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Determinants of Investment in the Manufacturing Sector: A Micro Level Analysis on the Example of Injibara

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Assefa Belay[1]

Abstract:

Purpose: *In this study an attempt was made to determine the factors influencing the probability of investment in manufacturing sector in Injibara city.*
Design/Methodology/Approach: *For this purpose both the heteroskedastic probit and probit models were evaluated. Following the theoretical foundations laid by Jorgenson's model of optimal capital accumulation and other variables added, which are deemed relevant for this particular research, the probability of investment in manufacturing sector was estimated.*
Findings: *The binary dependent variable invested in manufacturing sector was regressed with seven independent variables and with one variance function in the heteroskedastic probit model. The dependent variable was also regressed using the standard probit model to compare the results with the heteroskedastic probit model. Education, relative prices, blackout and initial capital are statistically significant at 5 percent level of significance. The variance function initial capital is also significant. When we look at the probit section only education, relative prices and blackout are significant. However, the maximum likelihood estimators of the probit model will be biased and inconsistent if the disturbances are either non-normal or heteroskedastic.*
Practical Implications: *The probit model proposed in this research will be only used for comparison basis in this paper not being the appropriate model for decision making.*
Originality/Value: *The research has proposed the variables which affect investment in manufacturing sector in Mekelle city at micro level, showing a significant importance for the determination of the level of investments in the manufacturing sector in the city of Injibara.*

Keywords: *Investment, manufacturing sector, heteroscedastic probit and probit models.*

JEL Classification: *L0, L6, L7.*

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[1]*Department of Economics, St. Mary's University, Addis Ababa, Ethiopia,*
Email: assefakebede66@gmail.com

1. Introduction

Investment spending is a central topic in economics for two reasons. First, fluctuations ininvestment account for much of the movement of GDP in the business cycle. Second, investmentspending determines the rate at which the economy adds to its stock of physical capital, and thushelps to determine the economy‘s long-run growth and productivity performance. Faster growingcountries generally invest a higher share of their GDP than slower growing countries (Dornbusch and Fisher, 1995).

Investment spending plays a key role in long-run growth and also in the short-run business cycle because it is the most volatile component of GDP. When expenditure in goods and services falls during a recession, much of the decline is usually due to a drop in investment. While spending onconsumption goods provide utility to households today, spending on investment goods is aimed at providing a higher standard of living at a later date. Investment is the component of GDP that links the present and the future (Mankiw, 2009; Jindřichovská *et al.*, 2020).

Many policy makers and academicians contend that investment can have important positiveeffect on a country‘s development effort. In addition to the direct financing capital it supplies,investment can be a source of valuable technology and know-how while fostering linkages between firms, which can help jumpstart an economy. Based on these arguments, industrialized and developing countries have offered incentives to encourage investment in their economies (Alfaro, 2003).

As with LDCs, investment is crucial for LDCs in their aspiration for development. LDCs need to increase investments related to the development of productive capacities (namely productive resources, entrepreneurial capabilities and production linkages). They also need to significantly step up investments which are related to productive capacities (especially in infrastructure and institutions). Only if LDCs overcome these constraints and successfully develop productive resources, will they benefit from a more favorable process of capital accumulation, technological progress and structural change (UNCTAD, 2007).

When deciding upon which sectors to invest, the investor has a multiple of choices to invest into. One of them is manufacturing sector. What is manufacturing? Manufacturing is the production of goods for use or sale using labor and machines, tools, chemical and biological processing, or formulation. The term may refer to a range of human activity, from handicraft to high tech, but is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. According to UNIDO it is the physical or chemical transformation of materials or components into new products, whether the work is performed by power-driven machines or by hand, whether it is done in a factory or in the worker‘s home, and whether the products are sold at wholesale or retail.

The assembly of the component parts of manufactured products is also considered as manufacturing activities. It includes many fields and sub fields under it.

2. Literature Review

Many researches have been published related with investment in manufacturing sector, albeit not in micro level. This section will provide with some of the related literature.

Alan K. Severn (1972) in his study of "Investment and financial behavior of American investors in manufacturing sector" based on the model of the theory of investment and financial behavior of the firm found that changes in the domestic economic circumstances of individual firms appear to have little direct impact on the balance of payments of the United States, since domestic liquidity offsets the substitution between net outflow and domestic investment plus dividends.

