

Labor Market Analysis
Department of Economics



EMPLOYMENT IN THE STEM INDUSTRY BY GENDER

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Abstract

This paper uses the 2016 American Community Survey (ACS) to estimate a probit model of the impact different factors, such as education and marriage, have on the probability a woman is employed in the STEM Industry. The study uses Polachek's (1979) model of human capital, which suggests there will be a negative relationship between the probability women are employed in the STEM industry and the variables that influence women to leave the labor force. An example of this variable would be having children. My results showed to be compatible with Polachek's (1979) development. With the exception of the variables, indicating a woman has never been married and a woman surpassed undergraduate school, having an unexpected relation to the probability a woman is employed in STEM.

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I have the Marginal Effect for the probit done, have not yet interpreted them so I will need to alter my results after I do that, but the style of writing would be similar. Since it is not completely finished I just snipped tooled those tables rather than making them out. Let me know how my other tables look because I will probably style the probit in a similar way and I am not the best at tables.

V.I. Introduction

Many think the equality gap between women and men is getting smaller year by year, yet this is not the case for all for all ~~sections~~ industries. In fact in 2016, the United States ranked 45 out of 144 countries in the Global Gap Index Report's, which measure Report's measures of the magnitude of gender disparities over ~~time~~ time, 45 out of the 144 countries used by the World Economic Forum (World Economic Forum, 2016). This is a decrease from 2011 when the United States ranked 17 out of 135 countries. A closer look at the rankings reveals ~~While looking into why this decrees could have happened, I noticed~~ that the U.S. ~~was is~~ not per say "getting worse" so much as other countries ~~were are~~ making much greater improvements. The ~~full Insight Report from the~~ World Economic Forum (2016) ~~goes further suggests that U.S. rankings declined because~~ ~~because~~ into explaining why a countries rank could have gone up or done in said year. Through this I found the States decreased in rank from the year before, when they ranked 28 out of 145 countries, of the decrease in women's economic participation and opportunity score. ~~It was also said in the insight report that F~~ female labor force participation has been stagnating ~~over the~~ for years (World Economic Forum, 2016). What is baffling ~~to me~~ is, that according to the Gender Gap Index (World Economic Forum, 2016), the United States has reached parity in education, meaning women have just as much education~~at~~ and training opportunities as men do, but are not as prominent in the labor force despite education increasing the likelihood of employment. ~~As for me, this was just more motivation to the problem already at hand. Narrowing my research I found,~~ Women comprise 48% of the United States workforce. Even more striking, women, yet they ~~only~~ hold ~~around just~~ 24% of occupations in the STEM industries (STEM For Her, 2015). This gender segregation ~~only~~ becomes more pronounced when looking at occupations that have an important role in future modernization (Eger, McLain, & Ashcraft, 2016).

Commented [W1]: Not sure what you mean by sections. Industries? Occupations, demographics?

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With economies becoming more dependent on science and technology, this industry will ~~only~~ continue to grow. In fact, an economy without STEM discoveries would not have remotely the same comprehension ~~when it comes to topics such as~~ gravity, space, or even genes (STEM For Her, 2015). ~~Women have had an important impact on STEM industries. Examining the history of women in STEM,~~ There are ~~been handfuls of many~~ women who have had a huge impact on the industry. For instance Katharine Blodgett was one of the developers of developed organic anti-reflecting glass and was the first female scientist at General Electric research lab (The College of St. Scholastica, 2015). ~~Women's participation in STEM is critical because women often bring different perspectives to the table than men. An example of this is medical research on women's heart disease. It was just around 30 years ago, it was discovered that women's heart disease forms itself differently in women than it does men (McDaniel, 2014). This is an important finding because women's heart dieses is a leading killer in women. One of the main reasons this was not discovered sooner is because heart disease was being researched by men (McDaniel, 2014).~~ ~~There~~ ~~here~~ are many women throughout the history of STEM, so the problem is not that an industry is not for women, but rather why are the women not in the industry? This study's focus is to look at the impact different labor supply characteristics have on the probability an individual is employed in the STEM Industry.-

