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Original Paper

Factors Affecting Employability of Women Graduates in Engineering and Technology Education: Evidence from Ethiopia

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Abstract

Employment opportunities for graduates are an important issue. This study has two objectives: analyzing female graduates' employment participation and investigating the factors affecting women graduates' employability in engineering and technology education in Ethiopia. Secondary data have been analyzed to establish women graduates' involvement in STEM employment using graduation and employment data. Primary data were collected from 384 women graduates of engineering and technology education. The Probit model results reveal that the unemployment of engineering and technology graduated women are negatively influenced by communication skills, Academic performance (cumulative GPA), willingness to migrate from one place to another for searching jobs, and non-technical skills. While job preference and marriage impact women's unemployment positively. Hence, graduated women themselves, the government, and other stakeholders should enhance women graduates' employment opportunities. Such as graduates must improve their communication skills and non-technical skills, record better grade points, and be ready to go everywhere to find jobs. They must also be prepared to do available work, become an entrepreneur, and decide for late marriage until they have a job. The government must create a channel between universities and firms through teaching with a work placement curriculum, more concern on practical works, approve the peace and security of citizens, and expand infrastructure.

Keywords

Unemployment, women graduate, engineering and technology education, Ethiopia

1. Introduction

Employability is about being capable of getting work (Hillage & Pollard, 1998). However, the persistent unemployment over the last decade has become a matter of great concern for academicians and policymakers. Studies by (Sabir & Naz, 2015; Batu, 2016) discussed that under-utilization of human capital or unemployment adversely affects the development of the country at the micro and macro level. It leads to under-utilization of resources, low-level potential output, resort to social vice

(such as robbery, prostitution, financial hardship, crime, homeless, frustration, and social isolation), erosion of healthy society, political instability, and loss of potential tax income revenue. The study by (Dessie et al., 2014; CSA, 2017) shows that this problem of unemployment is more severe on women than men.

According to Meece (2006), approximately only 63 women per 100 men have participated in the world's labor force. He also argued that women are less economically active in the Middle East, South Asia, North Africa, and other developing economies. Even though women in industrialized countries have made significant gains in paid employment, there is still considerable gender segregation in the workforce. For example, in the USA, he found 90% of women tend to be engaged in traditionally female jobs, such as lower and elementary class teaching, nurses, secretaries, etc.

Women generally had a discouraging experience while working with their male peers. Specifically, women participated less and lost confidence by comparing with the men who appeared confident and competent. Women have less likely engagement in full-time employment and earn a lower salary than men after graduation. Webster (2014) women's paid work has continued at a minimal range of jobs like banking, health, education, etc.

Women Participation in Engineering and Technology Employment

The importance of engineering and technology to modern society for wealth creation and maintaining living standards has long been recognized. However, the accessibility of employment opportunities is an issue; specifically, women who graduate in engineering and technology have the challenge to get the job. Several studies show that women's low employment status in engineering and technology graduates in most parts of the world (Salmon, 2015; Joseph, 2016). This supports the finding of Hosaka (2014) argued, engineering and technology workplaces continue to be uncertain environments for women graduates.

Another study states a smaller percentage of women engineering graduates than men who have got jobs and offered earnings of women are about 54% less than that of men in India (Choudhury, 2015; Singh and Peer, 2019). Female graduates in STEM majors have a lower unemployment rate and gender inequality in salary in the US. During 2008, the annual income of men $49,111 for full-time STEM employment and $37824 for females, and 4.8% of males were unemployed from total STEM graduate male and 5% female were unemployed from complete graduate female in STEM (Xu, 2017).

In Ethiopia, the government bodies concentrated on expanding higher education without matching higher education and employment. There is no proper channel of communication between higher education and employer companies. Furthermore, employers were overlooking recent graduates and only employing those with five years of work experience. This leads to a severe unemployment problem. The percentage of women unemployment from the total female labor force participation in Ethiopia and sub-Saharan African countries during 2007 to 2019 is around 3% and below seven, respectively (WB, 2020). Similarly, the average number of employed women in engineering and technology professions as teaching staff in Ethiopian universities from 2007 to 2016 is 7.6%. This is

confirmed by the finding of Jote (2017) states that there are substantial variations observed between men and women, and women's employment status is consistently lower in Ethiopia.

Factors Affecting Employability of Women Graduates in Engineering and Technology Education

Education level, socio-cultural perceptions, economic factors, and gender stereotypes

Cooke (2010) examined Asian women's employment participation by taking India, China, Japan, and South Korea. The finding reveals that education level, traditional societal value, employer strategies, and discrimination contribute to gender inequality in employment across these four countries. He also stated that institutional structures, persistent male-controlled gender norms and stereotypes, and ineffective representation limit women's bargaining power in the labor market and hold down their financial reward and career progression. Dasgupta and Stout (2014) also argued that there are gender gaps in STEM jobs. The answer for what drives these gender disparities in STEM are: learning environments, peer relations, and family characteristics, which become obstacles to STEM achievement, leads to the low opportunity of women graduates' in STEM employment.

According to ILO (2020), science, technology, engineering, and mathematics jobs are experienced with the gender gaps worldwide. This is due to gaps in education fueled by gender stereotypes and expectations, male-dominated STEM workplaces against prejudice, a lack of women role models, provision of low salary than their male co-workers, and bias that pushes women out of STEM careers.

Islam (2017) also discussed those graduate women attempting to pursue a career or postgraduate degrees are often excluded because of their gender and marginalized, which leads to much less entering the job market. He also argued that there are equal opportunities for both genders in principle, but social perception and prejudice determine which types of employment are particularly suitable for whom.