K.A. Bohr (1954) in his paper "Investment criteria for manufacturing sector in underdeveloped countries" discussed about the selection of manufacturing sector that can be adapted to the conditions that exist in the underdeveloped world. He concluded that any proper evaluation ofthe suitability of an industry must weigh advantages against disadvantages in the context of the particular situation. The situation can be for example the relative abundance of capital or labor.

Gilberto Libanio and Sueli Moro (2007) in their paper entitled "Manufacturing industry and economic growth in Latin America: A Kaldorian approach" analyzed the relation between manufacturing output growth and economic performance from a Kaldorian perspective by estimating Kaldor‘s first and second growth laws for a sample of eleven Latin American economies during the period 1980-2006. Their results confirm the ―manufacturing is the engine of growth‖ hypothesis, and suggest the existence of significant increasing returns in the manufacturing sector in the largest Latin American economies.

Janvier D. Nkurunziza (2004**)** analyzed issues relating to credit in African manufacturing, not directly tested for the effect of credit on firm growth. For Nkurunziza, the use of bank credit could affect firm growth in two opposite ways. The effect might be positive if credit allowed a firm to address its liquidity constraint and increase profitability. However, if macroeconomic shocks such as increases in interest rates made firm debts unsustainable as experienced in Kenya in the 1990s, indebted firms might be shrunk or even collapsed. The researcher used microeconomic data on the Kenyan manufacturing sector; the study found that conditional on survival, the firms that used credit grew faster than those did not.

A study by the center for the Study of African Economies (1997) shows that there is very low level of investment in Africa‘s manufacturing sector. Moreover a positive effect from profits onto investment is identified in a flexible accelerator specification of the investment function controlling for firm fixed effects.

Urgaia Rissa (2007) in his thesis growth of industrial manufacturing in Ethiopia indicated the long-term growth rate of investment in manufacturing sector is positively related to the weight placed on growth of the sector. While that of labor engaged in production, is the short-run effect. Hence the manufacturing sector in Ethiopia is characterized as labor intensive. In the meantime, he showed the sector growth is negatively influenced by total factors of production that represent the obsolete uses technological level in manufacturing activities accounts for the sector‘s stagnant growth.

3. Research Methodology

3.1 Research Approach and Design

The researcher used both primary and secondary data sources. Both sources are crucial for the research and would be used to analyze their effect on the dependent variable. Questionnaire was used as the main technique of collecting primary data. The target population only included investors who participate either in manufacturing or in non-manufacturing but not in both. If investors who participate in both sectors are included it will raise the question of statistical dependency between the samples and it could not be estimated using models which assume statistical independency.

This means investors who participate in both sectors are excluded from the sample. The target population was investors in Injibara who gained license and invested from2007 up to 2015 E.C. The target population did not include investors who gained authorization to expand an existing firm, i.e. only new investments were concerned.

In line with the above information the total number of investors from 1998-2007 is 692. They were divided into two groups, i.e., investors in manufacturing sector and investors who invested in other sectors. As a result there are 186 investors in manufacturing and 506 in non-manufacturing sector.

To figure out my sample size I used the slovin’s formula which is used in determining a sample size when there is no enough information about the distributional pattern of the population. Slovin‘s formula is expressed as:

$$n = \frac{N}{1 + Ne^2}$$

where N = total population
n = samples
e = margin of error.

Using 10% level of error or 90% level of confidence 87 samples were taken from the total target population. Since I was encountered with a heterogeneous population, stratified random sampling was applied which is a type of probability sampling. I chose stratified random sampling because it is useful in increasing a sample‘s statistical efficiency and in providing adequate data for analyzing the various subpopulations.

The type of stratification thought appropriate for this research is proportional sampling. After stratification the researcher used simple random sampling to select individual investors out of total population. So this means there would be 27 respondents for manufacturing and 67 for other non-manufacturing sectors Most of the secondary data was collected from Injibara investment bureau. The data from Injibara investment bureau portrays the year to year basis investment in Injibara town. In addition I used NBE annual report, EIA publications and other internet sources.

3.2 Data Analysis

Econometric techniques were employed to study the different variables.This study deals with categorical variables. There are three most common methods of estimating categorical variables, viz. linear probability model (LPM), probit (normit), and logit. The LPM method is plagued by different problems including Unbounded Predicted, Conditional heteroskedasticity, Non-Normal Errors, and Functional Form. This lives as with probit and logit as the best techniques of estimating categorical variables.