The data being used in this study is through ~~IMPUS-IPUMS~~ USA, the American Community Survey of the year 2016. I ~~will~~ run a probit model to measure these impacts. Instead of using an occupational choice theory, this study will look at ~~Solomon~~ Polachek's (1979) ~~development to the Human Capital approach~~ human capital model. Polachek's development predicts there will be a negative relationship between the probability women are employed in the STEM industry, and the variables that influence women to leave the labor force ~~and a positive relationship with the~~

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~~variables that indicate a women works more.~~ What is unique about this study is it will be taking more recent data and look at the supply side of women working in the STEM industry.

VI.II. Literature Review

There are numerous different reasons ~~why women's employment rates a women~~ may not be as equally ~~to employed as men's~~, especially in a certain industry. This could include biological differences, such as sensory, motor abilities and special aptitudes (Cornelson & Baker, 2016), as well as personal choice or unequal opportunities. For the duration of my research I looked into all three of these explanations. Personal choices, for instance having kids, could potentially lower the probability a female gets a job (Beller, 1982). To explain personal choice, ~~Beller in her paper,~~ ~~Occupational Segregation by Sex: Determinants and Changes,~~ uses Polachek's approach to the Human Capital Theory, which says that women being employed in a male-dominated occupation, would have negative relations associated to variables showing weaker attachment to the labor force (Polachek, 1979). ~~What Beller found was that men and women do make choices based on individual characteristics. These choices to higher and lower the probability a women is employed in a male dominated industry (Beller 1982). Horizontal segregation occurs when men and women complete different job tasks. Beller paper touches on this within the labor supply characteristics mentioned in her paper.~~

~~Horizontal segregation also appears within the paper written by Baker and Cornelson. Baker and Cornelson (2016 (year) in their study, Gender Based Occupational Segregation and sex differences in Sensory, Motor, and Spatial Aptitudes,~~ use natural aptitudes to explain occupational segregation, rather than individual characteristics and find, ~~(Cornelson & Baker, 2016). Also similar to both is Molly Chattopadhyay, Sonali Chakraborty, and Richard Anker's study Sex segregation in India's formal manufacturing sector. This Chattopadhyay, Chakraborty, and Anker (year) also ties into~~

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~~Horizontal segregation since they are only focuses on sex segregation within the male dominated manufacturing industry in India, women make employment choices based off these natural aptitudes. Other findings related to this include, Chattopadhyay, Charkraborty, and Anker (2013), they show employment rates for women were higher in industries that traditionally employed women and areas of India where women have a larger roles in society, which can be portrayed as a male dominated industry (Chattopadhyay, Chakraborty, & Anker, 2013).~~

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Although all papers above related to horizontal segregation, they use different models to estimate the results. Beller runs a simple linear probability model, whereas Baker, Cornelson, and Chattopadhyay use the Duncan Index, which is also known as the Index of Dissimilarity. Moving forward I found two other papers using the Duncan index as well, but were focused on factors a person cannot control, for instance economic growth used by Jennifer Ball, and business size or firm demographics examined by Seifert and Schlenker.

Ball (2008) uses the feminization U theory, which declares women are less active in the labor force during moderate levels of economic development and are more active during times of high or low development. Ball finds as Per Capita GDP increases, there is a decrease in segregation. ~~to help estimate job segregation by sex and neoliberal structural adjustment (Ball, 2008).~~ Whereas Seifert and Schlenker (2014 (year) examines what organizational characteristics, which include the business size and firm demographics, have on firm level segregation (Seifert & Schlenker, 2014). Seifert and Schlenker discover ~~it was found that~~ firm demographics, such as the structure of the work force and the portion of part-time employees (Seifert & Schlenker, 2014), can increase segregation, where has increases Per Capita GDP decreases segregation (Ball, 2008).

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It was found → S&S (2014) find that...