Sharma et al. (2019) indicate that wage, progression, security, unconscious biases, stereotypes, societal, cultural, and institutional issues are barriers for women to have science and technology job opportunities. Studies also show women were found to be underrepresented in STEM fields. This under-representation resulted from gender stereotypes, spatial skills differences, hierarchical and territorial segregation, and discrimination on job allocation. O'Leary (2012) identified factors such as women graduates in science and engineering suffer from job insecurity, the absence of expanding new businesses, and in many countries manufacturing economy is substituted by the knowledge economy, which creates short positions available for the number of graduates. Ong et al. (2011) argued that this under-representation of women in STEM jobs represents human capital's under-utilization and the financial loss of training qualified workforce in engineering & technology.

It is known that; a higher level of education is essential for joining the labor market and increasing public standing. However, Bryan and Guccione (2018) found bias in research financing grants, which favors men and culturally male-dominated fields (mostly engineering and technology areas) that exacerbate gender inequality. Even though women have a higher degree level of education, they face discouraging experience to work in a top position from a diverse source of obstacles.

The study by Torres-Guijarro and Bengoechea (2017) also reveals that there is a gender issue in the engineering college of Span. Women critic themselves severely, which indicates that they lack confidence in engineering and technology education, which can lead to low opportunities to get jobs. Bowen (2020) also explores that women face gender-biased experience in work-integrated learning internship placement or other jobs, particularly in the STEM sector, due to women and work's assumption. This leads to the low participation of women opportunities in terms of employment perspective. However, the creation of employment opportunities for women graduates in the engineering and technology field is essential from national development. Workplace environment, structures, and traditions often impose sets of male-dominated expectations on women graduates that limit their range of job opportunities. Xiaohao and Changjun (2013) also found that the financial crisis has negatively influenced student employment growth and has aggravated the already severe imbalance of supply and demand in the Chinese job market for university graduates.

Academic performance (cumulative GPA)

As educational attainment becomes increasingly essential in employment settings, the undergraduate grade point average (GPA) will be an attractive selection. Many positive findings lend credence to using GPA in applicant screening as a cost-efficient proxy for applicant mental ability and motivation. However, organizations should consider many factors and limitations in the selection process to ensure fairness and accuracy (Imose & Barber, 2015). Another study by Li and Zhang (2010) conducted a study in China and found that other things being equal, graduates with better college GPA were more likely to be employed. This finding was also confirmed by Drydakis (2016) conducted a study in the UK and found a positive relationship between GPA obtained from university and invitations to interviews for job allocation.

Communication skill and Non-technical skills

A study by Ting et al. (2017) revealed that employers regard language proficiency and communication skills as separate attributes in the Malaysian private sector. If they have strong communication skills, employers are willing to accept hiring applicants with average English proficiency. The findings also showed that strong communication skills would improve employability and career development opportunities. Baytiyeha and Naja (2012) also explored perceptions of engineering graduates regarding the difficulties of obtaining a job after graduation in Lebanon. Their finding reveals that communication skill, responsibility, and self-confidence were the main challenges facing engineering graduates for obtaining a job. Matthews et al. (2015) found that graduates with service-learning experience has significantly shorter time for getting job. According to Lowden et al. (2011) there is a broad understanding of what qualities, characteristics, skills and knowledge constitute employability both in general, and specifically for graduates. Employers expect graduates from their degrees to have academic and disciplinary abilities, but often need graduates to show a variety of wider skills and qualities, including teamwork, communication, leadership, analytical thinking, and problem solving.

Humburg et al. (2013) argued that the key characteristics that employers look at when they recruit

higher education graduates; the skills that graduates should possess to be employable, and how higher education institutions can best enable students to develop employable profiles. The analyses show that interpersonal skills (communication skills, teamwork skills, etc.) are almost as essential as professional expertise. To be employable, a graduate needs interpersonal skill, and below-average levels cannot be compensated for even by the best grades or the most relevant study field. Pan et al. (2018) also consider a proactive personality as a non-technical skill. The finding reveals that the indirect effect of bold nature on job search success is a variety of skill development to acquire job-related knowledge and skills and help achieve rapid job obtaining.

Marital status and Job preference

Previous studies have used this variable who found that 35.7% of the unmarried female with undergraduate education level has obtained more than three years agreement singed jobs, whereas 15.7% were currently married (Roy and Mukherjee, 2013). Another study found that employment preferences are heterogeneous according to graduates' ideal employment expectations (Schuster et al., 2020), leading to lower job opportunities.

We have reviewed many papers related to factors affecting the employability of women graduates in engineering and technology in the context of different countries in the world. Therefore, we found that the previous studies did not willing to migrate for searching a job. Consequently, we want to research factors affecting women graduates in engineering and technology education, including this factor with primary data collected from Ethiopia. These can add value to the scope of the literature on women in STEM education.

2. Materials and Methods

The objective of The Study

The objectives of this study are:

(i) To analyze the status of employment participation of women graduates in engineering and technology education; and

(ii) To analyze factors (academic performance, communication skill, willingness to migrate for the job searching, job preference, non-technical skill, and marital status) affecting women graduates' employability in engineering and technology education.

The Hypothesis of The Study

The study has the following hypothesis based on analyzing factors affecting women graduates' employability in engineering and technology. These are:

(i) Graduates in engineering and technology education with high cumulative GPA scores will have a probability of obtaining a job early (Imose & Barber, 2015).

(ii) Graduates in engineering and technology education with better communication skills will have a probability of obtaining a job early (Teijeiro et al., 2013; Osmani et al., 2015).

(iii) Graduates who are willing to go anywhere for the searching job will have a high probability of

getting a job than unwilling graduates.

(iv) Graduates who prefer a job will have less probability of getting employment than a graduate who has an intention for job preference (Schuster et al., 2020).

(v) Graduates who have better non-technical skills will have a high probability of getting employment (Lowden et al., 2011).

(vi) Married graduates will have less probability of getting a job (Roy and Mukherjee, 2013).

The procedure of Data collection and Sampling

This study has been conducted based on women's primary and secondary data in engineering and technology education from Ethiopia. There are nine states and two city administrations in a country. Primary data have been collected through stratified Sampling.