Furthermore the setup of the logit andprobit models is essentially the same. However the shortcomings of both standard probit and logit model are the priori assumption of homoskeadsticity. But if there is heteroskedasticity in the variances the parameter coefficients estimated will be biased, inconsistent and inefficient. In addition the standard errors are wrong. Thus to solve the problem of heteroskedasticity the paper applied the statistical estimation technique of heteroskedastic probit.

3.3 Econometric Model Specification

One approach to identification of the basic forces influencing investment is to start with the firm level neoclassical model of optimal capital accumulation (Jorgenson) where net worth (N) of the
firm is given by:

$$N= \int_0^\infty e^{-rt} \left[p(t)Q(t) - w(t)l(t) - q(t)i(t)\right] \quad (1)$$

Where :

P = Price of product
Q = Quantity o product

W =Price of variable inputs
L= quantity of inputs
i = invstentment in durable goods
R = discount rate time value of money.

Since investment is based on expected future income streams which are not known with certainty, expected income is probabilistic in nature. To reflect the fact that operators may value non uniform probabilistic income streams differently, the model must be placed in a utility framework. Thus, the utility of expected income becomes a basic factor which may influence investment.

From this model, it is clear that investment is a function of the prices of output, inputs and capital, the production function which establishes the level of output as a function of the amount of the amount of the amount of inputs and capital used and the time value of money or discount rate. This model is theory of optimal investment perse.

This model is very helpful in explaining the working of the economic environment especially the investment environment. But this doesn‘t mean we can totally rely on this model to explain the entire real world phenomenon. Strict adherence to the classical analysis leaves very important variables which appear to affect the dependent variable significantly.

In addition this paper is not concerned with the decision to invest or not or how much to invest. It is more related with which sector to invest. This means this paper will not use the model as it is. There will be alterations to the optimal investment theory of Jorgensen in this paper. Some variables will be left out and other variables will be added. In the following section the variables which are tested against the dependent one will be explained rigorously. The standard probit or the homoskedastic probit model assumes constant variance or homoskedasticity. But what happens if there is heteroskedasticity?

What if is not a constant? In the context of heterogeneous choice, is known or expected to vary systematically, such that = with i = 1…N. It should be clear, though, that if the errors are not constant(heteroskedastic), then $\hat{\beta} = \frac{\hat{\beta}}{\sigma}$ and the parameter estimates will be biased, inconsistent, and inefficient; the standard errors will also be wrong.

As a result this research focuses on the heteroskedasticity problem that is ignored in most of the probit applications. The rationale for focusing on heteroskedasiticity problem is related with the data especially with the variable initial capital. There are many outlier observations in initial capital. There are observations which deviate greatly in relation to the observations in the sample.

In other words there are observations with too maximum or minimum value. In face of such observation it will be hard to maintain the assumption of homoskedasticity. So the only solution is to use an estimation technique which relaxes the classical assumption of homoskedasticity, i.e., heteroskedastic probit.

One approach would be to treat the heteroskedasticity as a nuisance factor and use robust standard errors the same way with OLS and heteroskedasticity. However robust standard error need asymptotically large sample which is not available in this research. An alternative approach would be to estimate a heteroskedastic probit (or logit). We might want to do this if we are explicitly interested in knowing how an independent variable affects the variance in the probability of some choice.

Heteroskedasticity can cause problems such as incorrect standard errors, and biased and inconsistent parameters. For this reason the determinants of investment in manufacturing sector is examined using the heteroskedastic probit model. The standard probit model is as well used to compare with the results of the heteroskedasctic probit model. The following section presents the setup of the heteroskedastic probit model. The binary probit model is based on the assumption that a latent variable y* is linearly related to the observed x‘s:

$$y_i^* = x_i\beta + \varepsilon_i \qquad (2)$$

Where xi is the vector of values for the ith observation is a vector of parameters, and i is the unobserved error. The relation between y* and the observed binary variable y can be expressed as follows:

$$y_i = \begin{cases} 1 \ if \ y_i * > \tau \\ 0 \ if \ y_i * \leq \tau \end{cases} \qquad (3)$$