~~Although no relationship was found within between female participation in the manufacturing sector and job segregation Chattopadhyay, Charkraborty, and Anker (year)'s study, it was shown employment rates for women were higher in industries that traditionally employed women and areas of India where women have a larger roles in society (Chattopadhyay, Chakraborty, & Anker, 2013).~~

~~Results also The literature also shows men and women make employment choices based natural aptitudes (Cornelson & Baker, 2016) and individual characteristics (Beller, 1982) which affects, have an impact on occupational segregation, this would explain the correlation found in Chattopadhyay study. While these choices are declining over time (Beller, 1982), there are also those non-controllable factors that were revealed to have an effect on segregation. It was found that firm demographics, such as the structure of the work force and the portion of part time employees (Seifert & Schlenker, 2014), increases segregation where has increases Per Capita GDP decreases segregation (Ball, 2008).~~

~~My research on contrary to what is above will be looking at occupational differences in sexes from the supply side of the problem.~~ This study will be similar to what is seen in Beller's (1982 year) work's *Study of Occupational Segregation by Sex: Determinants and Changes*. The differences my research will hold is updated data using the year 2016, only approaching the individual characteristics supply side, and rather than looking at all occupations, as Beller does, I will be putting my focus towards on focus on the STEM Industry.

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Commented [W10]: How is this different? If FLFPR are affecting occupational segregation that is saying that the supply of women is affecting occupational segregation.

VII.III. Theoretical model development

~~When first approaching my research question I thought to use the theory of occupational choice, where individuals chooses an industry or occupation based on their expected returns, but, the~~

~~probability one would be employed in a certain industry would differentiate and be biased towards peoples preferred returns and is not specific towards gender. Since I am focusing on choices based on gender, this study will be using~~ Polachek's (1979) development for the human capital approach. Polachek's ~~prospective suggests~~ that women's labor supply choices are based on "sex-role" differences. Polachek considers atrophy rates, which measures the rate at which one losses skill when said skill is not in use. For instance when ~~a~~ women needs to leave the labor force temporarily, her skill will have atrophied or ~~in other words~~, declined. Polachek's approach takes into consideration that women may leave the labor force ~~to raise children amid rearing years~~ and will find occupations in which skills do not easily degrade, more appealing ~~(Polachek, 1979)~~

~~(Beller, 1982). As it is outdated that a women takes such an extended time off, her skills atrophy. This is still important to the STEM industry because we can make the assumption that hours women spend on housework when they are married or have children will take time away from the office. And STEM industries, such as medical or technology, will punish women who do not spend as much face time as others in the office. You are missing a very key sentence here. So are you proposing that male dominated industries such as STEM industries require skills that are more susceptible to atrophy? Therefore women will be less likely to choose these industries.~~

The variables being used in this study will include labor supplye characteristics that lead to a weaker attachment to the labor force, such as having children or getting married. ~~According to Polachek's human capital approach, I hypothesize that the probability a women will be employed in the STEM industry will have a negative relationship with these variables. Because of this we can predict I hypothesize~~ that the more children a women has, the lower her probability of being employed in ~~the a~~ STEM industry ~~is~~. If a womaen is a part time worker, this should lead to a lower probability, as well as if a womaen has a spouse, we should expect to see a lower probability.

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VIII.IV. Data and Methodology

The data being used in this study is available through from the American Community Surveys (ACS). This will be sampled from the year 2016 and will narrow my data to the age 22 to 65+8 and above. The ACS is a repeated survey that provides information on the US population. This survey is openACS provides information on-on for the general public to view so they are able to learn more about occupations, educational attainment, housing market, etc. (Ruggles, et al., 2016).

My dependent variable will be whether or not an individual is employed in them STEM industry.

I chose the STEM industry as any occupations relating to science, technology, engineering, math, and some medical professions. ¹ I was given a set list of occupations from the Industry variable in the ACS and chose from that point on. How do you define what a STEM industry is?