At first, the Amhara region was randomly selected as a sample state, one of among nine states in a country. The state has ten public higher institutions. Secondly, we categorized ten public- higher institutions into four-groups based on the establishment year. The first category includes the Universities of Bahir Dar and Gondar, established in 1954 as a college and recognized in 2000 as a university. The second group comprises the universities of Debre Birhan, Debre Markos, and Wollo, founded in 2005. The third group includes the universities of Debre Tabor and Woldia, founded in 2008. Finally, the fourth group includes Injibara University, Mekdela Amba, and Debark University, founded in 2015.

Thirdly, we select three universities from each group except the fourth category. These are Bahir Dar University, Wollo University, and Debre Tabor University. The selection of sample universities from each group has been made purposively. Since universities established at different times can have different experiences, universities' choice within a group was random. Data not collected from 4th group universities since they are new and started working in the 2017/2018 academic year, so that they may not have sufficient data for this study. In Ethiopia, higher education costs such as hostel fees, food, etc., are covered by the government via cost-sharing agreements. Most students are placed to go to university according to their grade 12 marks through placement by the education ministry. Students come from all directions of the country who represent different economic statuses, religions, cultures, languages, and so on. Hence, the sample is representative.

Fourthly, we determine the sample size. For this determination of the number of respondents, we follow procedures. Thus, we have a total population of 1840 women graduates in engineering and technology in the selected universities during 2016 and 2017. We have determined 384 sample respondents based on equation one (Del & Gonza ĺez-Ram´ırez, 2014).

$$n = \frac{z^2.p.q.N}{e^2(N-1) + z^2.p.q} \quad (1)$$

which is valid where n is the sample size, N = 1840 (population size), Z^2 is standard variate at the desired confidence level of 95.5% = $(2.01)^2$, e = 45% (0.045) is the desired level of precision (acceptable error) the range in which the true value of the population is estimated to be, p is the estimated proportion of an attribute that is present in the population taken as 42% and q is (1- p).

Fifth, we did proportions according to total women students in each sample university. Hence, 251(65.3%) respondents from Bahir Dar University, 46(11.9%) respondents from Debre Tabor, and 87(26.6%) respondents from Wollo University, a total of 384 respondents have been selected for the study as given in Table 1. Based on this procedure, primary data have been collected from 384 women graduates from the years 2016 and 2017 in engineering and technology during May 2018.

Table 1. Proportion of Sample Size on the Bases of Year of Graduation and Universities

	Bahir Dar University			Debre Tabor University			Wollo University			Total		
Graduation Year	No. of Graduates	No. of Respondents	Percentage	No. of Graduates	No. of Respondents	Percentage	No. of Graduates	No. of Respondents	Percentage	No. of Graduates	No. of Respondents	Percentage
2016	411	86	22.4%	26	5	1.3%	214	45	11.7%	651	136	35.4%
2017	790	165	42.9%	195	41	10.6%	204	42	10.9%	1189	248	64.6%
Total	1201	251	65.3%	221	46	11.9%	418	87	22.6%	1840	384	100%

Source: Sampled universities registrar

These selected respondents were asked through telephone interviews with a structured questionnaire. Our research questions were telephone surveys as closed-ended questions (Arnon & Reichel, 2009). We have received graduates' phone numbers from the universities registrar office by taking responsibility for our respondent's security guarantee. If a call was not answered or by agreement with the interviewees, the sample was entirely used by repeat calls. Before asking them, we explain ourselves legality and objectives of the study. The interviews were conducted through the language of Amharic, translated from English. Listed sample respondents are from two different years that some are from the 2016 graduating batch, and some are from 2017 graduates. Therefore, this data's nature is two-year cross-section data since these have been collected from two different years and different independent observations. We pooled these two-year cross-sectional data together that makes many observations.

Sample Description

As shown in Table 2, from the total sample of 384 respondents, 244 got a job, and the remaining 140 are unemployed. It shows that more than half of the respondents are employed. 53 employed and 27 unemployed respondents have less than five family members, whereas 185 employed respondents have five to ten family members. Only six respondents have more than ten family members. Two employed respondents are not interested in talking about their number of families. Out of 384 respondents, 272 live in an urban area; 186 are employed, and 86 are unemployed. The remaining 112 come from the origin of the rural regions. Of 384 respondents, 241 students have the educational background of their family, of

which 160 respondents are employed while 81 are unemployed. The annual income of the family of the majority of respondents is below 50,000 Ethiopian currency (Birr). The respondents are graduate students in the field of ten departments. Out of 384 representative samples, 46 are from chemical engineering, 99 from civil, 72 from textile, 40 are from the garment, etc. Only six respondents are from electrical engineering. However, there are no unemployed respondents from electrical engineering, garment, and leather technology graduates.

Table 2. Summary of Demographic and Socio-economic Status of Respondents

Demographic & socio-economic variables		Number of respondents		
		Employed	Unemployed	Total
Number of family members	Less than five	53	27	80
	Five to ten	185	111	296
	More than ten	4	2	6
	Unknown	2	0	2
	Total	244	140	384
Place of residence	Urban	186	86	272
	Rural	58	54	112
	Total	244	140	384
Educational background of the family	No	84	59	143
	Yes	160	81	241
	Total	244	140	384
Family income	50000 <	118	93	211
	50000 and <100000	78	32	110
	≥ 100000	48	15	63
Department of the respondents	Electronics engineering	10	18	28
	Fashion design technology	28	2	30
	Garment engineering	40	0	40
	Hydraulics engineering	12	20	32
	Leather technology	16	0	16
	Mechanical engineering	2	13	15
	Textile technology	60	12	72
	Total	244	140	384

Source: Authors own survey data, 2018

Definition of Variables and Measurements

Unemployment is a dependent variable measured by asking the question, “Are you unemployed or not?”. Unemployed women graduate in engineering and technology were denoted by 1, and 0 = otherwise. Drydakis (2016) measures in the same way that the probability of an applicant receiving a job interview takes the value 1 if the applicant receives an interview invitation for job allocation and 0 otherwise. Li and Zhang, (2010) also calculated unemployment =1 and 0=otherwise.