Where Ѓ is a threshold or cut point. The errors of yi* are assumed to follow a normal distributed, the binary probit model expressed as follows**:**

$$\Pr(y_i = 1) = \phi(x_i\beta) \qquad (4)$$

Where Φ is the cumulative normal distribution. In the probit model, the error term is assumed as a homoscedastic. Probability can be written as follows:

$$\Pr(y_i = 1) = \phi\left(\frac{x_i\beta}{\sigma}\right) \qquad (5)$$

When is a constant that equals 1, it is removed from equation to estimate . If the errors areheteroskedastic the parameters estimate will be biased in consistent and inefficient. In the context of heterogeneous choice, is known or expected to vary systematically such that with i= 1…N. The heteroskedastic probit model as proposed by Alvarez and Brehm (1995) can be expressed as follows:

$$\Pr(y_i=1) = \phi\left(\frac{x_i\beta}{\sigma_i}\right) \quad (6)$$

Where $\sigma_i = \exp(z_i\gamma)$ and z_i is and is a vector of covariates of the ith observation and is a vector of parameters to be estimated. If the s is equal to 0, the model is identified as a probit model. Thus, the probit model is nested in the heteroskedastic probit model. As a result, you can use a likelihood ratio test to determine whether you need to run the heteroskedastic version or not

Interpretation of coefficients obtained from probit model is complex. Coefficients are interpreted with the marginal effects. Marginal effect in a standard probit model with respect to same is:

$$\frac{\partial \Pr(y_i = 1)}{\partial x_k} = \Phi(\widehat{x_i\beta})\widehat{\beta_k} \quad (7)$$

Thus using the above setup for heteroskedastic probit the model specification for this research is as follows:

$$invmf = \beta_0 + \beta_1 edu + \beta_2 loan + \beta_3 blackout + \beta_4 area + \beta_5 r + \beta_6 inicap + \beta_7 rp + \varepsilon_i \quad (8)$$

3.4 Definition of Variables

As explained above though there are many investment theories which can explain how investment occurs, the Jorgensen model is better at explaining it at micro level. This research‘s objective is to investigate factors that led investors to invest in manufacturing sector. The dependent variable is invested in manufacturing sector. This variable has a value of 1 if some random investor invested in manufacturing sector and 0 if he/she invested in other sectors (i.e., in service or agriculture).

The study focuses on investors who invested in one of the sectors but not both. The model includes six economic and one behavioral (psychological) explanatory variable. One of the independent variable is education level of the investor. This variable is measured by the year of education the investor had gained. It is expected to have positive impact on investment in manufacturing sector. This is because manufacturing sector needs more technological expertise than other sectors. In addition since manufacturing sector is thought to be riskier business an educated investor would be better off by making the right decision to minimize risk.

It is assumed manufacturing sector needs more finance than other sectors. This also leads to the conclusion that if investors are provided with money from different financial institution the probability that they invest in manufacturing sector increases. In this research access to finance is measured by a proxy variable in the name of loan. Loan measures the frequency of times loan isgiven by bank to an investor in the last 10 years. It is thought to have positive correlation with investment in manufacturing sector. This is because if investors are provided with better finance they would be in the sector that have higher profit margin which is manufacturing sector.

Another variable that is assumed to affect investment in manufacturing sector is access to reliable electricity. An infrastructure the status of electricity has a huge influence on investment decision. Though much of the firms‘ have access to electricity its reliability differs from firm to firm. A disruption in the transmission of power could have a huge impact on the manufacturing sector.

As a result to measure the reliability of electricity the variable blackout has been used. Blackout quantifies average power blackout in weeks per hour for a random firm. It is expected to have a negative coefficient. The explanation for this could be with high power blackout more and more investors will abstain from investing in manufacturing sector.

One of the constraints facing investors in Ethiopia is access to land. Especially for the manufacturing it is one of the main factors hampering the growth of the sector. In Mekelle too there is problem of land administration, ownership and provision. The variable area is used as a proxy to access to land. It measures the total area of the firm‘s production plant or store in meter squares. The variable area is expected to have positive sign because with more provision of area the more will be the probability of investment in manufacturing sector.

Initial capital is another variable which will be verified whether it has an effect on decision of investment in different sectors. It is also the variance function. A variance function specifies the variables on which the variance is assumed to depend. Initial capital was chosen as a variance function because the recurrent occurrence of outliers. This means an there is an observation which is too large or too low in relation to the observation on the sample.

Another variable included in this model is relative price of domestic goods over similar imported goods. In market economy price conveys cost of production and the reward for producers. Many capitalists base their investment decision on price. It is expected to have positive sign. Because if there is high reward for internally produced goods investors will be more likely to produce that good than import it from other country

The behavioral model included in the model is the discount rate of the investor. Discount rate measures the rate at which we are willing to trade future benefits to present benefits. The need for this variable arises because the return for manufacturing sector is most of the time realized at latter stages. This variable can decide us whether a random investor chooses immediate profits or higher profits at latter stages. This variable is estimated using the choice-based method.