My empirical models are as below:

$$P_i = \beta_0 + \beta_1 \text{Female}_i + \beta_2 \text{OnceMar}_i + \beta_3 \text{Single}_i + \beta_4 \text{FullTime}_i + \beta_5 \text{NCHILD}_i + \beta_6 \text{AGE}_i + \beta_7 \text{SomeHS}_i + \beta_8 \text{HSGrad}_i + \beta_9 \text{SomeCollege}_i + \beta_{10} \text{AfterCollege}_i + \beta_{11} \text{WWorked}_i + \epsilon$$

$$P_i^s = \beta_0 + \beta_1 \text{Single}_i^s + \beta_2 \text{OnceMar}_i^s + \beta_3 \text{PartTime}_i^s + \beta_4 \text{NCHILD}_i^s + \beta_5 \text{AGE}_i^s + \beta_6 \text{SomeHS}_i^s + \beta_7 \text{HSGrad}_i^s + \beta_8 \text{SomeCollege}_i^s + \beta_9 \text{AfterCollege}_i^s + \beta_{10} \text{WWorked}_i^s + \epsilon$$

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¹ See Table 1 for List of occupations

The variables that will impact the probability of someone being employed in the labor force thus far will include *Female* if a person is female or not, *OnceMar* if someone is divorced, widowed, or separated. *Single*, which represents the individual never being married. *FullTime* if an individual is full time or not measured by usual hours worked per week, *NCHILD* number of children in household, *AGE*, if a person is over 22 and under 65, *WWorked* if an individual works more than 26 weeks in a year, *SomeHS* if the individual did not finish High School, *HSGrad* if the individual has graduated High School, *college* *SomeCollege* if one has gone to college, but not yet or did not graduate, and *AfterCollege* refers to schooling past undergraduate school. - In my sample I chose to exclude those who were still in schooling ing, and 22 is around the average age one graduates or is settling into a more professional job. I excluded ages over 65 because that is about the age people retire. For this study I will conduct a test using a probit model to measure the impact these labor supply characteristics have on the probability of being employed in the STEM industry. The second model includes *s*, which is the sex of a person, male or female. I will run this separately for both sexes to compare the results.

Descriptive statistics are provided in Table 2 as well as Table 3². Within the sample, 11% of the population is in a “STEM” industry and females make up 50% of my data, which according to The U.S. Census Bureau is around the countries average in 2013 (The Council of State Government, 2016). Those who are married make up 57% of my surveys population, 60% also work full time, and the average age is 44. Table 3 contains the means of those only in stem, women in stem, and women not in stem, all women, and all men. Through this means we can compare and contrast the different groups. We can see that 72% of women in STEM work full time and 83% work over half the year, but only 50% of women *not* in STEM work full time and 66% work more than half a

² Table 2 and 3 found in the Appendix

year. Through this we can assume that women in STEM do have to work more than the average woman. We can also see that women in STEM are more prominent in the higher education variables. Comparing men and women, more men are working full time and over half a year than women. And more women in my sample have children than men.

IX.V. Results

~~The first thing I did was run my means to gain a prospective of the data I am working with. As you can see in table one 11% of our population makes up the “STEM” industry and females make up 50% of my data, which according to The U.S. Census Bureau is around the countries average in 2013 (The Council of State Government, 2016). Those who are married make up 57% of my surveys population, 60% also work full time, and the average age is 44.~~

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~~The next step was to I first run a ecombined-pooled~~ probit regression³ with both sexes, leaving married males who graduated college as my reference group. My results showed to be to have significant coefficients. Moving forward, finding the marginal effects of the probit, females have a 4.7% ~~fewer-lower~~ probability of working in the STEM industry. This is significant since only 11% of my population is in STEM. Another aspect of this regression worth pointing out is the educational status of a person. If a person, male or female, did not graduate high school, they are already 11.6% less likely to be employed in the STEM industry.