Academic performance has been measured by the cumulative GPA of women obtained from the faculty of engineering and technology in the duration of a five-year study period. Cumulative marks in higher education are ranging from zero to four scale awards A = 4, B = 3, C = 2, D = 1, and F for 0 with a "plus" or "minus" grade awarded. A and A + have the same grade point, and 2 points average score is a minimum graduation criterion. Hence, academic achievement has been measured by student’s average score mark. Li and Zhang (2010); Xu (2017) also measure students’ academic performance by cumulative GPA taken from their official transcript, which can determine the probability of women graduates getting a job.

Communication skills are required for graduates to deal with the information exchange in workforce settings, considered a dummy variable and valued 1= “I am right in communication skill, and 0 = other, using the questionnaire “How is your communication skill? We have taken these variables in the literature (Teijeiro et al., 2013; Humburg et al., 2013; Osmani et al., 2015).

Marital status (MR) refers to whether graduated women have got married or not, which will impact the probability of obtaining a job. It is a dummy and explanatory variable measured by denoting 1 for married respondents and 0= unmarried participants through asking a question, “Are you married or not?” Roy and Mukherjee (2013) were also adopted the same mechanism.

Willingness to migrate has been taken by considering that people can move from one place to another place for searching jobs that could be a factor to increase or decrease the unemployment problem. It has measured as 1 = able to migrate for searching jobs, and 0 = otherwise, using questionnaire “Are you ready to go to another place for searching a job?”

Job preference is considered a dummy variable valued as 1 = unemployed because of not getting the job they are looking for, and 0 = otherwise using the question "Are you unemployed because of not getting the job you are looking for?" The scarcity of jobs that a woman would like to do increases the chance of being unemployed. *The non-technical skills also have* been measured by 1 = observations who had good non-technical talent, and 0 = not good, by asking the participants, “How are you in skills like working in groups, able to negotiate things, searching information through media, etc.?” Pan et al. (2018) consider proactive personality as a non-technical skill and measured through asked the participants to indicate the extent to which they agreed with statements regarding proactivity using five Likert scales (from 1 = “strongly disagree,” to 5 = “strongly agree”). The year 2017 dummy variable (YD) has denoted as 1 = the respondents in 2017 graduates and 0 = observations in 2016. Since data has collected from two different years (2016 and 2017) batch pass out graduates, we have added year

dummy variable in the regression (Wooldridge, 2010).

Data Analysis

The unemployment of women graduates in engineering and technology education is a dependent variable affected by independent factors. Checking the reliability of data is an essential issue during primary data analysis. One of the most used reliability estimators is Cronbach's Alpha (Mohamad et al., 2015). This reliability test has computed that shows data are reliable with a scale reliability coefficient of 0.7991. The correlation of each independent factor with unemployment of women graduates in engineering and technology has also computed using Spearman's rank correlation coefficient as given in Table 3. From this table, all variables' correlation coefficient is less than the standard significant level $p \leq 0.05$ and significant, which shows a strong correlation with the dependent variable.

Table 3. Spearman's Rank Correlation Test Result

Variable	Correlation coefficients of variables with unemployment of graduates	P-value (significance level)
Marital status	-0.1966	0.0001
Communication skill	-0.7757	0.0000
Willingness to migrate for searching job	-0.5357	0.0000
Job preference	0.9043	0.0000
Non-technical skills	-0.3144	0.0000
Academic performance	-0.4152	0.0000

Source: Authors own data computation

To examine the most important factors influencing the unemployment of women graduates in engineering and technology, which are the explanation for the gender gap in STEM jobs, Probit Regression Analysis was performed. In addition, all diagnostic tests were measured, such as multicollinearity, heteroscedasticity, and the Hosmer-Lemeshow test. Furthermore, to verify the estimated coefficients and model fitting impartiality, a normality test of residuals was performed. Secondary data have been also been tested by descriptive approaches. All analyses were performed with the program STATA 14.

Model specification

Two key issues were considered to construct a valued model; first, the data are pooled cross-section. Second, a dependent variable used is binary. Having these issues, we have employed the Probit model for the dependent variables' binary nature (Li & Zhang, 2010; Drydakis, 2016). And fortunately, the same methodology used for cross-section analysis can apply to pooled cross-section data. Using pooled cross-sections, we should usually include the year dummy variable (Wooldridge, 2010). Let Y* is an unobserved or latent variable that can take all values of $(-\infty, +\infty)$ (Gujarati, 2004):

$$Y = \begin{cases} 1, & Y^* > 0 \\ 0, & Y^* \leq 0 \end{cases} \quad (2)$$

Given $Y^* = \beta_0 + X^T\beta_i + \epsilon_i$ where β_0 is constant, X is vector regressor variables, β_i is slope coefficients and ϵ_i is approximated to standard normal distribution $N(\mu, \delta_2)$, μ (mean) = 0 and δ (standard deviation) = 1. Then Probit model is constructed based on this latent variable.

$$\begin{aligned} P(Y = 1|X) &= P(Y^* > 0|X) \\ &= P(\beta_0 + X^T\beta_i + \epsilon_i > 0|X) \\ &= P(\epsilon_i > -(\beta_0 + X^T\beta_i)|X) \\ &= 1 - F(-(\beta_0 + X^T\beta_i)) \end{aligned}$$

with the assumption of ϵ_i is normally distributed. This gives

$P(Y = 1|X) = 1 - \phi\left(\frac{-(\beta_0 + X\beta_i)}{\delta}\right)$ since $\delta = 1$, due to symmetry, the function becomes

$$P(Y = 1|X) = \phi(\beta_0 + X^T\beta_i) \quad (3)$$

$P(Y = 1|X)$ is a probability that an event occurs given the value of X, β_i is slope parameter estimated, and ϕ is the standard normal cumulative distribution function (CDF):

$$\mathrm{P(Y = 1|X)} = \phi(\mathrm{Y}) = \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{Y} e^{-\frac{x^2}{2}}dx$$

Having these procedures, we have Probit model formulated as:

$$P(Y = 1|X_i) = \phi(\beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7) \quad (4)$$

Where, $Y =$ Unemployment (UN), $X_1 =$ Marital status (MR), $X_2 =$ Academic performance (GPA), $X_3 =$ Communication skill (CS), $X_4 =$ willingness to migrate for searching a job (WM), $X_5 =$ Job preference (JP), $X_6 =$ Non-technical skill (NTS), and $X_7 =$ Year dummy variable (YD).