Choicebased methods generally present participants with a series of binary comparisons and use these to infer an indifference point, which is then converted into a discount rate. This variable is expected to have negative coefficient. The reason for this can be investors with high discount rate (present oriented) are expected to neglect the manufacturing sector which takes longer span for the returns to be realized.

4. Results and Discussion

The main aim of this section is to provide results of the study as well as to discuss each one of them rigorously. All the variables were tested using descriptive and econometric methods of data analysis. In addition in line with the objectives of the paper secondary data from NBE and injibara investment agency was used to study the status of investment in manufacturing sector in Ethiopia and injibrara town respectively. This section begins with the discussion of recent trends in Ethiopia‘s manufacturing sector and then proceeds on to the same discussion ininjibrara . It will then advance to the discussion of the descriptive analysis of the research. Eventually this section will present the final results of the study supported by econometric analysis.

4.1 Econometric Analysis

In this study an attempt was made to determine the factors influencing the probability of investment in manufacturing sector in Injibara city. For this purpose both the heteroskedastic probit and probit models were evaluated. Following the theoretical foundations laid by Jorgenson‘s model of optimal capital accumulation and other variables added, which are deemed relevant for this particular research, the probability of investment in manufacturing sector was estimated. In the following sections the results and post estimation of the model is presented.

4.1.1 The Heteroskedastic Probit Model Estimation Result

The binary dependent variable invested in manufacturing sector was regressed with seven independent variables and with one variance function in the heteroskedastic probit model. The dependent variable was also regressed using the standard probit model to compare the results with the heteroskedastic probit model.

According to Table 1 education, relative prices, blackout and initial capital are statistically significant at 5 percent level of significance. The variance function initial capital is also significant. When we look at the probit section only education, relative prices and blackout are significant. However, the maximum likelihood estimators of the probit model will be biased and inconsistent if the disturbances are either non-normal or heteroskedastic. This means the probit model will be only used for comparison basis in this paper.

The probit model reports that education, relative prices and blackout are significant at 1 percent level of significance while the rest are insignificant. The model is overall significant having log likelihood of -33.47. The Hosmer-Lemeshow chi^2 for goodness of fit reveals that the probit model fits reasonably well. This test is a test of the observed against expected number of responses using cells defined by the covariate patterns. To do the test we regrouped the data into a group of 8 based on the predicted probabilities.

But as it has been discussed earlier we cannot use the probit model based on the goodness of fit since the coefficients will be biased if we use the probit model. In addition the diagnostic tests of the heteroskedastic probit reject the use of standard probit model.

As it has been discussed earlier the coefficients of the standard probit model are biased. To resolve this problem the heteroskedastic probit model is applied. It is clear that some estimated. coefficients of the heteroscedastic probit model are different from the probit model.

All the variables are considered in the mean equation, and initial capital was estimated in the variance equation. As well acknowledged, the coefficients cannot be interpreted directly in the heteroscedastic probit models. In such a case, the marginal effects can be computed as a nonlinear combination of the regression coefficient.

According to heteroskedastic probit‘s output the Wald test of the full model versus the constant only model is significant with Likewise, the likelihood-ratio test of heteroskedasticity, which tests the full model with heteroskedasticity against the full model without, is significant with The first thing to notice is that if all the elements of then exp (0) =1 and the model is just our standard probit model.

Thus, the probit model is nested in the heteroskedastic probit model. On the contrary the above model reveals that the variance function is significantly different from zero. i.e., lnsigma2 is significant at 1 percent. We can also use the likelihood ratio test to determine whether you need to run the heteroskedastic version or not.

Table 1. *Results of probit and Heteroscedastic Probit Model*

Table 4.10: Results of Probit and Heteroscedastic Probit Model

Dependent Variable: INVMF

Variance	Probit model	Heteroskedastic probit model	
		Mean function	Variance function
EDU	0.1899***	0.3382***	
	(0.0659)	(0.1222)	
LOAN	-0.0427	-0.0089	
	(0.0487)	(0.0592)	
BLACKOUT	-0.2903***	-0.3727**	
	(0.1047)	(0.1535)	
AREA	0.0009	0.0003	
	(0.0007)	(0.0011)	
R	-0.0360	-0.0058	
	(0.0393)	(0.0488)	
RP	2.1575***	2.8493**	
	(0.8144)	(1.1330)	
INICAP	2.46e-06	0.0002**	0.0000325***
	(4.04e-06)	(0.00006)	(9.82e-06)
Constant	-3.0859**	-5.9283***	
	(1.2080)	(2.067)	
Observations	94	94	
Pseudo R^2	0.4063		
Log-likelihood	-33.4652***	-27.15997	
Prob>chi2	0.0000		
Hosmer-Lemeshow chi2 for goodness of fit	6.95		
Prob>chi2	0.3253		
Wald		19.27***	
Prob > chi2		0.0074	
Lnsigma2		12.61***	
Prob > chi2		0.0004	

(i) *, **, *** indicate significance at the level 10%, 5% and 1%, respectively.

