manufacturing firms have 130 educated workers.

The amount of salary payed to their workers by the manufacturing firms is vary from 900 up to 132,000(for foreign firm) this indicated that there is high amount of variation in salary payed to their workers by the manufacturing sector. The mean value of salary payed to the workers is 8282. This shows on average the manufacturing firms pay 8282 birr per month to their workers.

The finding indicates that positive but insignificant effect of research and development on labor productivity. Even if research and development activities are important to increase labor productivity in different ways by generated new knowledge and bring new products to the firm and to the market. Most of the manufacturing firms are have no budget for research and development. 29(36%) of the manufacturing firms are no budget for research and development.

Estimation result from the logit model dictate that from eight explanatory variable six of them have statically significant effect on the probability of producing high amount of output per unit of labor. Variables such as year of experience, size of firm, capital accumulation, salary payed to the workers, number of educated workers and access to external source of finance have statically significant variables. Year of experience, size of the firm, salary payed to workers and educated workers have positive effect on the probability of producing higher amount of output per unit of labor to be positive at 5%, 5%,1%,5% level of significance respectively. Whereas capital accumulation and access external source of finance has negative impact on the probability of producing higher amount of output per unit of labor to be negative at 10%, 5% level of significance respectively.

The rest two variables that are gender and research and development are statistically insignificant to affect the probability of producing higher amount of output per unit of labor. From the result of logit model the sign of the coefficient of the determinant variable are intuitively make sense as already hypothesized except the three variables (i.e. capital accumulation and access to external source of finance and gender).

5.2 Recommendation

Based on the result of the study, the following recommendation are suggested to be considered for future intervention strategies by regional government and town administration which are aimed for increasing manufacturing sector labor productivity in the town.

The positive and significant effect of education on the labor productivity of the manufacturing firms obey important message to the regional government and city administration to open more TVET training center and other academic training center to increase number of educated labor force in the town that is important to enhance the productivity of manufacturing sector in the town. The federal and regional

government should build a strong foundation to increase labor productivity of the manufacturing sector by investing more in education and training more labor force to support the productivity of manufacture sector. This is also an important message to the manufacturing firms itself to enhance educational level of their workers and to employ high number of educated worker to enhance their productivity.

The positive and significant effect of salary on the labor productivity of the manufacture firms show that manufacturing firm pay high amount of salary to their workers rewarded by higher amount of output per unit of labor but those manufacturing firms pay low amount of salary to their workers are lead to lower output per unit of labor (labor productivity) and thereby to low enterprise profit which again yielding to low wage. This makes manufacturing firms which pay low salary to their workers to stay in the lower productivity, competitiveness trap and vicious circle problem. This is an important message to the reginal government, town administration and federal government to solve the lower productivity, competitiveness trap and vicious circle problem of the manufacturing firms. Increase the salary of the workers can be taken as one policy to solve lower labor productivity, competitiveness trap and vicious circle problems of the manufacturing firms in the town.

The amount of salary payed to their workers is vary from 900 up to 132,000 (for foreign firms), this indicated that there is high amount of inequality in salary payed to their workers by the manufacturing firms. This high salary inequality among the workers negatively affect labor productivity of the manufacture firms due to the fact that wage inequality may induce workers who believe their salary is unfair to supply less effort. This is an important implication to the regional government and town administration salary policy. The regional government and the local administration should reduce the high inequality of salary in the manufacturing firms in order to increase the productivity of labor and work effort of workers.

Out of the total 80 manufacture firm 35 of them are medium manufacturing firms. As our result shows that large manufacture firm are more productive than medium manufacturing firm this is due to the fact of large economic of scale at the firm level. The study recommends that the regional government and town administration should be encourage increase in firm size as a way of increasing labor productivity and lowering costs of production. Regional government and town administration should also subsidize the medium manufacturing firm of the town in order to increase their capacity and productivity.

The positive and significant effect of work experience on the labor productivity is an important message for the firms to develop the organizational and managerial experience and to employ more experienced workers.

The study also recommended to the banks and other financial institution to give long-term loan to the manufacturing firms in order to enhance manufacturing firms' productivity in the town and to increase firm's investment in equipment and machinery.

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