Next I ~~ran-ran~~ a regression excluding males and then another excluding women, so that I was able to compare the results. Results are also shown in Table 4³. Findings show if a woman who is divorced, separated or widowed she has 0.5% less probable chance to be employed than a woman who is married. Whereas never married women are 1% less probable to be employed than a woman

³ See Table 4 in appendix

who is married. Men have similar results where if he is divorced, separated, widowed he is 1.4% less likely to be employed in the tech industry than if he were never married and 2.1% less probable than a married man. Contrary to Polachek's approach for Human Capital, which predicts a negative relationship between variables that influence a woman to leave the labor force, my results show that single women are in fact, less probable than married women to be employed in the STEM industry. Comparing the male to female marital status variables, married men are more likely to be employed in STEM than married women. This relates back to the idea that married women have more of a reason to not have as much face time in the office than married men, and are punished because of it. Looking at the Variable *FullTime* and *WWorked* we can see that women are 5.1% more likely to be employed in STEM if they work full time rather than if they were part time and 2.5% more likely if they work more than 26 weeks in a year. For men we observe a full time worker is 8.7% more probable to be employed than the part time worker and 3.1% more likely if they work more the 26 weeks in a year. Women have a lower probability to be employed in STEM full time and working more than half a year compared to men which is compatible with the Polachek approach. This is because according to the approach women pick jobs that they are able to leave the labor force and not have their skills diminish, or where they can spend less time in office and not be punished. Full time jobs are less easy to leave for long periods of time, and require more time spent away from home than part time. Males who graduate High School have a lower probability of being employed in STEM by 10%, than those who graduated college. Women who graduate High School are 8.6% less probable to be employed in STEM then women who graduate college. What was not expected is, women and men who go further with schooling, past undergraduate degrees, are 0.6% less likely to be employed in STEM. This would have been

expected to be the opposite because many degrees in the medical, math, and engineering, encourage you further your education past a bachelor's degree.

Continuing on to the NCHILD, you can see that for men having a child makes you less likely to be employed by 0.3% and for women 0.5% less likely. I was expecting women with children would have a lower probability than they did because having children is a large reason women to either leave the labor force or have less office face time.

X.VI. Conclusions

Using the 2016 ACS to estimate the impact different factors have on the probability a women in employed in STEM related fields, my results showed to be compatible with Polachek's (1979) development. As predicted women who have children have a lower probability of being employed in the STEM industry than men who have children. It was also predicted a women who is part time would have a lower probability of being employed in STEM then women who are full time. While this is true, we also found males who are full time are more likely to be employed in STEM than women who are full time. There were some unexpected results, for instance women who are single have a less probable chance of being employed in STEM than women who are married, but this could be from the limitation; I chose what was included in the STEM industry. Since there was no defined list of STEM occupations, there could be occupations that I considered to be STEM that another person does not or vice versa, and this could affect results. Moving forward with this project, I would have liked to use the Oaxaca decomposition to measure any segregation that could be taking part in women's employment in STEM.

Table 1

STEM
Computer systems design and related services
Specialized design services
Other professional, scientific, and technical services
Management, scientific, and technical consulting services
Business, technical, and trade schools and training
Computer and peripheral equipment manufacturing
Electronics stores
Electronic component and product manufacturing, n.e.c.
Household appliances and electrical and electronic goods merchant wholesalers
Electronic and precision equipment repair and maintenance
Data processing, hosting, and related services
Software publishing
Computer and peripheral equipment manufacturing
Machinery manufacturing, n.e.c. or not specified
Communications, and audio and video equipment manufacturing
Navigational, measuring, electro medical, and control instruments manufacturing
Wired telecommunications carriers
Telecommunications, except wired telecommunications carriers
Internet publishing and broadcasting and web search portals
Specialized design services
Administration of economic programs and space research
Agricultural chemical manufacturing
Paint, coating, and adhesive manufacturing
Miscellaneous manufacturing, n.e.c.
Aerospace products and parts manufacturing
Motor vehicles and motor vehicle equipment manufacturing
Electric lighting and electrical equipment manufacturing, and other electrical component manufacturing, n.e.c
Other information services, except libraries and archives, and internet publishing and broadcasting and web search portals
Accounting, tax preparation, bookkeeping, and payroll services
Management, scientific, and technical consulting services
Architectural, engineering, and related services
Scientific research and development services
Veterinary services
Other health care services
Home health care services
Electronic and precision equipment repair and maintenance
Commercial and industrial machinery and equipment repair and maintenance