(ii) Numbers in parentheses are standard errors.

Source: *Own study.*

The likelihood ratio test reported rejects a model without heteroscedasticity. This means we completely reject the standard probit model.

The heteroskedastic probit estimation result reports that while education is significant at 1 percent; blackout, relative prices and initial capital are significant at 5 percent. The variance function (Lnsigma^2) is also significant at 1 percent and having the same sign with the mean function initial capital. All the variables have the expected sign except for loan. Tough loan was expected to have positive effect on the probability of investment in manufacturing but according to the heteroskedastic model it has a negative effect.

The explanation for this can be the prevailing finance structure in injibara in particular and Ethiopia as a whole. Manufacturing sector has much less access to finance due bank policy. The financial sector in Ethiopia at the moment embraces only short-term financing.

The manufacturing sector, which requires relatively long-term financing, suffers from lack of such finance scheme. This scheme applies to injibara city investors especially the ones who are participating in the manufacturing sector. They have been taking fewer loans from bank compared with other sector investors. Another variable which is insignificant is discount rate of individuals.

The result shows that with increasing discount rate, i.e., moving towards present oriented persons, the probability of investment in manufacturing sector decreases. However I am short of deciding it has an insignificant effect on probability of investment in manufacturing sector. The reason for the insignificance could be the method (choice based method) I used. I asked only four discount rates for which the investor to choose from.

Another advanced discount rate determining methods shall be used to assess its effect on probability of investment in manufacturing sector. Inconclusion the researcher recommends for further study on the effect of discount rate since it greatly affects decisions which involve longer periods.

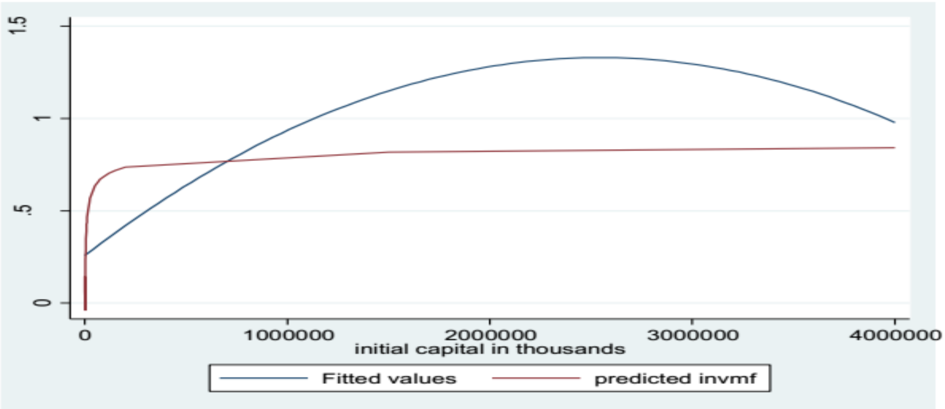
The above graph demonstrates the quadratic relationship between investment in manufacturing sector and initial capital. As we can observe from the plot investment in manufacturing sector increases at increasing rate at lower levels of initial capital while it increases at decreasing at higher levels of initial capital.

4.1.2 Marginal Effects of Independent Variable

If we are interested in understanding how the independent variables affect the unobservable latent variable then the probit and logit coefficients can be interpreted in exactly the same way as OLS coefficients i.e., the coefficient tell you how much changes with a one unit increase in the independent variables. Of course, it is almost never the case that you will be interested in Instead, you want to know the effect of your independent variables on i.e., theprobability of getting a 1 or 0.

The marginal effects result reports that education, relative prices and initial capital have significant marginal effect on investment initial capital. The coefficients in Table 2 reveal the sign of the variables. But they are not helpful in estimating the exact effect of the independent variable on the dependent variable. We mostly use marginal effects to interpret the coefficients of the each independent variable.