By substituting these variables in to equation 4 we can formulate equation 5 :

$$P(UNE = 1|x) = \phi(\beta_0 + \beta_1MR + \beta_2GPA + \beta_3CS + \beta_4WM + \beta_5JP + \beta_6NTS + \beta_7YD) \quad (5)$$

Since the data are from two different years, we have to interact explanatory variables with year dummy Wooldridge (2003) and compute the difference of the effects of the variables in the year 2016 and 2017. Why because we cannot find real interaction effects directly from the Probit estimation of the coefficients (Norton et al., 2004). It is done through marginal computing effects of variables at different values of the other variable and taking the difference, which gives the interaction effect. The interaction effect changes in the marginal effect of one variable induced by changes in another variable's value (Karaca-Mandic et al., 2012). This interaction effect is performed based on the following procedure (Norton et al., 2004):

$$F(Y|X_1, X_2, X\beta) = \phi(\beta_1X_1 + \beta_2X_2 + \beta_{12}X_1X_2 + X\beta) \quad (6)$$

where a given Probit model $F(.)$ is the simple normal cumulative distribution function; X_1 and X_2 are interacted variables which are dummy, β's are slope parameters, and ϕ is a probability function. In the scope of this paper, two types of interacted models are specified.

[A] when the interacted variables are both dummy variables, the interaction effect is the discrete double-difference formulated as equation 7 derived from equation 6.

$$\frac{\Delta^2 F(y|x_1,x_2,X)}{\Delta x_1 \Delta x_2} = \frac{\Delta^2 \phi(u)}{\Delta x_1 \Delta x_2} = \phi(\beta_1 + \beta_2 + \beta_{12} + X\beta) - \phi(\beta_1 + X\beta) - \phi(\beta_2 + X\beta) + \phi(X\beta) \quad (7)$$

$where \quad u = \beta_1 x_1 + \beta_2 x_2 + \beta_{12} x_1 x_2 + X\beta$

[B] when the interacted variables are one continuous and one dummy variable, the interaction effect is the discrete difference concerning a single variable formulated as equation 8 derived from equation 6.

$$\frac{\Delta\left(\frac{\partial F(u)}{\partial x_1}\right)}{\Delta x_2} = (\beta_1 + \beta_{12})\phi((\beta_1 + \beta_{12})X_1 + \beta_2 + X\beta) - \beta_1 \phi(\beta_1 x_1 + X\beta) \quad (8)$$

Where X_1 is continuous variable, X_2 year dummy, Δ is difference, and ∂ is a representation of partial derivative of $F(u)$ with respect to X_1.

3. Results and Discussion

Descriptive Result Analysis

As already specified in a second section, this study's first objective is to show employment participation of women graduates in STEM education, based on available data from Ethiopian educational statistics annual abstract MOE (2016), National Assessment (Beyene, 2015), World Bank WB (2020) and International Labor organization (ILOSTA, 2020).

Figure 1 shows the percentage of women unemployment from the total female labor force participation in Ethiopia and sub-Saharan African countries during 2007 to 2019, which has an almost stagnant trend. In Ethiopia, the average percentage of women unemployment is around 3%, while in sub-Saharan Africa, it is below 7% on average. The status of women's employment participation in engineering and technology as an academic teaching in government and non-government universities in Ethiopia has been given in Table 4, Figure 2, and Figure 3. The number of employed women in this job is lower, and there is a significant difference between genders. Moreover, Figure 4 also shows, there is low proportional status of women graduates participation in the engineering and technology employment (Addissie & S. S., 2020). Figure 5 also shows the percentage share of women in STEM jobs globally, that most of the countries have more than 30% participation. However, Niger (9.8%), United Arab Emirates (15%), and Pakistan (18.9%) have the lowest share of women participation in STEM occupations during 2020 (ILO, 2020).

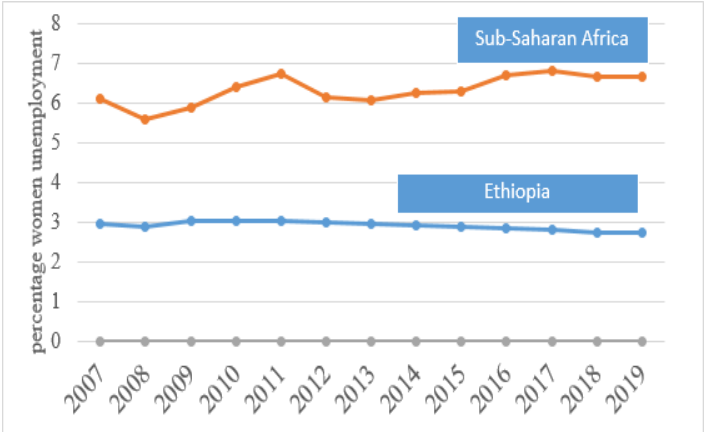

Figure 1. Percentage of Women Unemployment from the Total Female Labor Force

Source: World Bank

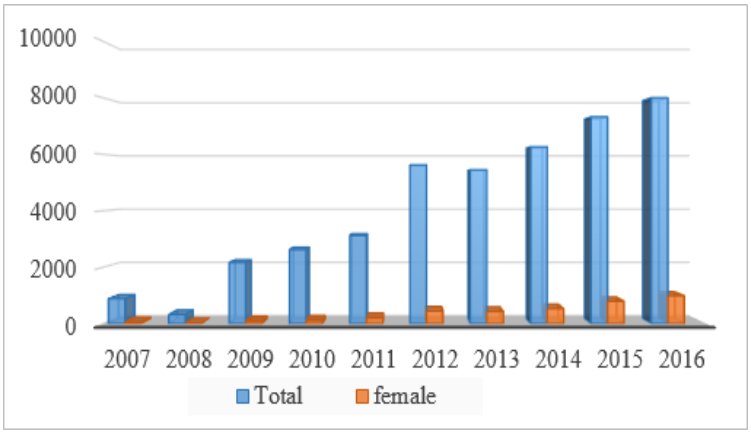

Figure 1. Status of Women in Engineering and Technology Teaching Professional Employment in Government Universities