Public finance activities

Table 2

Variable	Label	Mean	Std Dev	Min	Max
Stem	Whether someone is in the Stem	0.114	0.317	0	1
Female	Female	0.509	0.500	0	1
Male	Male	0.491	0.500	0	1
Marstat	Married	0.576	0.494	0	1
OnceMar	Divorced, Separated, or Widowed	0.161	0.367	0	1
Single	Never Married	0.263	0.440	0	1
FullTime	If a person works full time or not	0.612	0.487	0	1
NCHILD	How many children a person has	0.792	1.114	0	9
AGE	Age	44.49	12.79	22	65
SomeHS	If someone graduated high school	0.049	0.215	0	1
HSGrad	A high school graduate	0.356	0.479	0	1
SomeCollege	If someone never graduated college	0.249	0.432	0	1
CollegeGrad	A college graduate	0.220	0.414	0	1
AfterCollege	Post college schooling	0.125	0.332	0	1
WWorked	If someone works > 26 weeks in a year	0.722	0.448	0	1

Table 3

Variable	STEM MEANS	FEMALES STEM MEANS	FEMALES NOT STEM MEANS	FEMALE MEANS	MALE MEANS
Stem	1	1	0	0.085	0.142
Female	0.383	1	1	1	0
Male	0.617	0	0	0	1
Marstat	0.631	0.597	0.582	0.583	0.567
OnceMar	0.132	0.171	0.186	0.185	0.135
Single	0.237	0.232	0.231	0.231	0.296
FullTime	0.815	0.728	0.502	0.522	0.705
NCHILD	0.803	0.778	0.867	0.859	0.722
AGE	44.02	43.97	44.83	44.76	44.21
SomeHS	0.019	0.014	0.043	0.040	0.056
HSGrad	0.241	0.234	0.337	0.328	0.383
SomeCollege	0.228	0.235	0.263	0.261	0.236
CollegeGrad	0.326	0.333	0.223	0.233	0.206
AfterCollege	0.184	0.183	0.131	0.136	0.116
WWorked	0.871	0.834	0.663	0.678	0.766

Table 4

Parameter	Combined	Female	Male
Intercept	-1.1829*** (0.0077)	-1.4351*** (0.0109)	-1.1667*** (0.0107)
Female	-0.2590*** (0.0027) [-0.047]	-	-
OnceMar	-0.0541*** (0.0039) [-0.010]	-0.0334*** (0.0054) [-0.005]	-0.0681*** (0.0057) [-0.014]
Single	-0.0885*** (0.0038) [-0.016]	-0.0669*** (0.0056) [-0.010]	-0.0975*** (0.0051) [-0.021]
FullTime	0.3735*** (0.0039) [0.068]	0.3411*** (0.0052) [0.051]	0.4108*** (0.0060) [0.087]
NCHILD	-0.0203*** (0.0013) [-0.004]	-0.0354*** (0.0020) [-0.005]	-0.0136*** (0.0018) [-0.003]
AGE	-0.0004*** (0.0001) [-0.000]	-0.0009*** (0.0002) [-0.000]	-0.0006*** (0.0002) [-0.000]
SomeHS	-0.6378*** (0.0084) [-0.116]	-0.5700*** (0.0145) [-0.086]	-0.6792*** (0.0103) [-0.145]
HSGrad	-0.4249*** (0.0035) [-0.077]	-0.3144*** (0.0053) [-0.047]	-0.5021*** (0.0047) [-0.107]
SomeCollege	-0.2627*** (0.0036) [-0.048]	-0.2241*** (0.0054) [-0.034]	-0.2945*** (0.0049) [-0.063]
AfterCollege	-0.0326*** (0.0041) [-0.006]	-0.0649*** (0.0061) [-0.010]	-0.0016*** (0.0056) [-0.000]
WWorked	0.1624*** (0.0044) [0.029]	0.1690*** (0.0060) [0.025]	0.1459*** (0.0066) [0.031]
Standard errors in parentheses			
Marginal effects in brackets			
*, **, *** indicates significance at 90%, 95%, and 99% level.			

XII.VIII. BIBLIOGRAPHY

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