Figure 1. *The relationship between initial capital and investment in manufacturing sector*



Source: *Own study.*

Table 2. *Marginal Effects of Heteroscedastic Probit Model*

Table 4.11: Marginal effects of Heteroshedastic Probit Model

Variables	dy/dx
EDU	0.0083* (0.0045)
LOAN	-0.00022 (0.0015)
BLACKOUT	-0.0092 (0.0056)
AREA	8.38e-06 (0.00003)
R	-0.000143 (0.0012)
RP	0.0701* (0.04123)
INICAP	-3.89e-06* (0.0000)

(i) *, **, *** indicate significance at the level 10%, 5% and 1%, respectively.

(ii) Numbers in parentheses are standard errors.

Source: *Own study.*

These marginal effect estimates are simply the estimates of the change in probability of choice which we expect conditioned on a change in the value of the particular independent variable.

According to the above Table 2 a 1 percent increase in relative prices is transferred as 0.07 percent increase in probability of investment in manufacturing sector. The likelihood of investing in manufacturing sector also increases by 0.009 percent if there is an increase in education by one school year. Other variables marginal effects are interpreted in the same way. The most captivating part of this result is that there are differing results in the marginal effects and heteroskedastic probit model results.

The heteroskedastic probit model reports positive coefficient while the marginal effects reveals that there is negative relationship between the dependent variable and initial capital. This is due to marginal effects being reported at the mean values of the independent variable. At its mean value it may have negative effect on the likelihood of investment in manufacturing sector. But to know the effect of initial capital we take all the values so we conclude that it has positive effect on investment in manufacturing sector.

4.1.3 A Meassure of Elasticities of Independent Variable

In the above section we have computed the marginal effects of each variable with respect to the predicted value of the dependent variable. This section will discuss other forms of marginal effects albeit with different interpretation. In other words we will obtain margins of derivatives of responses in different forms. Derivatives are of interest because they are an informative way of summarizing fitted results. The change in a response for a change in the covariate is easy to understand and to explain.

The derivatives can be expressed as elasticity of the independent variables. By doing this we get three types of elasticity; namely eyex, eydx and dyex. These elasiticities are computed at observational level. The formulas are as follows:

$$ey/ex = dy/dx \times (x/y)$$

$$ey/dx = dy/dx \times (1/y)$$

$$dy/ex = dy\ /dx \times (x\ )$$

In the following sections the results of each independent variable will be presented with respect to the probability of investment in manufacturing sector.

The coefficients are interpreted proportionally. This means for a proportional change in the independent variable there is a proportional change in the dependent variable. Probability of investment in manufacturing increases with initial capital at a rate such that, if the rate were constant, probability of investment in manufacturing would increase by 0.7517 percent if initial capital had increased by 1000.

Table 3. *Average marginal Effects (ey/ex) of Independent Variables*

Table 4.12: Average marginal effects (ey/ex) of independent variables

Variables	ey/ex
EDU	3.5759**
LOAN	-0.0564
BLACKOUT	-3.0172**
AREA	0.0742
R	-0.1020
RP	4.3837**
INICAP	0.7517**

(i) *, **, *** indicate significance at the level 10%, 5% and 1%, respectively.

Source: *Own study.*

In the same way for education probability of investment in manufacturing sector would increase by 3.6 percent had there been a one percent increase in school year of an investor. A unit of school year can be substituted with less than one year of entrepreneurship skill training. This means there is a space for the concerned government bodies to maneuver entrepreneurship skills to boost investment in manufacturing sector. From Table 3 one can deduct that education the most elastic of all. This means for one percent increase in supply of education investors‘ responsiveness will more than one percent.

Table 4. *Average Marginal Effects (ey/dx) of Independent Variables*

Table 4.13: Average marginal effects (ey/dx) of independent variables

Variables	ey/dx
EDU	0.5392**
LOAN	-0.0141
BLACKOUT	-0.5942**
AREA	0.0005
R	-0.0092
RP	4.5426**
INICAP	0.0004**

(i) *, **, *** indicate significance at the level 10%, 5% and 1%, respectively.

Source: *Own study.*

The above type of elasticity is interpreted as for a change in the independent variable there is a proportional change in the dependent variable. If the rate was constant an increase in one unit of relative prices there will be a proportional 4.54 percent increase in the likelihood of investment in manufacturing sector. The coefficient in the education also indicates a one year increase in school year increases the likelihood of investment in manufacturing by 0.54 percent proportionally.