Source: Ethiopian Ministry of Education

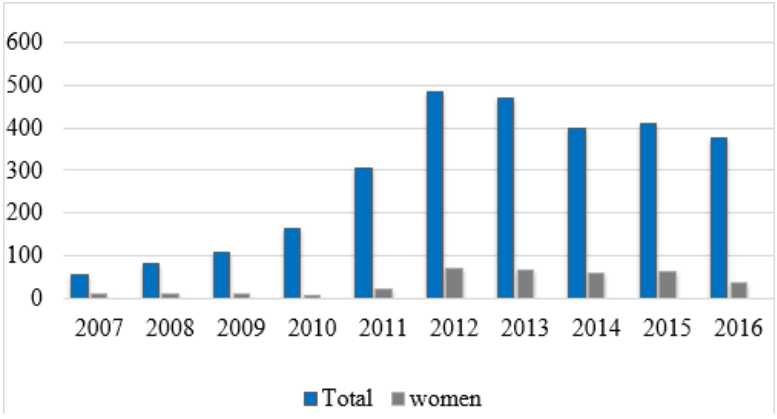

Figure 3. Status of Women in Engineering and Technology Teaching Professional Employment in Non-government Universities

Source: Ethiopian Ministry of Education

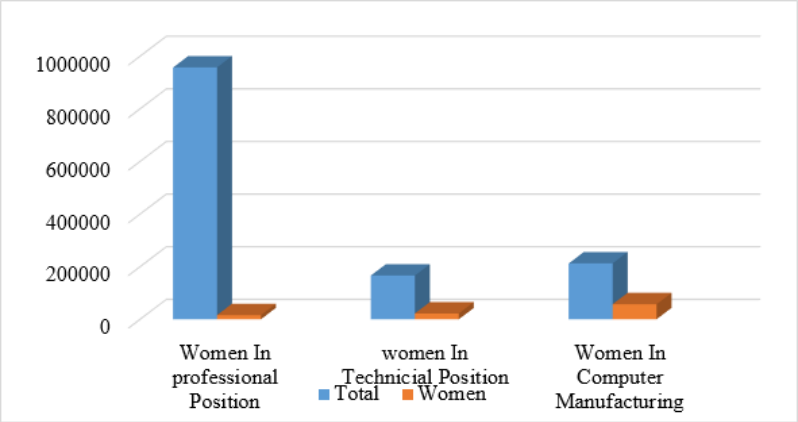

Figure 4. The Status of Women Participation in the Engineering & Technology Employment in Ethiopia

Source: National Assessment data

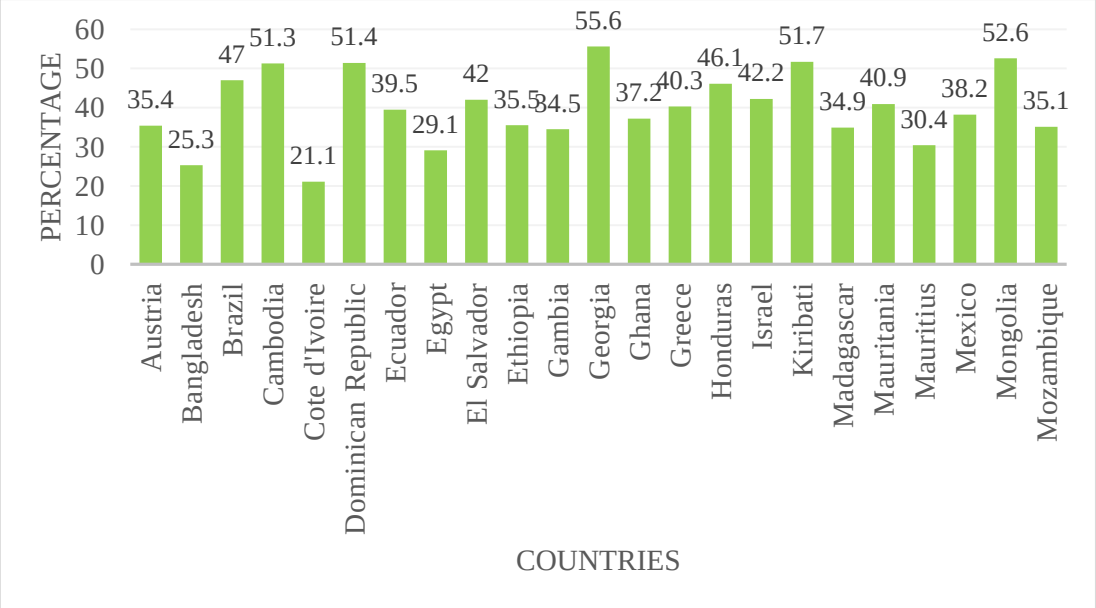

Figure 5. Percentage Share of Female in STEM Jobs in 2020

Source: ILOSTAT, 2020

Table 4. Trends of Women Employment Participation in Engineering & Technology as Academic Staff in Government Universities

Year	Man	Women	Total	% Women
2007	827	62	889	6.97%
2008	307	19	326	6.13%
2009	2072	95	2167	4.38%
2010	2419	118	2626	4.49%

2011	2918	207	3125	6.624%
2012	5174	450	5624	8%
2013	5054	436	5450	8%
2014	5731	534	6265	8.5%
2015	6530	797	7327	10.88%
2016	7013	991	8004	12.38%
Average women percentage from the total = 7.635%				

Source: Ethiopian Ministry of Education

Probit Regression Result Analysis

Probit binary regression was used to identify the factors that affect employability of women graduates in engineering and technology education. As explained in the second section of the paper, the dependent variable is the unemployment of women graduates in engineering and technology education. After checking Spearman's rank correlation test, seven independent variables were included in the model, and various diagnostic tests were conducted. The value of Pseudo R^2 = 93.71% shows the model fit. The existence of the multicollinearity problem has been tested using a pairwise correlation test. The regressor variables are free from serious multicollinearity problems. The fit of the model is also tested by the Hosmer-Lemeshow test, with the maximum p-value of (p=0.9968) showing that the model is fitted. Robust regression, if any, is used to avoid the heteroscedasticity problem. Wald chi^2, which is highly important with a p-value of zero, evaluated the overall significance of the model. The result also shows 97.66% outcomes are classified correctly. This presented in Figure 6 which is receiver operating characteristic curve (ROC) that indicates the model is good since the area under the ROC curve is 0.9987 which is high enough.

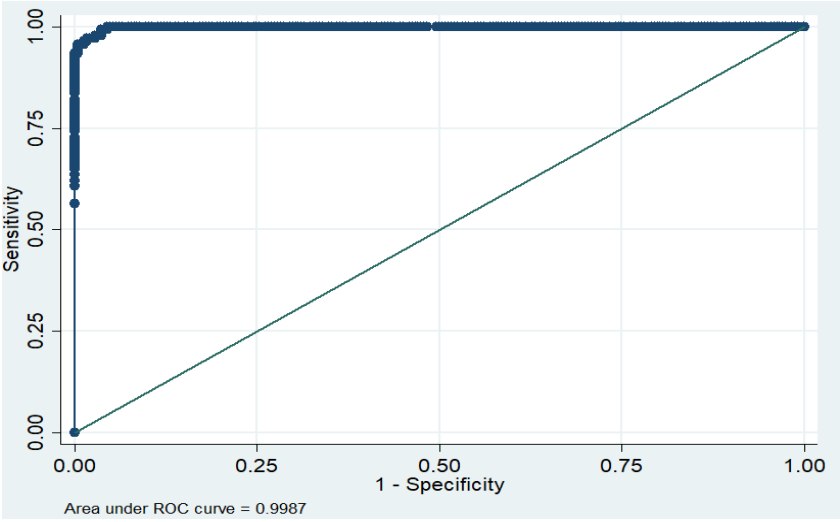

Figure 6. Sensitivity vs. Specificity Test True Classification of Outcomes

Source: Authors own computation

Corresponding to all of these diagnostic tests of regression coefficients, the marginal effect of the variable in Probit estimation has been presented in Table 5. From this table, marital status has a positive and significant impact on unemployment of women graduates in engineering and technology. Married women graduates are 7.98 % more likely to remain unemployed in comparison with unmarried women graduates in engineering and technology, keeping other factors constant. The result is in line with the finding of Roy and Mukherjee (2013), stated that unmarried women graduate have higher probability to get a job than married graduates. This increasing employment opportunity of women graduates leads to increase the benefits of women's economic independence (Mamun et al., 2008).

Academic performance measured by cumulative GPA is another significant variable, and it has negative impact on unemployment of women in engineering and technology graduates. A unit increase in the average cumulative marks of graduates, resulted in 9.68% less likely to remain unemployed, keeping ceteris paribus. The result confirms the previous study by Xu (2017) found cumulative GPA of graduates have negative impact on unemployment, and concluded that student who was confident in self assed readiness and competitiveness in academic achievement were more likely to seek jobs. They should pursue academic knowledge and prepare for work simultaneously. Moreover, individual competency is a key measure of obtaining employment and future career development. Other previous studies (Imose & Barber, 2015; Drydakis, 2016) also found the positive association between graduate employability and academic performance.

As the estimation shows, when graduates' communication skills improved by 1%, it leads to declines in their probability of remaining unemployed by 13.98% than those who are not decent communicators. The result confirms the hypothesis of the positive relationship between women graduates with good communication skills and employability. This is supported by the previous studies (Osmani et al., 2015), who stated that communication skill is the significant criteria of graduate employability, which becomes an issue since there are broad mismatches between the acquired graduate skills from university and the required skills by employers. This result is also consistent with a study by Salleh et al. (2010), who argued that communication skills are soft skills that employers need to hire graduates in particular occupations. The result also confirms (Teijeiro et al., 2013) stated participating in various activities such as student councils, scouts' clubs, sports, music, and arts clubs besides academic studying, will improve graduate's communication skill. This contributes to increasing the probability of their employability.

The absolute value of the z-score of the variable communication skill presented in Table 5 and Table 6 is more than others that can say it has a higher impact on women graduates' employability than others. According to the rule of thumb, this is true, which tells the value of z- score more than 2.0 shows the significance of variables. Therefore, employability could be enhanced through work-integrated learning and collaborative practice, which are essential for women to intensify confidence, improve social interaction, and thoughtful principal for employment after graduation (Wilson & Wilson, 2019).