This elasticity is similar with the prior one. According to Table 4 the most significant variable is blackout. This means a one hour decrease in power outage per week will have more than proportional positive effect on investment in manufacturing sector. But we can‘t say that blackout is the most elastic because the interpretation is not done on the same unit.

Table 5. *Average Marginal Effects (dy/ex) of Independent Variables*

Table 4.14: Average marginal effects (dy/ex) of independent variables

Variables	dy/ex
EDU	0.3387***
LOAN	-0.0045
BLACKOUT	-0.1613***
AREA	0.0079
R	-0.0055
RP	0.3342***
INICAP	0.0525***

(i) *, **, *** indicate significance at the level 10%, 5% and 1%, respectively.

Source: *Own study.*

Analogous to the above elasticities dy/ex is interpreted as for a proportional change in the independent variable there will be a change in the dependent variable. For instance if we take initial capital, if it had doubled the likelihood of investment in manufacturing sector would have increased by 0.05 percent. Correspondingly the probability of investment in manufacturing sector decreases by 0.16 percent if the power blackout doubles. These variables are interpreted holding the assumption that the rates are constant at every observation.

Table 5 unveils that with the same effort on all significant variables, education has more productive output. It is the most powerful tool of increasing investment in manufacturing sector at micro level. Apart from education initial capital and a decrease in power blackout collectively play a strong role in developing manufacturing.

4.1.4 Assessing Heteroskedastic Probit Model Fit

Analysts often look for a one-number summary of model fit. In linear regression, we have the R^2. In binary response models, we don't even have an R^2. STATA will report a _pseudo- R^2' but as its name indicates it is even worse than an R^2. There is no distribution and hence no way of knowing whether one pseudo- R^2 is significantly different from another pseudo- R^2.

There are number of different way of evaluating model fit in binary response model. PCP (percent correctly predicted), PRE (percentage reduction in error) and ePCP (expected percent correctly predicted) are the most used methods of calculating model fit. All of them will be discussed in the succeeding sections.

PCP (percent correctly predicted) is a technique of computing model fit where we answer thequestion of how many percent of the observation is correctly predicted. We usually use the threshold level of 0.5 to determine the predicted probability. A predicted probability greater than or equal to 0.5 should be classified as a 1 and any observation with a predicted probability less than 0.5 should be classified as a 0. The formula is as follows:

$$PCP = \frac{100 \times (Number\ of\ correct\ predictions)}{N}$$

One alternative to PCP is known as the percentage reduction in error (PRE). PRE is based on a comparison of PCP and PMC, where PMC is the percentage of observations in the modal category of the observed data. In this paper it would be invested in non-manufacturing sector (0).

$$PRE = \frac{PCP - PMC}{1 - PMC}$$

PRE seeks to compare the information provided by probit fitted categories with the classification errors a researcher would make if he/she naively assigned all fitted categories to the modal category. Another model fit testing statistical tool is expected percent correctly predicted (ePCP) proposed by Herron (1999). This statistic essentially provides the expected percentage of correctpredictions and helps avoid the problem of treating an observation withˆ the same as an observation withˆ ePCP is calculated as:

$$ePCP = \frac{1}{N}\left(\sum_{y_i=1} \hat{p} + \sum_{y_i=0} (1 - \hat{p})\right)$$

According to the above definitions of model fit the goodness of the heteroskedastic probit model was estimated using the above three methods. The following Table 5 presents the results:

Table 5. *Goodness of Fit of the Heteroscedastic Probit Model*

Table 4.15: Goodness of fit of the heteroskedastic probit model

Model fit technique	Value
PCP	90.43%
PRE	66.67%
ePCP	82.24%

Source: *Own study.*

5. Conclusion

The above Table 5 unveils that the heteroskedastic probit model has a good explaining power. Using the available techniques of testing model fit the model has more than average explaining power. Especially for the PCP it can explain 90.43 percent of the change in the dependent variable.

For ePCP, considered the most rigorous of all, it has an explaining power of 82.24 percent. In other words looking at PCP only 9.57 percent of the change in the likelihood of investment in manufacturing sector is explained by variables ignored by this research paper. All in all looking at the above results it can be concluded that the model has very good explaining power.

The result in Table 5 also shows how robust the model specification is. This means most of the variables which affect investment in manufacturing sector in Mekelle city at micro level are included in this paper‗s model specification. This in turn to some extent solidifies the theoretical robustness of neoclassical model of optimal capital accumulation (Jorgenson) which this paper applies. With good model specification and a promising goodness of fit we can infer from the samples to generalize it into the whole population.

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