Table 5. Probit Regression Results of Average Marginal Effects of Significant Variables

Variables	Delta-method					
	Coefficient	Robust SE.	z	$P > \|z\|$	(95 % Conf. interval)	
Marital status	0.0798111	0.0173748	4.59	0.000	0.045757	0.1138651
GPA	-0.0967624	0.017043	-5.68	0.000	-0.1301661	-0.0633587
Communication skill	-0.1398106	0.015546	-8.99	0.000	-0.1702803	-0.1093409
Willingness to migrate	-0.0554699	0.0142542	-3.89	0.000	-0.0834075	-0.0275322
Job preference	0.1734469	0.0263274	6.59	0.000	0.1218462	0.2250476
Non-technical skill	-0.0457021	0.0151482	-3.02	0.003	-0.0753919	-0.0160122
Year dummy 2017	-0.0298002	0.0142708	-2.09	0.037	-0.0577704	-0.0018299
Model VCE: Robust		Number of obs = 384				

Source: Authors own computation

Table 6. Results of Interaction Effect

1 at: YD = 0 2 at: YD =1		Dy/dx	Std. err	z	$P > \|z\|$	(95 % Conf. interval)	
1. MR	at 1	0.0947772	0.0296748	3.19	0.001	0.0366157	0.1529388
	at 2	0.0642114	0.0214668	2.99	0.003	0.0221372	0.1062856
1. GPA	at 1	-0.0500624	0.0345745	-1.45	0.148	-0.1178272	0.0177024
	at 2	-0.1061452	0.0776175	-1.37	0.171	-0.2582727	0.0459824
1. CS	at 1	-0.1828978	0.0278222	-6.57	0.000	-0.2374284	-0.1283672
	at 2	-0.2445419	0.0289438	-8.45	0.000	-0.3012708	-0.1878131
1. WM	at 1	-0.1130036	0.0194068	-5.82	0.000	-0.1510402	-0.074967
	at 2	-0.0163193	0.0073633	-2.22	0.027	-0.030751	-0.0018876
1. JP	at 1	.4617063	0.0512428	9.01	0.000	0.3612723	0.5621403
	at 2	0.448005	0.0208866	21.45	0.000	0.407068	0.488942
1. NTS	at 1	-0.068717	0.0271723	-2.53	0.011	-0.1219737	-0.0154603
	at 2	-0.016342	0.0056993	-2.87	0.004	-0.0275123	-0.0051717

Source: Authors own computation

The result also indicates that willingness to migrate is another significant factor, which reduces the unemployment of women graduates in engineering and technology education. It suggests that a 1% increase in women who can travel for searching jobs can decrease their probability of unemployment by 5.55% than who couldn't move from place to place for searching a job by assuming other things remain constant. Graduates may not be freely moving from place to place for searching a job due to political instability, shortage of money to cover moving cost, preference of residence, and week

inter-industry labor mobility that leads to graduates remaining unemployed. Existing studies in the literature did not study this variable as a factor that affects women graduates' employability. Hence, this factor's finding, which negatively influences unemployment, will add value to the existing literature.

Another result of this study indicates that job preference has a positive and significant impact on women graduates' unemployment in engineering and technology education. Women who prefer a job by any means increase their probability of being unemployed by 17.34% than those who do not prefer a job, keeping other factors constant. This is consistent with Schuster et al. (2020), who found that graduates' job preferences and expectations may be heterogeneous with available employment that leads to increased unemployment of graduates.

This study also confirms the hypothesis of the negative association between women graduates in engineering and technology education with well non-technical skills and unemployment. Thus, women graduate who have better non-technical skills are 4.57% less likely to remain unemployed than those who don't have such talent keeping other variables unchanged. Apart from engineering, technology, and technical skills, graduates need to have many non-technical skills such as negotiating, aware of the fiscal system, self-management, teamwork, business and customer awareness, problem-solving, etc. Due to a lack of them, a woman may not get a job. The result of the study is also supported by (Humburg et al., 2013; Jackson, 2016; Pan et al., 2018) showed that working in a team, being given duty, and joint learning in work placement has provided tremendous value for generating skill development and actual knowledge, which is vital to get employment after graduation. So that graduates must be taking the initiative and improving their entrepreneurial skills.

Additionally, the estimated coefficient of the included year dummy variable, the intercept in 2016 and 2017, is differed by -2.98 percent. The interaction effect based on equations 7 and 8 have also been given in Table 6. This shows the estimated coefficient of the interaction between explanatory variables, and the year dummy is the difference between the effect of independent var in the period 2017 and 2016. Hence, marriage's impact on the probability of employability of women graduates in engineering and technology differs between the period 2016 and 2017 by -3.05 percentage points. Similarly, the impact of decent communication skills and willingness to migrate for searching jobs on the predicted probability of unemployed women graduates differs between 2016 and 2017 by -6.2 and 9.7 percentage points. The effect of job preference and non-technical skills also vary between these two periods by -1.4 and 5.2 percent, respectively.

4. Conclusion

The study has made a modest attempt to discuss women graduates' employability in engineering and technology education in Ethiopia. The statistical analysis of secondary data shows women under-represented in STEM employment in Ethiopia and the world, even though some countries have better trends. The question of what will be the reason needs to be investigated to add value in the literature about women graduates participation in engineering and technology employment in Ethiopia.

Hence, this study analyzes factors affecting the employability of women graduates in engineering and technology jobs with collected data from 384 respondents.

The Probit model results reveal that the unemployment of engineering and technology graduated women is negatively influenced by communication skills, Academic performance (cumulative GPA), willingness to migrate from one place to another for searching jobs, and non-technical skills. While job preference and marriage positively influence women's unemployment, it implies that women graduate who prefer a job and married will increase their probability of remaining unemployed, keeping other things constant. These results are confirmed by model fitting diagnostic tests such as the Hosmer-Lemeshow test and the multicollinearity pairwise correlation test.

This study provides an attempt for graduated women themselves, parents, governments, and firms. Engineering and technology graduates must improve their communication skills and non-technical skills beyond recording better grade points to decrease their probability of being unemployed after graduation. Graduates must be ready to go anywhere to search for jobs rather than comparing and preferring jobs under the presence of job scarcity. The government must provide more concern for apparent-ship, practical works, and workshops in addition to class teaching. These can help students improve their communication skills and technical and non-technical skills, which is the basis to get employment. The finding related to marital status implies that graduated women should not engage in marriage before having her job to reduce economic dependency.

Moreover, the government should approve citizens' peace and security and expand infrastructures such as power, roads, and health. Accordingly, graduates will have the freedom to go everywhere in the country to search for jobs. The government must work on a channel between universities and firms through teaching with a work placement curriculum. These all can reduce human capital resource wastage and unemployment problems among graduates.

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